Coastal Roots: Connecting Students with Sustainability in Mississippi and Louisiana

Christine E.H. Coker[1,7], Gary Bachman[2], Chris Boyd[3], Pamela B. Blanchard[4], Ed Bush[5], and Mengmeng Gu[6]

Additional index words. environmental education, curriculum, school-based nursery, container production, stewardship

Summary. **The Coastal Roots School Seedling Nursery Program for Habitat Restoration was initiated by Louisiana State University in 2000 in cooperation with Louisiana Sea Grant. The program enhances learning areas such as plant growth, wetland issues, conservation, and hands-on habitat restoration, and includes the installation of a small container nursery for the production of coastal plants in schoolyards. The program was adopted by Mississippi State University's Coastal Research and Extension Center in 2008. The aim of this article is to provide an overview of the program as well as Mississippi's plans to adapt the Louisiana model to demonstrate teaching by example through hands-on demonstration that will supply students with real-world conservation and stewardship experience.**

The Louisiana State University (LSU) Coastal Roots School Seedling Nursery Program for Habitat Restoration (Coastal Roots) was initiated in Jan. 2000 to assist students in Louisiana in developing an attitude of stewardship toward Louisiana's coastal resources and to provide a constructive active learning situation in which they can explore strategies for sustaining our coastal ecosystems. To this end, school-based nurseries have been established at 38 public, private, and parochial southern Louisiana schools. Participating teachers represent upper elementary (grade 3) through high school, and integration of the program is mostly through science classes and extracurricular environmental clubs. Students at participating schools conduct a year-round, on-going nursery program in which they grow native Louisiana grasses and trees that can be used by students in a hands-on restoration planting field trip 9 months later. Integrated with this hands-on aspect of the program, students learn about nursery maintenance, plant growth, wetland issues (e.g., coastal land loss), the functions and importance of wetlands, how wetlands are being restored, and other restoration and conservation information.

As people become environmentally literate, they progress through four stages: awareness, concern, understanding, and action (Roth, 1992). By means of demonstration and instruction, students become aware of the consequences of human interaction with nature. This raises concern or the perception of the potential consequences of such interactions and helps to formulate changes that are needed. Through instruction and hands-on activities, the student is able to acquire detailed information about potential environmental problems and an understanding of their impacts. By the end of the instruction and discovery process, the students are able to apply their understanding of the problem and take action to reduce the negative consequences of these interactions.

For learning to be complete, the learner progresses through the four phases as described by Kolb (1984). Environmental and ecological stewardship can be viewed as an appropriate form of active testing of, or action on, newly synthesized knowledge that is the culmination of a fully realized learning cycle on an environmental issue. Thus, teachers who incorporate ecological and environmental stewardship actions in their classroom are providing an activity designed to help students become aware, learn about, and make informed decisions regarding their environments, and make their learning known by taking appropriate action.

In the LSU Coastal Roots program, students in grades 3 through 12 from 38 public, charter, and private schools across 17 parishes in southern Louisiana grow native seedlings in school-based nurseries (Blanchard, 2007; Coleman and Bush, 2002). Students plant their seedlings at a partner restoration site, which will help protect the fragile wetlands and forests of southern Louisiana. Through this ecological stewardship project, students learn about the importance of healthy, functioning coastal ecosystems and how they are being damaged by natural processes and human actions (Roth's awareness, concern, and understanding phases), as well as how to germinate and grow seedlings that can be a part of the solution to help restore damaged ecosystems (Roth's action phase). As part of the project, these students make a trip to plant their seedlings in an area in need of habitat restoration (Roth's action phase). Through this cycle of learning, students in grades 3 through 12 learn how they can help create and sustain coastal habitats, maintain habitat diversity, and provide food for coastal animals and birds. The Coastal Roots program components are designed

Approved for publication as Mississippi State University Mississippi Agricultural and Forestry Experiment Station journal article J-11638.

