PROCEEDINGS

One-Day Symposium:

Current Status of Coastal Wetland Plants Research and Restoration Efforts

November 14, 2008

Rice Research Station
1373 Caffey Road
Rayne, LA 70578

Presented jointly by:
Rice Research Station, LSU AgCenter, and
NRCS Golden Meadow Plant Material Center

LSU AgCenter Research & Extension

United States Department of Agriculture
NRCS Natural Resources Conservation Service

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ACKNOWLEDGMENTS

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One-Day Symposium

Current Status of Coastal Wetland Plants Research and Restoration Efforts

Date: November 14, 2008
Time: 9:00 AM – 4:00 PM
Place: Rice Research Station, LSU Agricultural Center
1373 Caffey Road, Rayne, LA 70578

Meeting Overview

Coastal wetland disappearance has been a major issue in Louisiana for more than a decade. Efforts are underway to develop superior and highly adaptive native coastal plants, seed-based technologies for large-scale restoration, and innovative engineering revegetation techniques. These plant-based products and revegetation technologies are being developed by several laboratories and could be tailored into current construction engineering to develop more successful coastal wetland loss remediation. The magnitude of Louisiana coastal marsh loss is unprecedented and occurs at the estimated rates of 65-91 km^2 annually, representing 80% of the entire coastal wetland loss in the United States. This will necessitate large-scale revegetation efforts to reduce the loss and will require sophisticated approaches beyond a typical crop planting system. Engineered structures and beneficial pumped dredge materials used in new marsh creation can be used strategically to slow down the erosion rate and provide a firm base to reduce the effects of subsidence, sea level rise, and man-made hydrologic modification, ditching, and dredging. Genetically improved native species will help develop robust, healthy, and sustainable wetland systems on currently degraded or newly created marshes to maximize ecosystem functionality.

This one-day symposium will discuss current findings from various research projects being conducted on major coastal marsh plant species, including smooth cordgrass, California bulrush, seaoats, and black mangrove. The overview will also include the technologies being used in these research efforts, such as genetics, plant breeding, genomics and molecular biology, micro-propagation, cellular selection, and tissue culture. Potential aerial applications of seed-based revegetation, roles and participation of plant nurseries and growers, and some implications in restoration policies and contracts will be reviewed. Discussion will also include current and potential future research collaboration among university researchers and restoration agencies.

Meeting Purposes

The objective of this meeting is to facilitate research information exchange from different laboratories and to provide restoration agencies and end users with current information in coastal plant research programs, coastal plant releases, and planting technologies that support large-scale restoration efforts. More importantly, this meeting will facilitate a direct interaction among researchers, coastal restoration agencies, restoration practitioners, growers, and nursery managers.

Who Should Attend

The meeting will bring together researchers, government agencies, and private sector leaders who are interested in coastal wetland restoration efforts. The expected audience will include individuals with interest in plant development, resource management, restoration, and conservation.

Attendance (Pre-Registration is Required)

There will be no fee to attend the meeting (lunch is provided), but pre-registration is required. Anyone interested is encouraged to pre-register as soon as possible through this webpage http://www.lsuagcenter.com/en/our_offices/research_stations/Rice/Features/Publications/Coastal+Wetland+Plant+Symposium.htm.

Hotel Accommodations

Attendees who plan to spend a night before or following the meeting may reserve hotels in the Crowley area directly [La Quinta Inn, Crowley, 9565 Egan Hwy., Crowley, Tel. (800) 531-5900; Crowley Inn, 2111 N. Cherokee Dr., Crowley, Tel. (337) 788-0970; Acadia Hotel (Days Inn), 9571 Egan Hwy., Crowley, Tel. (337) 783-2378]. These hotels are about 5 minutes away from the Rice Research Station.

