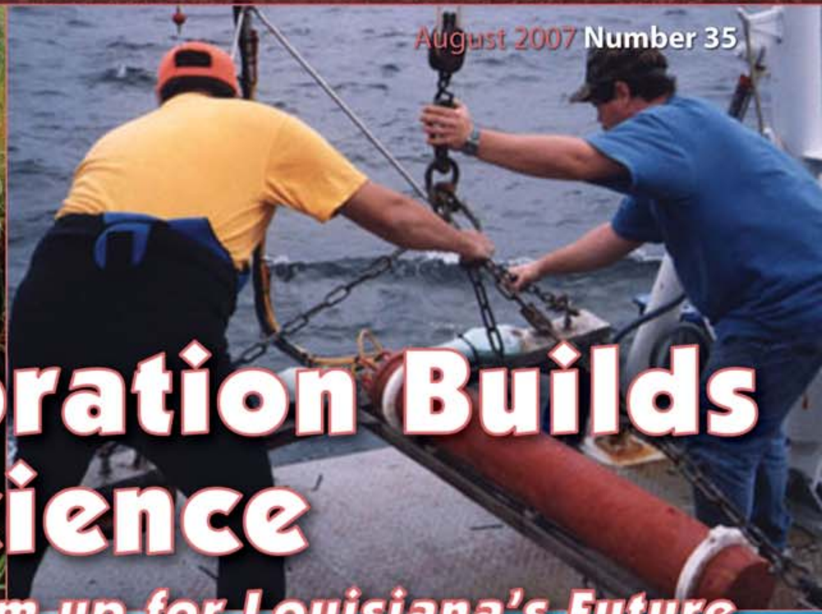
WATER MARKS

Louisiana Coastal Wetlands Planning, Protection and Restoration News

August 2007 Number 35



Coastal Restoration Builds on Coastal Science

Engineers and Scientists Team up for Louisiana's Future

www.lacoast.gov

August 2007 Number 35

WaterMarks is published three times a year by the Louisiana Coastal Wetlands Conservation and Restoration Task Force to communicate news and issues of interest related to the Coastal Wetlands Planning, Protection and Restoration Act of 1990. This legislation funds wetlands restoration and enhancement projects nationwide, designating approximately $60 million annually for work in Louisiana. The state contributes 15 percent of total project costs.

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ABOUT THIS ISSUE'S COVER . . .

In the living laboratory of Louisiana's wetlands, scientists working in numerous disciplines unravel the complexities of this vast, interdependent ecosystem. Their insights provide the scientific foundation for the goals and techniques of coastal restoration.

Photos courtesy of NWRC and Dr. Robert Lane, LSU

WaterMarks

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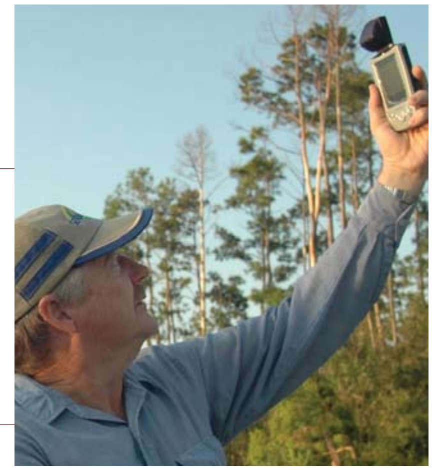

For more information about Louisiana's coastal wetlands and the efforts planned and under way to ensure their survival, check out these sites on the World Wide Web:

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www.btnep.org
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www.dnr.state.la.us/crm
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www.lacoast.gov/newsletter.htm