[1]Associate Research Professor, Mississippi State University Coastal Research and Extension Center, 1815 Popps Ferry Road, Biloxi, MS 39532

[2]Assistant Extension Professor, Mississippi State University Coastal Research and Extension Center, Coastal Research and Extension Center, 1815 Popps Ferry Road, Biloxi, MS 39532

[3]Assistant Extension Professor, Mississippi State University Coastal Research and Extension Center, Coastal Research and Extension Center, 1815 Popps Ferry Road, Biloxi, MS 39532

[4]Assistant Professor, Louisiana State University, Department of Educational Theory, Policy, and Practice, 223-E Peabody, Baton Rouge, LA 70803

[5]Associate Professor, Louisiana State University, School of Plant, Environmental, and Soil Sciences, 137 JC Miller, Baton Rouge, LA 70803

[6]Assistant Extension Professor, Mississippi State University, Department of Plant and Soil Sciences, 117 Dorman, Stone Boulevard, Mississippi State, MS 39762

[7]Corresponding author. E-mail: ccoker@ra.msstate.edu.

Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
2.54	inch(es)	cm	0.3937

to make the program as hands-on as possible, meaningfully integrated into school subjects, and flexible enough to accommodate a wide range of school courses, grade levels, and needs.

One problem that programs such as this must address and overcome is the perception that environmental studies are in themselves science-oriented and thus must be taught within the science curriculum. Surveys of environmental studies programs found that over 60% were taught by science faculty and 30% were taught by social studies faculty (Pettus and Schwab, 1978; Tewksbury and Harris, 1982). Environmental studies incorporate so much more than basic science (National Council of Teachers of Mathematics, 2000). Environmental studies should be included and promoted in science of inquiry, mathematics, language arts, health and nutrition, and social studies.

The major overlapping objectives of this joint program are learning by providing situations in which students and teachers can actively explore strategies for sustaining our coastal ecosystems; growing enhanced professional development opportunities for teachers by strengthening educational components through science-based wetland and restoration content and educationally sound pedagogy; and practicing interactive outreach opportunities for teachers and students to share information from their programs with a larger community interested in ecological and environmental stewardship.

In 2008, the Coastal Roots program was expanded to Mississippi. The Mississippi State University (MSU) Coastal Research and Extension Center is implementing a pilot restoration program patterned after the LSU Coastal Roots program. The goal for school participation in the Mississippi Coastal Roots program is to have one school participating in 2009 and up to four by 2011. The first school participating will be Woolmarket Elementary School, Biloxi, MS. About 50 gifted and special needs students will participate the first year. The first proposed restoration site is within the Crosby Arboretum, a native plant conservatory located in Pearl River County, MS.

The Mississippi State Board of Education made recommendations in the 2010 Mississippi Science Framework to enhance and improve science education for school districts in Mississippi. The framework emphasizes that science education should be a central, integrated part of the total elementary education [Mississippi Department of Education (MDE), 2008]. It is proposed that in addition to enhancing science at the elementary level, the concepts, principles, processes, and skills acquired could also be used to enhance reading comprehension and math skills.

Starting in the fourth grade, the teaching of science as inquiry should be embedded throughout the curriculum. For example, fourth grade students are asked to explain and use the skills required to conduct scientific inquiry, including hypothesis formation and outcome prediction, be able to use qualitative information (size, shape, color, texture, etc.), describe cause-and-effect relationships in terms of environmental variation, be able to use simple visual data representation, and be able to explain why scientists work in teams with team members contributing to the results (MDE, 2008).

The competencies for older students would build upon the previous grade's concepts and would explore the interrelationships in the context of society and the environment. For example, eighth grade students would be expected to design and conduct inquiries using experimental controls, distinguish between qualitative and quantitative observations, analyze data to form explanations and draw conclusions, and develop a logical argument for defending conclusions (MDE, 2008).

Through the presentation of science as inquiry, problem-solving skills are improved and the capabilities of performing scientific investigations are enhanced. Students would be able to identify problems and propose solutions through the use of scientific methods. Interpretation of data and results presented in graphs and other visual media will allow students to draw conclusions of the validity of the investigation. Students will also learn to effectively communicate and explain the results of their investigations using appropriate terminology (MDE, 2008).

The school nursery will be the focal point of the first phase of curricular activity. The students will produce plant species that are native to the coastal region of Mississippi. These native plants will be specific for the restoration site matched to the school. The school nursery design is modeled after the LSU Coastal Roots design (E. Bush and P.B. Blanchard, unpublished data). The school nursery is contained within a fenced area that has a gravel surface covered with ground cloth. Irrigation is directly plumbed into the school water supply and is applied using overhead risers in the corners and controlled with a battery-operated timer and solenoid valve. Coastal native plants are grown from seeds in round nursery seedling cells measuring 1 1/2 inches in diameter × 8 1/4 inches in depth. The installation of the school nursery is a one-time event and materials used will be reused year after year. This reuse of materials emphasizes the theme of sustainability, thereby broadening the students understanding of good stewardship beyond the restoration portion of the project. In LSU Coastal Roots, several schools have been using the same materials for nearly a decade.