Meeting Organizer/Program and Contact Information:

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Meeting Chair/Co-Chair:

Richard Neill, Ph.D., NRCS-Golden Meadow PMC; Chair
Herry Utomo, Ph.D., Rice Research Station, LSU AgCenter; Co-Chair
Steven Hall, Ph.D., Biological and Agricultural Engineering, LSU AgCenter; Co-Chair

Agenda

One-Day Symposium

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LSU Agricultural Center
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9:00 AM - 9:30 AM	Registration
9:30 AM - 9:45 AM	Welcome/Opening Remarks, Steve Linscombe Director, LSU AgCenter Southwest Region
9:45 AM - 10:10 AM	Coastal Restoration and Conservation in Louisiana (Past, Present, and Future), Steve Carmichael, State Resource Conservationist
10:10 AM - 10:20 AM	The Golden Meadow Plant Materials Center and Coastal Ecological Restoration, Richard Neill, NRCS Golden Meadow Plant Material Center
10:20 AM - 10:40 AM	Challenges and Issues Associated with Implementing Vegetation Components in Coastal Restoration Efforts, Cindy Steyer, USDA NRCS
10:40 AM - 11:00 AM	Improving Native Plants for Coastal Restoration, Carrie Knott, School of Plant, Environmental & Soil Sciences, LSU AgCenter
11:00 AM - 11:20 AM	Seed-Based Propagation of Smooth Cordgrass and Its Potential Application For Large-Scale Coastal Erosion Control and Habitat Restoration, Herry Utomo Rice Research Station, LSU AgCenter
11:20 AM - 11:40 AM	Factors Controlling the Restoration of Deteriorating Salt Marsh with Sediment-Slurry Amendments, Mike Materne School of Plant, Environmental & Soil Sciences, LSU AgCenter
11:40 AM - 12:00 PM	From Vegetative Planting to Large Scale Diversions: Examining the Cost-efficacy of Coastal Restoration in Louisiana, Rex Caffey, Agricultural Economics & Agribusiness Dept., LSU AgCenter
12:00 PM - 1:00 PM	Lunch (provided)
1:00 PM - 1:10 PM	Development of Salt-Tolerant California Bulrush, Ida Wenefrida, Rice Research Station, LSU AgCenter

Agenda
(continued)

1:10 PM -	1:30 PM	Contribution of Graduate Students to Improve Coastal Marsh Plants, Prasanta Subudhi, School of Plant, Environmental & Soil Sciences, LSU AgCenter
1:30 PM -	1:50 PM	Molecular Genomics and Genetics Studies in Smooth Cordgrass, Niranjan Baisakh, School of Plant, Environmental & Soil Sciences, LSU AgCenter
1:50 PM -	2:10 PM	Bioengineered Wave Breaks for Coastal Protection and Restoration, Steven Hall, Biological and Agricultural Engineering, LSU AgCenter
2:10 PM -	2:30 PM	Louisiana Native Plant Initiative, Scott Edwards Acadiana RC&D Council, Inc.
2:30 PM -	2:45 PM	The Role of Plants in Maintaining the Organic Component of Marsh Soils, Ron Boustany, NRCS
2:45 PM -	3:00 PM	Break
3:00 PM -	3:30 PM	Open Discussion and Recommendations
3:30 PM -	4:00 PM	Touring Tissue Culture Lab, DNA Lab (DNA fingerprinting project), Greenhouses (*Spartina* seed-based syn-1 genotypes and California bulrush salt screening), and Field (*Spatina* polycross plots and Syn-1 test plots)
4:00 PM		Adjourn

COASTAL RESTORATION AND CONSERVATION IN LOUISIANA (PAST, PRESENT, AND FUTURE)

Steve Carmichael

Within the past century, it has been estimated that over one million acres of Louisiana's coastal wetlands have disappeared into the Gulf of Mexico. In 1998, the report 'Coast 2050: Toward a Sustainable Coastal Louisiana' notes that more than two-thirds of a million additional acres could be lost by the year 2050.

Causes of wetland loss along the Louisiana coastline cannot be blamed on any one reason. Man's intervention, including efforts to maintain navigable channels, infrastructure protection from flood and storms, and oil and gas exploration have undoubtedly impacted the dynamic natural processes that exist related to the building, natural subsidence, and erosion of the deltaic lands.

In 1990, restoration in Louisiana gained new momentum with the passage of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), which is expected over the next 50 plus years to infuse needed financial resources into restoration projects.

In recognizing the need for long-term answers to marsh restoration and conservation, many federal, state and local governments and private groups, including USDA-Natural Resources Conservation Service, Louisiana State University Agricultural Center, Louisiana Department of Natural Resources, Barataria-Terrebonne National Estuary Program, and the U.S. Army Corp of Engineers, are working together to identify scientifically sound methods and develop the tools needed to address the problems faced in south Louisiana.