REMEDIES MUST WORK IN A DYNAMIC NATURAL SYSTEM

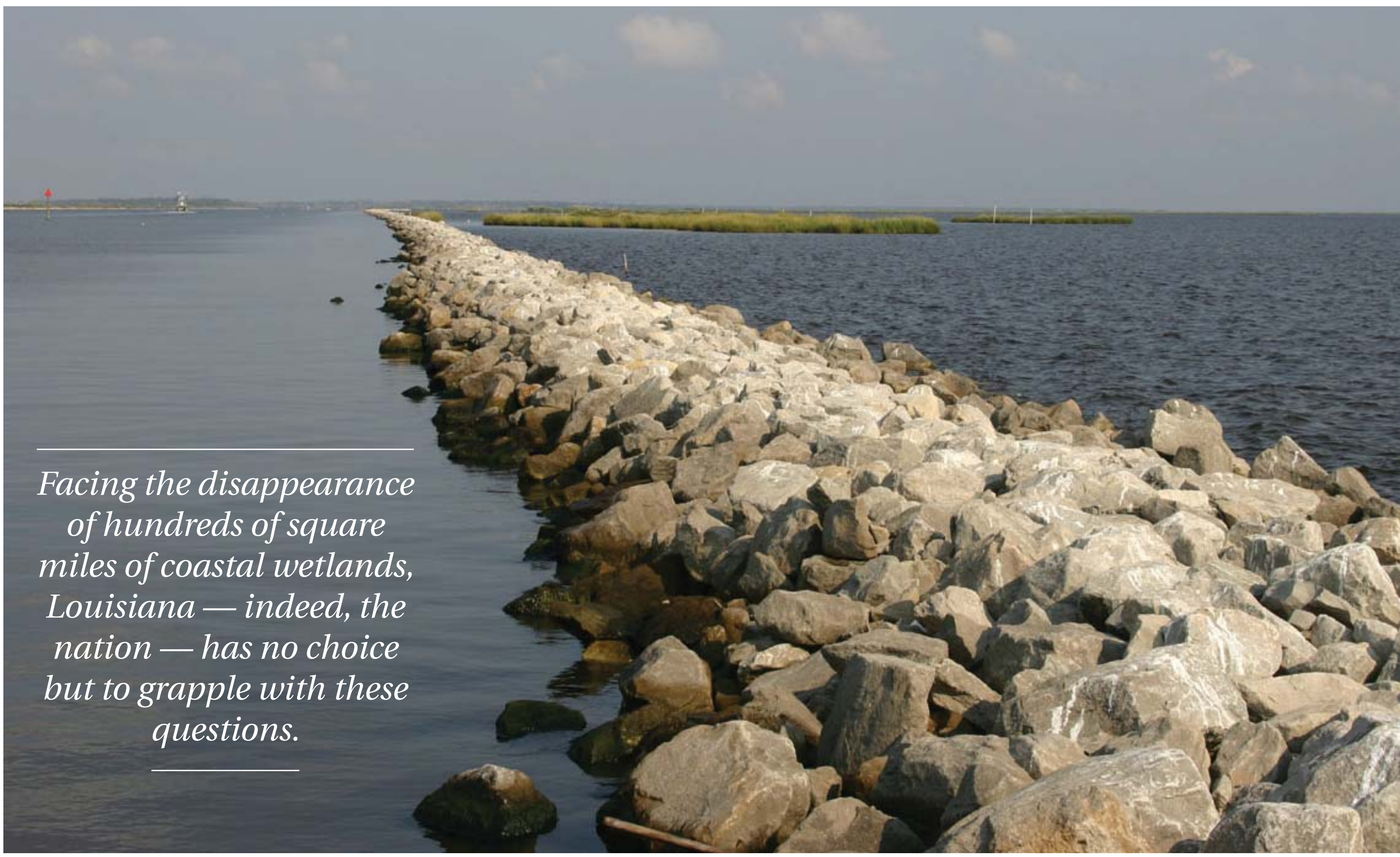
Complex Solutions Rely on Science and Engineering

The mission sounds simple: Restore Louisiana's wetlands. And, on the surface, the methods to accomplish it sound equally simple: erect barriers to stop erosion, import sediment to raise elevation, divert river water to nourish degraded marshes.