While MSU facilitates the construction of the nursery and serves as resource partners, it is the teachers and students who are ultimately responsible for its operation and maintenance. Teachers and/or school district personnel are expected to provide oversight for the nursery even when school is not in session. Irrigation timers installed at the time of construction greatly decrease the potential for crop failure within the nursery.

Codirectors of the Coastal Roots program have identified the important goal of developing and strengthening the educational components of the Coastal Roots program, and of helping to facilitate the expansion of the program to nearby states. The expansion of the program into Mississippi allows for close collaboration between the LSU and MSU programs, geographically as well as in similarities and dissimilarities in coastal habitat and restoration needs.

Mississippi contains some of the most diverse flora and fauna in the United States. The state of Mississippi contains four ecoregions: the southeastern plain, the Mississippi alluvial plain, the Mississippi Valley loess plain, and the southern coastal plain. These regions contain different vegetation, climate, soils, land use, wildlife, and hydrology that should be protected

and restored for future generations to enjoy and to serve its many ecological services (Bailey et al., 1994). The Mississippi southern coastal plain contains the Gulf coast flatwoods, floodplains and terraces, Gulf barrier islands, and coastal marshes. The habitats range from the Gulf coast pine savannas that contain slash pine (*Pinus elliottii*), long leaf pine (*Pinus palustris*), grasses (Poaceae), sedges (Cyperaceae), rushes (Juncaceae), pitcher plants (*Nepenthes* spp.), and orchids (Orchidaceae); river swamp forests containing bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and oaks (*Quercus* spp.); salt and brackish marshes, dunes; beaches that contain the saline intertidal plants, smooth cordgrass (*Spartina alterniflora*), marshhay cordgrass, (*Spartina patens*), and saltgrass (*Distichlis spicata*); and the barrier islands that contain xeric pine scrub vegetation and live oak (*Quercus virginiana*) (Chapman et al., 2004).

With the extensive variety of habitats and plants in the coastal region, endless opportunities to educate students about many subject areas related to the science of restoration are available within just a few miles of the classroom. Potential subject areas include: geology, plant science, geography, soils, water quality, hydrology, marine science, ornithology, forest ecology, agricultural science, and greenhouse technology. Providing students with the hands-on experience of growing plants that are adapted to particular habitats and then later planting the vegetation on site will allow students to better understand the big picture of ecology.

Within the northern Gulf of Mexico region, there are many restoration projects that need to be accomplished. Potential restoration projects include shoreline stabilization, wetland habitat creation, stream restoration, creation of riparian and agricultural buffer zones, dune restoration, and invasive species eradication. Restoration opportunities for the MSU Coastal Roots program will be identified by researchers, natural resource managers, city planners, and state and federal agencies. Previous restoration projects that have been successful through other education-based programs include replacing a degraded seawall with a living shoreline containing wetland plants (e.g., smooth cordgrass and marshhay cordgrass); stream bank stabilization using native species based on the location of the project site; and reestablishing a long leaf pine forest through prescribed burn management and tree replanting.

Ecosystem restoration attempts to return the altered, degraded, or destroyed landscape back to the preexisting condition (Anderson, 2007). The main goal is to return the major ecological functions and services provided by the natural flora and fauna when economical and scientifically feasible. Habitat restoration projects provide many ecological services such as stabilizing unconsolidated sediments in shallow water, reducing turbidity, decreasing shoreline erosion, increasing biodiversity of aquatic and terrestrial species, preserving access, improving water quality, increasing the amount of organic matter needed for the maintenance of wetlands, and increasing community resiliency protection during storm events.

Students and teachers will learn the process of how to conduct a restoration project by learning about the steps of proper site selection using resources and tools such as aerial photographs, topographic maps, and soil handbooks. This will help the students see the overarching goal of the restoration project. They will also learn how to create or judge the restoration alternatives that will be the most ecologically sustainable, regionally compatible, physically feasible, and fit within the project goal and overall vision.