Tools, including modeling programs, engineering designs for marsh restoration, and an extensive plant materials development program, have been created to address restoration needs. As we move into the new century, the need to better understand ecological processes along the Gulf coast and having more efficient technologies to restore vegetative communities will continue to be of high priority for restoring Louisiana's coastal wetlands.

THE GOLDEN MEADOW PLANT MATERIALS CENTER AND COASTAL ECOLOGICAL RESTORATION

Richard Neill

The Golden Meadow Plant Materials Center is located in Galliano, LA, in south Lafourche Parish about 90 miles southwest of New Orleans. Our mission is to identify superior germplasms of coastal wetland, dune, swamp, and prairie plants that have native ranges in the north Gulf of Mexico. We have worked with plants from southeast Texas through the Mississippi coast. We concentrate on native plants.

We have nine species from which we have identified superior genomes. At present, all of our releases are vegetatively propagated except a seed release of Black Mangrove. The mission of the NRCS Plant Materials Program directs us to do the long-term testing and then give the propagules to licensed nurserymen to expand the stock to provide for ecological restoration projects.

Our facilities include about 90 acres of ponds and fields, all of which are heavy soils, including mucks (Rita) and clays (Sharkey). The site is ideal for the plants with which we now work. For prairie plants and now seed production, we have a cooperative agreement with Nicholls State University to use land on their farm that has some soils of lighter texture.

The facilities also include a conference room and dormitory in which we can entertain up to 32 visitors.

Our most requested releases include: ‘Vermilion’ Smooth Cordgrass, Brazoria Seashore Paspalum, Fourchon Bitter Panicum, Caminada Seaoats, ‘Gulf Coast’ Marshhay Cordgrass, and Pelican Black Mangrove. The most recent release is Bayou Lafourche California Bulrush.

Our work is highlighted by our cooperation with the LSU AgCenter Rice Research Station and Herry Utomo. We also actively work with several departments in the University to provide plant material and identify collection sites. Herry has provided us with the DNA fingerprint of our smooth cordgrass. With his assistance, we are able to identify when our production fields are becoming contaminated with wild stock or selfed seedlings. Recent cooperative efforts include our joint work with California bulrush in which we have done field work while Herry is doing genetic studies to identify salt tolerance. This project will have importance in ecological restoration projects in which saltwater intrusion or temporary inundation would kill other genetic strains of bulrush.

In the future, we look forward to introducing California bulrush strains with salt tolerance and Marshhay strains with special horticultural uses. We are working with LSU and other cooperators on strains that may have decorative uses. We also cooperate in the Louisiana Native Plant Initiative to collect, clean and produce seed of native plants useful for conservation reserve lands and right-of-way revegetation.

CHALLENGES AND ISSUES ASSOCIATED WITH IMPLEMENTING VEGETATION COMPONENTS IN COASTAL RESTORATION EFFORTS

Cindy S. Steyer

Since the early 1990s, the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) and other coastal restoration programs have utilized vegetative applications alone and in combination with other restoration techniques, such as ridge, barrier island, and hydrologic restoration, shoreline protection, marsh creation, and terracing. Several of those projects have proven to be very successful, but in order to stem catastrophic loss, the efforts to restore and protect the Louisiana coastal ecosystem are being expanded. In addition to current programs, incorporation of parallel endeavors that focus on complex, landscape scale approaches is being pursued. Some alternatives now being considered would attempt to recreate large, strategic wetland landscape features that are sustainable over a 50- to 100-year lifespan. Restoration at this spatial and temporal scale will require large-scale vegetation applications, as well as cost effective techniques suitable for a wider array of environments and site conditions.