But the solutions' seeming simplicity belies the complexity of restoring Louisiana's dynamic coastal ecosystem. Will the underlying soils support the weight of a barrier? What marine organisms will need to migrate through that barrier? About that sediment — how high should it be stacked? How fast will it compact? What kind of vegetation does it need to support? And diversions — how much water should be released? How fast should it flow? How will plant and animal communities change in a freshened marsh?

Even the simple statement of mission raises myriad questions: restore to what condition? For how long? And at what cost socially as well as financially? Yet, facing the disappearance of hundreds of square miles of coastal wetlands, Louisiana — indeed, the nation — has no choice but to grapple with these questions.

Sharon Coogle, Koupal Communications



Facing the disappearance of hundreds of square miles of coastal wetlands, Louisiana — indeed, the nation — has no choice but to grapple with these questions.

Structures as simple as rock barriers can effectively halt some causes of land loss, but in the dynamic coastal ecosystem even such straightforward measures as using rocks to buffer wave action can alter the hydrology, biology — even the chemistry of the wetlands they protect.

A pioneer in environmental restoration, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) has confronted such questions and sought answers based on the best scientific and engineering knowledge available. On each CWPPRA project, scientists and engineers bring up-to-date understanding of coastal ecosystems and current thinking about restoration techniques and collaborate to set goals, develop designs and monitor results.

Science Describes the Goal, Engineering the Means

When a location is considered for a CWPPRA project, scientists join engineers to visit the proposed site and recommend conditions to set as project goals, such as the depth and salinity of the water, the stability of the shoreline, or the kind and coverage of vegetation.

Dr. Robert Lane, LSU

How quickly does drought affect salinity levels? Does a high nutrient count inevitably result in algal blooms? What is the ideal hydrologic flow for sediment delivery? Analysis of water samples taken back to the laboratory contributes to unlocking even the smallest secrets of the wetlands.

"We rely on scientists to provide us with the in-depth, empirical data we need to improve restoration projects," says Rick Raynie, a coastal resources senior scientist with the Louisiana Department of Natural Resources (LDNR) and co-chair of CWPPRA's Monitoring Workgroup. "For example, there is widespread anecdotal evidence that wetlands dampen storm surge, but to incorporate that into restoration plans we need to know how vegetation dissipates wave energy, what species of vegetation to plant and at what density for maximum results."

In turn, engineers tell scientists what is possible to build — if the subsoil will support hard structures such as rock barriers, if sufficient fresh water can be diverted to nurture the preferred vegetation, if pipelines can traverse the distance between sediment source and delivery site. "There is a lot of feedback and interaction between the two groups to shape projects, determine their feasibility and modify them to provide the desired benefits," says Raynie. "Scientific evaluations influence management decisions, and project data contributes to scientific understanding of the complex coastal ecosystem."

Keeping CWPPRA Current

CWPPRA's process involves scientists and engineers in every project phase. Personnel from CWPPRA-affiliated government agencies provide expertise by serving


Dr. Robert Lane, LSU

Monitoring the effects of projects on wetland conditions provides data used to select future restoration techniques and to adjust management practices. Here, a scientist spreads feldspar on the marsh surface to provide a marker for measuring land accretion in future core samples.

on CWPPRA committees, including the following:

- the Environmental Workgroup, charged with reviewing candidate projects, recommending ways to achieve and enhance wetland benefits, and estimating projects' annualized benefits
- the Monitoring Workgroup, which develops standard operating procedures and oversees implementation of field monitoring programs
- the Engineering Workgroup, providing engineering standards, quality control, support and review of cost estimates for numerous aspects of proposed projects

Additionally, project teams include scientists from LDNR who prepare the ecological review document during a project's engineering and design phase. Using monitoring data, engineering designs, and scientific literature, they evaluate project goals from a biological and ecological perspective and assess the likelihood of achieving the proposed biotic benefits and desired ecological responses.