Project monitoring using technology such as GPS mapping of planting sites could be added to program curriculum for second year or advanced students. The students would go to the restoration sites to conduct project maintenance such as removing storm debris, pruning trees, installing new plant material, or adding sediment after major storm events. Physical and chemical monitoring could include benthic and invertebrate sampling, nutrient sampling, surveying, erosion and accretion measurements, plant growth measurements, and site surveys. These data will allow the researchers and students to determine the overall success of the project over time. Students will learn that not all projects will necessarily accomplish all of the goals proposed, but the information gained from the project is critical to fully understanding the science of habitat restoration.

More resources are needed for elementary science teachers, and school districts are encouraged to partner with appropriate outstanding educational resources. Each school and planting site manager that participates in the Coastal Roots program fosters partnerships with outside entities. Partnerships include but are not limited to area colleges and universities, state Extension services, and federal agencies. Each school has their own design for students' involvement and classroom integration of the programs. Teachers have the freedom to use the program to supplement existing curricula or to create lesson plans for use with the program.

Mississippi Coastal Roots participants will benefit from the partnership with the LSU program through the participation of Mississippi teachers interacting with Louisiana teachers currently participating in the LSU Coastal Roots program. Two-day workshops are designed to introduce new teachers to the program as well as provide further professional development opportunities for participants. The initial benefit to Louisiana's program will be its broadened outreach and impact. The success of the Mississippi program will allow for further expansion of the program into other regions.

Ecological and environmental stewardship programs such as Coastal Roots provide long-term avenues for student participation by providing activities designed to help students become aware, learn about, and make informed-decisions concerning their environments, and make their learning known by taking appropriate action. It falls to the institutions that facilitate these stewardship programs to provide quality professional development for the participating teachers so that they, too, can increase their personal awareness, knowledge, and ability to take action about pressing coastal issues.

While LSU's Coastal Roots program serves to facilitate that of MSU, the two programs are in no way duplicates. Each state's program caters to its own unique conservation needs and the needs of teachers and students. There is no structured curriculum associated with the program, thus each participating teacher may use the program to foster and enhance conservation education within

their own learning units. While LSU's program is well-established, MSU's program is in its infancy. Many challenges and opportunities lie ahead (e.g., continued funding, long-term nursery maintenance, etc.). However, the opportunities far outweigh the obstacles. As the Coastal Roots program begins to take hold in Mississippi, new curricula will be developed by teachers and new opportunities for restoration and conservation education will be identified and addressed. The success of the LSU Coastal Roots program provides the initial foundation on which MSU Coastal Roots is the first block and model for more states to build similar programs.

Literature cited

Anderson, M.G. 2007. Primer on ecosystem restoration. Pacific Northwest Natl. Lab. PNNL-SA-55142.

Bailey, R.G., P.E. Avers, T. King, and W.H. McNab (eds.). 1994. Ecoregions and subregions of the United States. U.S. Department of Agriculture, Forest Service, Washington, DC.

Blanchard, P.B. 2007. Coastal Roots: A pre-college plant-based stewardship program to connect students with coastal issues. Plant Sci. Bul. 53:138–146.

Chapman, S.S., G.E. Griffith, J.M. Omernik, J.A. Comstock, M.C. Beiser, and D. Johnson. 2004. Ecoregions of Mississippi. U.S. Geological Survey, Reston, VA.

Coleman, E. and E. Bush. 2002. Putting down roots: Starting a seedling nursery for wetland replanting. Louisiana Sea Grant College Program, Louisiana State Univ., Baton Rouge.

Kolb, D. 1984. Experiential learning: Experience as the source of learning and development. Prentice-Hall, Englewood Cliffs, NJ.

Mississippi Department of Education. 2008. 2010 Mississippi science framework. Mississippi State Board Education, Jackson, MS.

National Council of Teachers of Mathematics. 2000. Principles and standards of school mathematics. 24 Sept. 2009. <http://standardstrial.nctm.org>.

Pettus, A. and K. Schwab. 1978. A survey of Virginia public school principals on the state of environmental education. J. Environ. Educ. 10:35–42.

Roth, C.E. 1992. Environmental literacy: Its roots, evolution, and directions in the 1990s. Education Resources Information Center/Center for Science, Mathematics and Environmental Education, Columbus, OH.

Tewksbury, S. and G. Harris. 1982. The status of environmental education in northern New York. J. Environ. Educ. 13:30–38.