A number of challenges and issues associated with current restoration efforts exist that will need to be overcome to address even greater future needs. First, a relatively small number of coastal wetland plant species are presently being utilized, chiefly because of the extensive time required to identify and release appropriate conservation plants with specifics on production and application procedures. It is imperative that additional species and ecotypes be added to the pool from which restoration planners can select in order to create more plant and habitat diversity across very large restoration areas. Second, nearly all restoration plantings utilize hand labor to transplant vegetative material, which is cost and time limited at all levels of implementation. Additional application methodology must be developed for successful plant establishment and maintenance that demonstrates cost-effectiveness, accessibility and feasibility at increasing scales, which could also translate into more rapid achievement of project targets and benefits realization. Third, this must be accompanied by development of new or improved production techniques that can be successfully adapted by commercial ventures. This will ensure that sufficient and timely supplies of the necessary plant materials are available. Fourth, the planning, engineering, and design - and funding - of restoration projects should be habitat-driven in order to optimize the success of the restoration effort. That is, in addition to geotechnical and hydraulic concerns, aspects of the physical design must accommodate the establishment needs of the desired plant community, whether to be achieved by promoting natural colonization or expansion of a targeted planting component into a stable diversified community. Specific examples will be presented that illustrate how some challenges and issues could be addressed in an actual application using the habitat-driven design of the Raccoon Island Marsh Creation Project as a case study.

IMPROVING NATIVE PLANTS FOR COASTAL RESTORATION

Carrie Knott

Coastal erosion and wetland deterioration are serious and widespread problems affecting all coastal states in the contiguous United States. Unfortunately, Louisiana experiences the greatest wetland loss, losing approximately 90% of the national total, although it has only 30% of the total wetlands. To mitigate wetland loss, native plants are being utilized in vegetative-based restoration projects in Louisiana. Vegetative restoration costs less and is more effectively in preserving the original ecosystem than other types of restoration, such as engineered structures. Smooth cordgrass (*Spartina alterniflora* Loisel.) and sea oats (*Uniola paniculata* L.) are two wetland grass species that have been used extensively in restoration projects in Louisiana and are being improved with traditional plant breeding methodology at the LSU AgCenter. Activities and the importance of the Coastal Plants Breeding Program will be discussed.

SEED-BASED PROPAGATION OF SMOOTH CORDGRASS AND ITS POTENTIAL APPLICATION FOR LARGE-SCALE COASTAL EROSION CONTROL AND HABITAT RESTORATION

Herry Utomo

Native to salt marshes along the eastern U.S. seaboard and the Gulf coast, smooth cordgrass (*Spartina alterniflora* Loisel.) is the predominant plant species in coastal salt marshes. A current practice in coastal erosion control and habitat restoration involves the use of *S. alterniflora*. *Spartina alterniflora* possesses an extensive root system and can provide an effective wave and tidal energy buffer, trapping suspended sediments and providing shoreline protection from erosion. The released cultivar '*Vermilion'* is the only available commercial variety of *S. alterniflora* in Louisiana. It has demonstrated superior growth characteristics, has performed well on newly created, enhanced, or in highly disturbed salt marshes and is often specified as the species of choice by many federal and state conservation agencies when issuing vegetative restoration contracts. However, it has a low seed set (20.6%) and low germination (35%).

A total of 13 genetically diverse, superior, and high seed producing lines were developed by the Louisiana State University AgCenter. These lines, VRES-1, VRES-2, VRES-3, VRES-4, VRES-5, VRES-6, VRES-7, VRES-8, VRES-9, VRES-10, VRES-11, VRES-12, and VRES-13, were space planted randomly to produce synthetic or polycross seed. Seed was hand harvested typically around mid-November, and to obtain maximum harvest, the panicles were stored under room temperature in plastic bags to provide 100% humidity for 1 month to allow all seed to mature and shatter. Specialized harvesters, such as the Flail-Vac harvester, may be used to mechanically harvest the seed as it matures. The average seed set of the polycross population was 56.5%, with an average germination rate of 82.2%. Cold stratification at 2°C in 100% humidity for 1 month was applied to effectively break seed dormancy. Vitavax solution (5 mg/L) was applied to minimize fungus contamination during storage. Following 1-month cold stratification, seed started to germinate in the cold storage (2°C). Seedling viability of polycross seed remains highly viable in a 6-month period. However, its viability becomes rapidly deteriorated thereafter.