To be sure its projects are based on the best science and engineering available, CWPPRA may contract with private firms, independent scientists and scientists from Louisiana's universities who serve on CWPPRA's Academic Advisory Group (AAG).

The AAG works with other CWPPRA committees to evaluate proposed projects, suggest modifications, and develop and implement field monitoring programs that provide data for ecological reviews. "We help describe how a wetland would change if a project is built, or if it is not built," says Dr. Jenneke Visser, associate research professor at Louisiana State University and current chair of the AAG. "Evaluation procedures differ for different types of wetlands, and we are always adjusting them to adopt the most current scientific findings."

"The AAG brings the latest research in coastal restoration to the field," says Kevin Roy, a biologist with the U.S. Fish and Wildlife Service and chair of CWPPRA's Environmental Workgroup. "Using scientific literature, monitoring and other data, the AAG contributes to reviews that determine whether a proposed solution makes sense and incorporates the appropriate science in its engineering." WM

SCIENTISTS SAY WHAT, ENGINEERS SAY HOW

Coastal Specialists Collaborate to Restore Ecosystem Functions

For eons a natural cycle of land loss and land gain sustained the complex, dynamic ecosystem of the Mississippi River delta.

The expanse of land built from sediment deposited by the river's floodwaters roughly balanced land lost to the natural forces of erosion and subsidence.

But by reshaping the landscape for social and economic interests, human interference in the ecosystem has upset this natural equation. No longer self-sustaining, the Louisiana coast has lost hundreds of square miles over the past century.

Continued land loss threatens the economy and security of the entire nation, dependent on the region for natural resources, oil and gas infrastructure, shipping routes and storm protection. Consequently state and federal agencies have undertaken protecting and restoring Louisiana's wetlands. The agencies rely on scientists and engineers to remedy the ecological disruption. Halting, or even reversing, the trend of land loss will depend on their success in replicating the ecosystem's natural functions.

Sharon Coogle, Koupal Communications

Above: A biologist turns over a clump of cordgrass in a subsiding marsh to show how soil around the roots has washed away. Without roots anchored in sediment, the plant will tear free and float off, exposing a new edge of marsh to erosion.

Opposite: The success of a restoration project may be determined by comparing the structural and functional characteristics of the rebuilt wetland to those of a nearby healthy, or reference, marsh. Drawing on all disciplines of coastal science, comparisons consider factors such as species composition, the growth rate of the biomass, changes in elevation, the texture and nutrient content of soil particles, drainage regimes, and use by fish, benthic invertebrates and other animals.

Causes of a Complex System's Decline

To mimic the ways that wetlands naturally nourish and sustain themselves, restoration scientists and engineers must understand the ecosystem's structure and functions and the reasons for their current demise. Study of the wetlands is conducted through the four broad disciplines comprising coastal science: biology, geology, hydrology and chemistry. "In the wetlands," says Richard Neill, manager of the Plant Materials Center, Natural Resource Conservation Service (NRCS), "you can't be a good biologist — or hydrologist or geologist or chemist — without knowing the other fields. Everything interrelates — it's an interdependent, dynamic system."


Richard Neill, PMC, NRCS

Scientists describe land loss in the terms of their own disciplines. Biologists point out that conversion of land to open water is directly related to the loss of vegetation. "Kill the plants and you expose the soil," says John Jurgensen, an engineer and project manager with NRCS. "Without a root mat to hold it together, soil washes away."

But vegetative death is part of the ancient natural cycle, contributing essential organic bulk to wetland soils. What causes plant death to outstrip plant production, undoing the age-old balance?