The average yield of *S. alterniflora* polycross population was 347.2 lb/A, which is equivalent to approximately 16.9 million viable seeds. Though it has not been as productive as rice (106.3 million seed per acre), cultivation of *S. alterniflora* in a managed environment will provide a large source of seed supply suitable for aerial applications. Populations of *S. alterniflora* have been cultivated and maintained under freshwater conditions at several research institutions for years and have performed well consistently. An aerial seeding can be used to reach interior marshes most affected by erosion and not only to restore coastal marshes but also maintain the entire salt marsh systems. Hundreds of acres can potentially be planted aerially in a day at a fraction of the cost of current planting practices.

FACTORS CONTROLLING THE RESTORATION OF DETERIORATING SALT MARSH WITH SEDIMENT-SLURRY AMENDMENTS

Mike Materne

Projects that effectively lengthen the life expectancy of existing wetlands until a more natural hydrologic and sedimentation regime is re-established have an important place in Louisiana's coastal restoration strategy. Using sediment in combination with vegetation has proven to be a cost-effective technique, capable of preserving and restoring significant portions of Louisiana's coastal marshes. Currently, there is little information available on building, managing, and vegetative restoration of highly-disturbed dredged soils. Working with the Louisiana Department of Natural Resources Division of Coastal Restoration, we were able to conduct a large-scale, manipulative, and multi-year study to assess the effects of dredge sediments on marsh recovery following a catastrophic event. Four primary objectives of the study were to: 1) an assessment of pre- and post-treatment spatial changes across treatment and control sites; 2) construction of hydrologic models to assay the distribution, frequency, and duration of flooding effecting treatments and controls; 3) assay physico-chemical factors controlling natural vegetative recruitment and controls; and 4) determine of the effects of artificial plantings and supplemental nutrients on vegetative recovery, recruitment, succession, and aboveground productivity.

The study was conducted on a small segment (~40 A) of a large marsh die-back (~110,000 A) that occurred in Louisiana’s saline marshes in 2000 and 2001. The project design consisted of constructing five, 6-acre contained cells that received hydraulic sediment pumped over ambient marsh in depths varying from 5 to 20 inches. The project design also included two controls that were 4-acre unconfined cells that did not receive sediment and two healthy reference (ambient) marshes adjacent to the project site.

Approximately 210 transects were established across the sediment treatment, control, and reference cells. A number of vegetative responses, such as species recruitment, density, and cover, were measured. Concurrent with the vegetative recruitment measurements, several physico-chemical variables, such as reduction-oxidation potential, bulk density, organic matter, electrical conductivity, pH, and soil particle distribution, were measured during each sampling period. In addition, extractable NH_4-N, NO_3-N, and P and exchangeable Ca, Mg, K, Na, Fe, Mn, Cu, and Zn were measured.

Within the sediment treatment, control, and reference cells, we established 430 plots of six plant species treatments. Species included *Avicennia germinans* (black mangrove), *Distichlis spicata* (saltgrass), *Juncus roemerianus* (black needlerush), *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (marshhay cordgrass), and unplanted.

A geographical information system (GIS) project was created by integrating a series of time-period base maps using high resolution geo-referenced aerial photographs from which a geospatial dataset could be developed, and subsequent change could be accurately measured across the life of the study. In addition, we measured water temperature (°C), specific conductance (µS/cm), salinity (ppt), and water levels (in.) at 30-minute intervals. The sonde logged approximately 21,000 entries continuously and uninterrupted over a 15-month sampling period.