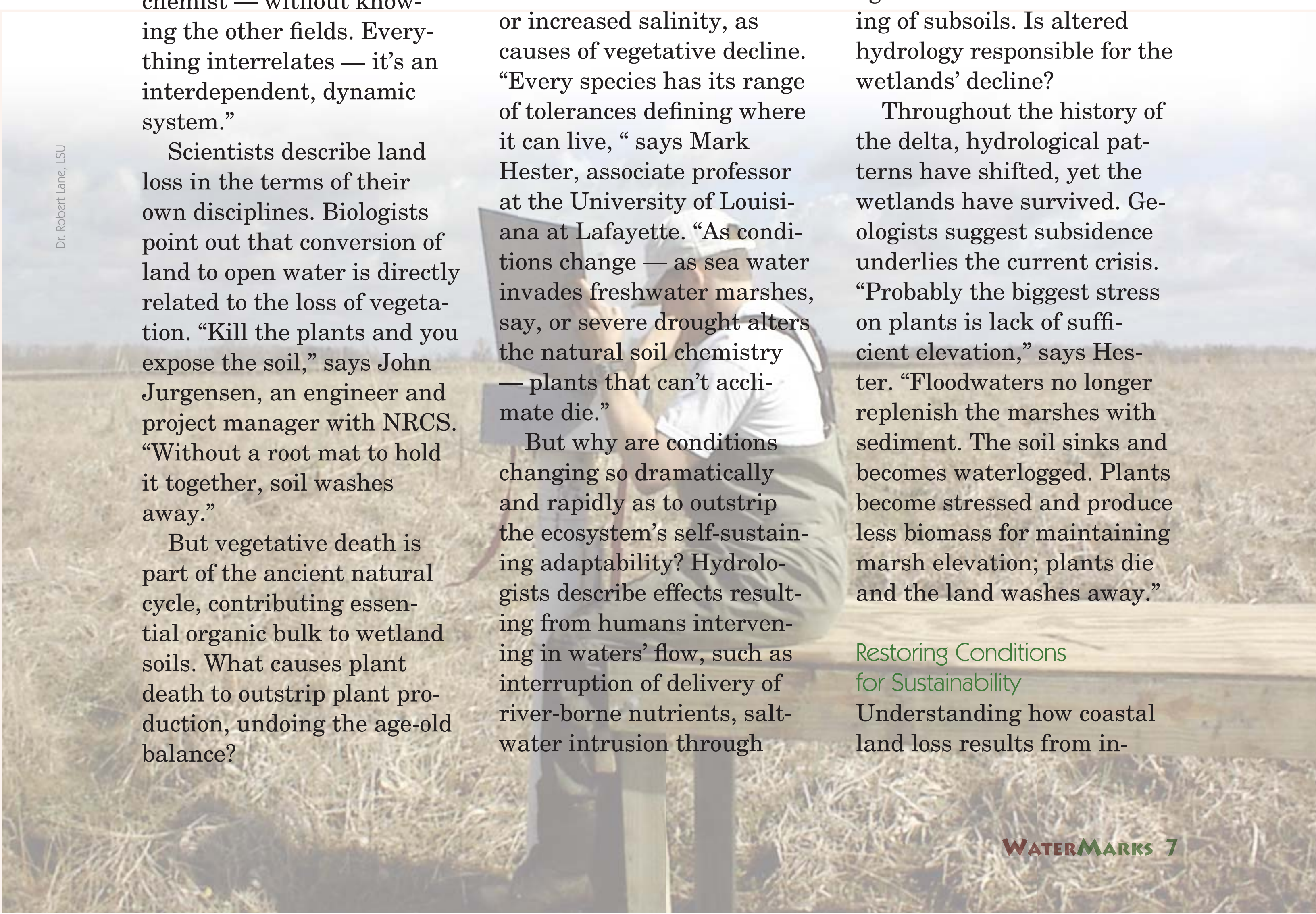
Chemists cite changes in the chemical profile of water, such as decreased nutrients or increased salinity, as causes of vegetative decline. "Every species has its range of tolerances defining where it can live, " says Mark Hester, associate professor at the University of Louisiana at Lafayette. "As conditions change — as sea water invades freshwater marshes, say, or severe drought alters the natural soil chemistry — plants that can't acclimate die."