FROM VEGETATIVE PLANTING TO LARGE SCALE DIVERSIONS: EXAMINING THE COST-EFFICACY OF COASTAL RESTORATION IN LOUISIANA

Rex H. Caffey

The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) has been the largest single source of restoration funding in Louisiana for the past two decades, providing more than half a billion for projects since 1991. However, recent evaluations of CWPPRA indicate that the annual level of program spending constitutes less than 10% of the funding required to sustain coastal Louisiana as it exists today. This constraint, combined with the obvious need to maximize restoration benefits, provides the rationale for an examination of program cost-efficacy. A descriptive analysis of all authorized, active CWPPRA projects (n=128) was conducted to examine the costs and benefits associated with various attributes (e.g., location, technology, and sponsor). Results of the analysis indicate that barrier island and shoreline protection have become preferred restoration approaches under the CWPPRA program in recent years. Despite their popularity, such projects yield the lowest average ratio of benefits to costs according to the Wetland Valuation Assessment (WVA) method, the primary protocol used within CWPPRA for project comparison. A second stage of the research employed a binary logit analysis to determine the degree in which the economic and physical attributes of candidate projects (n=299) affected project selection in the CWPPRA program. Cost-efficiency was found to be significant (Pr>z=0.002) and negatively related to project selection over the 14-year span of the program, indicating that managers have been generally mindful of the annual budget constraint. This was especially the case during the initial years of the CWPPRA program (1990-1995), when projects were ranked according to cost-efficiency, and those with the lowest $/AAHU were usually selected for funding. In recent years (1999- 2004), however, the least efficient projects (i.e., higher costs per AAHU) were found to be significantly and positively related to project selection (Pr >z =0.001). In many cases, these less efficient projects were very expensive, large-scale barrier island and shoreline protection projects. At a minimum, the recent trends identified in this research are problematic given the program’s fixed annual budget. Additional implications emerge regarding the past and future evolution of the WVA protocol, and the degree to which the current model is capturing the full suite of direct and indirect benefits available through various restoration project types.

DEVELOPMENT OF SALT-TOLERANT CALIFORNIA BULRUSH

Ida Wenefrida

Native to Louisiana, California bulrush (*Schoenoplectus californicus*) is a perennial graminoid plant commonly found in marshes, swamps, seeps, lakes, washes, and floodplains, along lake and stream margins, and in wet meadows. It spreads primarily by vegetative propagation, producing new stems from an extensive system of underground rhizomes and, to a limited extent, through seed dispersal. It can grow in relatively deep water of 36 inches or more to produce extensive colonies. When established in conjunction with shorelines, California bulrush provides an effective buffer that dissipates wave energy, reduces shoreline scouring, and traps suspended sediments and other solids. Dense stands of California bulrush are efficient users of available nutrients, producing significant amounts of organic matter. The accumulative effects of organic matter production, sediment trapping, and erosion control not only provide shoreline protection but also accelerate sediment accumulation and near-shore building. In addition, this plant has been known to provide a favorable habitat for wildlife, including some endangered species.

The potential of California bulrush for erosion control, however, is limited because it is a freshwater marsh plant that can only tolerate salt concentrations of up 6 parts per thousand. Greater salt tolerance in California bulrush would increase its role in preserving and restoring salt marshes. In an attempt to improve salt tolerance, parts of actively growing flowers from one of the most tolerant lines were used to produce callus cultures on media containing growth regulators. This produced millions of break-free individual cells. Under appropriate laboratory conditions, these individual cells are capable of self-regeneration into whole plants. Millions of cells were screened under a lethal dose of salinity inside controlled growth chambers to identify cells possessing elevated levels of salt tolerance. Surviving cells were rescued and regenerated into whole plants. Using this approach, what would require thousands of acres to grow millions of plants in a typical farm setting can substantially be reduced into laboratory-size Petri dishes. The cellular selection has yielded 384 putative salt-tolerant lines. These lines currently are being grown in the greenhouse for further evaluation in the field in coming years. These salt-tolerant mutants are not considered genetically modified organisms and, therefore, will not be subjected to a strict regulation associated with the use of genetically modified organisms. If these plants retain their salt tolerance as they did at the cell level, they will be readily available for use in coastal marsh restoration.

CONTRIBUTION OF GRADUATE STUDENTS TO IMPROVE COASTAL MARSH PLANTS

Prasanta K. Subudhi, Xiaobeng Fang, Neil Parami, Alicia Ryan, and Diptee Sahoo

Since the inception of the Coastal Plants Program, graduate students made notable contributions to the coastal plants breeding and genetics research conducted at the LSU Agricultural Center. Three MS level and one PhD level graduate students have successfully completed their graduate program in the School of Plant, Environmental, and Soil Sciences with research focus on genetic improvement of coastal plants. Research was conducted in diverse fields of breeding, genetics, molecular biology, and tissue culture that provided necessary impetus to accelerate development of improved plant materials and technology for coastal restoration effort. The projects carried out by the graduate students are: (a) Reproductive biology of smooth cordgrass (*Spartina alterniflora*), (b) Amplified fragment length polymorphisms characterization of sea oats (*Uniola paniculata L.*) accessions from southeastern Atlantic and Gulf coasts of the United States, (c) Agronomic and molecular characterization of Louisiana native *Spartina alterniflora* accessions, and (d) Micropropagation through somatic embryogenesis and cotyledonary nodal culture in sea oats (*Uniola paniculata L.*).