But why are conditions changing so dramatically and rapidly as to outstrip the ecosystem's self-sustaining adaptability? Hydrologists describe effects resulting from humans intervening in waters' flow, such as interruption of delivery of river-borne nutrients, saltwater intrusion through man-made canals into marsh interiors, or blocked drainage that causes the drowning of subsoils. Is altered hydrology responsible for the wetlands' decline?

Throughout the history of the delta, hydrological patterns have shifted, yet the wetlands have survived. Geologists suggest subsidence underlies the current crisis. "Probably the biggest stress on plants is lack of sufficient elevation," says Hester. "Floodwaters no longer replenish the marshes with sediment. The soil sinks and becomes waterlogged. Plants become stressed and produce less biomass for maintaining marsh elevation; plants die and the land washes away."

Restoring Conditions for Sustainability

Understanding how coastal land loss results from in-


Dr. Robert Lane, LSU

Richard Neill, PMC, NRCS

Whether killed by waterlogged soils resulting from subsidence, by increased salinity due to advancing gulf waters, or by other causes, these trees stand as evidence to an ecological change so swift, so extreme, that they were unable to survive.

terrupting natural ecosystem functions provides the framework for designing projects to restore the wetlands. Using nature as their model, scientists describe optimal conditions for a project to create, and engineers determine the best way to achieve them.

"As an engineer I tend to focus on physical factors, such as wave height and energy, that influence structural choices," says Jurgensen. "However, often my co-manager on projects is a biologist. He analyzes the project's probable effects on the living ecosystem and recommends features, such as openings in shoreline protection to allow tidal exchange, to support functions upon which living organisms depend."

Scientists may use healthy marshes adjacent to project areas as reference marshes to establish standards for natural features such as elevation; the type, coverage and growth rate of vegetation; the nutrient load carried in water; or the speed and direction of water currents.

"The first step is to look at what naturally is in a functioning wetland," says Neill. "We shouldn't fight nature. We have to figure out the reasons why a plant grows here and not 100 yards over there. It goes back to the chemical, hydrological and geological conditions that define and distinguish any single ecosystem."

Project design incorporates information from all these coastal science disciplines. For instance, geologists may help select locations by identifying areas of greatest potential land gain. Hydrologists might calculate the frequency and depth of flow from diversions that move nutrients farthest into the wetlands. Chemists could measure the rate of organic carbon decomposition in the soil to determine the nutrient release available for plant growth.

But wetland conditions are not only a complex interplay of geologic, hydrologic, biologic and chemical factors, they are also dynamic, in constant flux. Restoration projects must factor changing conditions, whether taking place within hours or over decades, into their designs.

Sea level rise is an example of a change anticipated by scientists. "With rising sea levels we expect salinity to increase in interior marshes," says Neill, "so we're looking for plants with greater salt tolerance to use in restoration. It might take 10 or 12 years to find and develop such a plant."

Establishing target elevations for marshes enhanced with dredged material presents another example of how project design must consider change over time. Should the ideal height be established with the initial delivery, or should the marsh reach its target height after a few years' subsidence? How many years should the target height be sustained? The decision influences when, and for how long, the desired plant community will flourish. When conditions are optimal, the plants will make positive contributions, such as trapping sediment and providing organic matter, that influence the lifespan of the project.