Research on flowering phenology, pollen viability, and crossability in smooth cordgrass provided useful information to improve seed set. Agronomic and molecular characterization of smooth cordgrass accessions of Louisiana resulted in the identification of several elite lines with improved features for successful wetland restoration. In sea oats, genetic relationship among several accessions from southeastern Atlantic and Gulf coasts of the United States was investigated using molecular markers. The relationship between genetic diversity and geographic source of sea oats populations of the United States as revealed through our study will be helpful to resource managers and commercial nurseries in identifying suitable plant materials for restoration of new areas without compromising the adaptation and genetic diversity. An efficient micropropagation technique also has been developed to generate sea oats seedlings in a mass scale to accelerate coastal restoration efforts.

MOLECULAR GENOMICS AND GENETICS STUDIES IN SMOOTH CORDGRASS

Niranjan Baisakh and Prasanta Subudhi

In an effort to understand the molecular basis of salt tolerance in smooth cordgrass (*Spartina alterniflora*), a dominant salt marsh grass in the Gulf and Atlantic coasts of the United States of America, we employed cDNA-AFLP (amplified fragment length polymorphism) and expressed sequence tags (EST) approach to study differential expression of transcripts under salinity stress. This understanding will facilitate future development of salt-tolerant plants through molecular breeding by marker-aided selection (MAS) and/or genetic manipulation. Of a total of 1,255 ESTs, a number of genes involved in ion transport, general stress response, transcription machineries, protein synthesis, and transport were identified to be involved in the primary response of the halophyte as an adaptive preparedness to salinity. Sequence annotation and BLAST search revealed, in general, genes from smooth cordgrass shared more than 80% similarity with genes from the glycophytic rice. Transgenic tobacco and rice plants overexpressing two halophytic genes (*MIPS* and *VHA*) showed enhanced tolerance to salt stress in comparison with the non-transgenic control plants. Further, stress-inducible promoters have been isolated and are being characterized for understanding the temporal and spatial regulation of the downstream genes under salt stress.

Mining of the ESTs generated from smooth cordgrass for simple sequence repeat (SSR) markers showed an abundance of di- and tri-nucleotide repeats. Fifteen out 100 marker pairs tested were polymorphic among the 12 genotypes of smooth cordgrasss and 11 of them were cross transferable among five other species of *S. alterniflora*. These markers successfully discriminated the members within and among the different species of *S. alterniflora*. The released variety Vermilion (CP8), along with CP10, formed a distinct cluster. Interspecific microsatellite data showed that *S. alterniflora* and *S. foliosa*, as expected, cladded together in the phylogenetic tree. Studies on the population structure through the use molecular markers will help identification of suitable and adaptive plant materials for restoration of new marsh areas while maintaining genetic diversity.

The results of these studies will be discussed in detail.

BIOENGINEERED WAVE BREAKS FOR COASTAL PROTECTION AND RESTORATION

Steven Hall

Concerns over coastal wetland losses have been discussed in numerous recent articles and made more obvious by hurricanes Katrina and Rita (2005), as well as Gustav and Ike (2008). The ongoing problem of coastal wetland loss caused by subsidence, sea level rise, loss of sediment, and tropical storms, has raised awareness of the fragile nature and importance of coastal wetlands for both ecological and human services. This is true in Louisiana and in coastal wetlands around the world. One possible contributor to restoring coastal wetlands is the use of bioengineered reefs, which also serve as wave breaks, protecting fragile wetlands, providing habitat, and enhancing local ecology.

As opposed to heavy rock breakwaters and other traditional structures that are often too costly and tend to sink through poorly compacted mud sediments common in this region, lower density, biologically dominated engineered erosion reduction structures, such as "Oysterbreaks," can help address these issues and have the added benefits of contributing to habitat restoration and oyster production in areas like the Gulf Coast.

The "Oysterbreak" design, which has been significantly developed in recent years, reduces erosion, restores estuarine habitat, and enhances or maintains healthy oyster production through both biological and physical processes. Aquatic organisms, including sessile reef building animals such as oysters, can build mass on structures which encourage such growth. In this process, waterborne material is converted to biomass and thus added to the coastal area, while simultaneously, the reduction of wave energy behind the structure tends to encourage deposition of additional material. Recent studies have found a variety of aquatic organisms, including oysters, barnacles, worms, finfish, crabs, snails, algae and plants increasing the biomass on and adjacent to these structures. The increased biomass performs multiple functions, including reducing wave energy, providing habitat and increasing spatset of oysters and other aquatic organisms. Additionally, this may be a sustainable way to remove carbon from the atmosphere and water column and lock it up for centuries in carbonaceous oyster shell.

Challenges remain in both scientific and engineering arenas, but the combination of relatively low cost, low density, and eco-friendly components make these patented and patent-pending materials intriguing and encouraging technologies. One additional interest is to produce and optimize integrated plant/animal combinations, with consideration of *Spartina alterniflora* and *Avicennia germinans* of particular interest.

LOUISIANA NATIVE PLANT INITIATIVE

Scott D. Edwards

The Louisiana Native Plant Initiative will collect, preserve, increase, and study native grasses, forbs, and legumes assembled from Louisiana ecosystems. Its ultimate goal is to conserve a vanishing natural resource and to provide an essential step in the development of a Louisiana native plant industry. There is a growing interest from public and private sectors to utilize locally adapted native plant materials for restoration and revegetation projects. Conservationists have experienced inconsistent results when establishing native species, ranging from success to complete stand failure. The lack of commercially available cultivars that are adapted across the state of Louisiana is the largest contributing factor to stand failures. Cultivars that are not adapted to the state exhibit signs of summer stress and are less vigorous with lower biomass yields then local ecotypes of the same species. Commercial available sources of locally adapted plant materials have the potential to provide substantial ecological and economic benefits for Louisiana. Under the leadership of the Acadiana RC&D Council, the LNPI partnership has expanded to a total of 20 partners. In 4 years, this program has 45 extensive collections from across the state, 15 species in initial evaluation, 5 breeder blocks, and 3 species in foundation seed increase. Three production facilities are currently being operated at McNeese State University, Nicholls State University, and University of Louisiana at Lafayette. This initiative will try to meet the demands of a diverse customer base by utilizing both local ecotype and cultivar releases. Commercially available sources of locally adapted plant materials have the potential to provide substantial ecological and economic benefits.

THE ROLE OF PLANTS IN MAINTAINING THE ORGANIC COMPONENT OF MARSH SOILS

Ron Boustany

Wetland soils consist of both organic and mineral components. Organic production is critical to maintaining the organic fraction of wetland soils and may constitute over 50% of the dry weight matter in wetland soils. Nevertheless, quantitative analysis of organic production in the maintenance of coastal wetland ecosystems is often overlooked; particularly as it relates to salinity control and nutrient introduction. A desktop numeric model was developed as a coastal restoration planning tool to estimate the benefits of nutrients and freshwater introduced into wetlands from diversions. The model is based on the rate of plant production and the residual contribution of assimilated organic material to maintenance of wetland acreage. The nutrient contribution is a function of volume flow into the receiving area, the concentration of total N and P, the rate of plant productivity, and the retention of nutrients in the system. The model calculates the potential organic matter production as a result of the introduced nutrients to the system. Salinity benefits are determined from the percent reduction in the average salinity in the project site and the impact of the reduction on percent of maximum plant productivity. Both the nutrient and salinity benefits are then factored as an offset to the land loss rate to determine the annual acres of benefit. Test applications of the model were compared with data from two existing projects. The method analyses indicate that volume, concentration, and retention of materials are the most important controlling factors in determining the efficiency of marsh building. Sites closest to the main river, where material concentrations are highest, are capable of forming land at higher rates than areas influenced by smaller tributaries several orders removed from the main river. However, off-river sites with ≥50% preexisting marsh vegetation can potentially rebuild at comparable rates because of high retention rates. Lowest rates of land development are in off-river sites with highly degraded marsh and new delta formations in deep open water. The method has proven to be a very useful tool for rapid assessment of benefits, ranging from large scale diversions to small flow restoration projects.

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