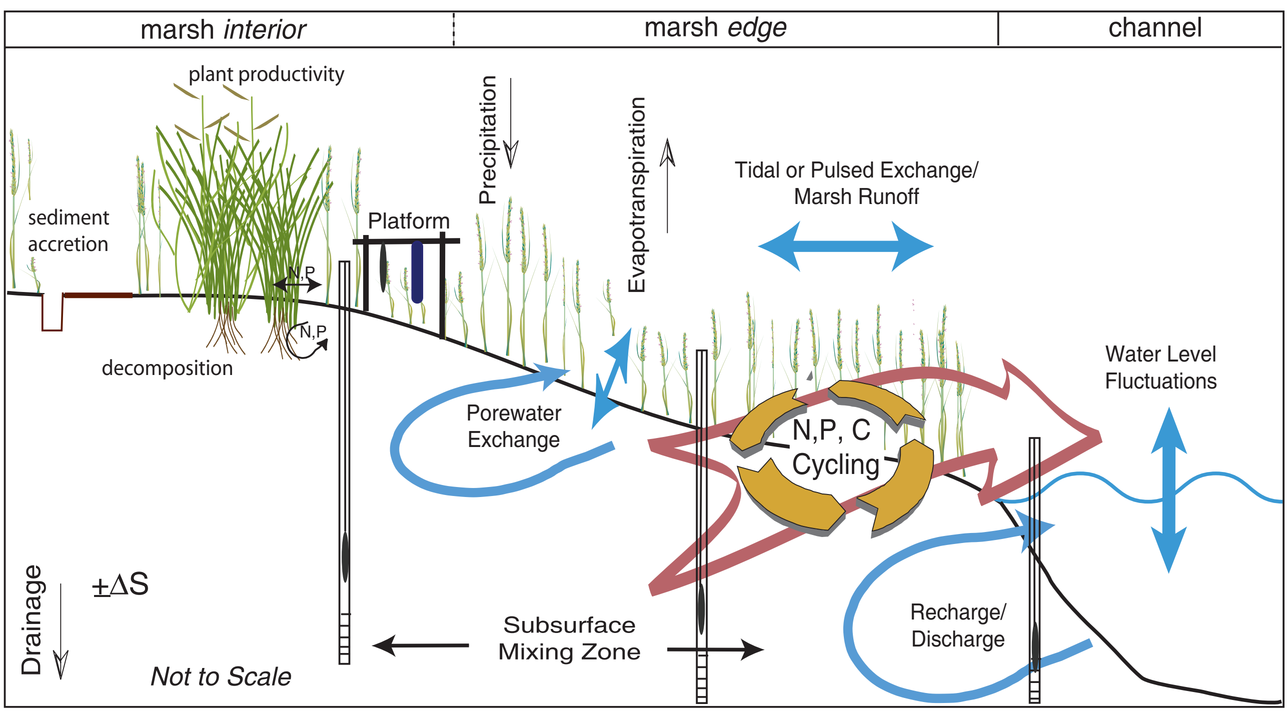
Project areas suffer changing conditions the same as do natural wetlands. Without maintenance, they are subject to decay and decline. "Although designing wetland restoration projects for self-sustainability is the ideal goal," Hester says, "maintaining projects is as important as building them, helping to reduce costs in the long run."

Learning from Louisiana

Although located within the state to address the state's crisis of land loss, Louisiana's coastal restoration projects make global contributions to science and engineering.

"For instance, our studies of brown marsh die-back

Jaye Cable, LSU



Suggesting the complex interplay of factors comprising a dynamic wetland ecosystem, this diagram illustrates the multidisciplinary considerations of a study investigating the exchange of carbon, nitrogen and phosphorous between marshland and adjacent waters. "When you have several people in different disciplines working together, there's always the opportunity for tremendous exchange and insight that you don't get if you're doing only your own type of work," says Irving Mendelssohn, a plant ecologist and one of the four LSU professors conducting the research. "In this study hydrologists are investigating how water flows both above and below the marsh surface. Subsurface hydrology directly affects plant growth, so the hydrological differences these scientists measure help me interpret plant response. At the same time, my study of plant transpiration — the degree to which water evaporates through plant tissue — helps hydrologists understand the vertical movement of water that they see occurring below ground."

Wetlands Center Develops Science for Sound Restoration

Where has coastal land loss been most severe? How might global climate change threaten flora in brackish wetlands? What technology is used to collect data on migratory bird populations?

Government agencies, academicians, even the interested public ask such questions of the National Wetlands Research Center (NWRC). If an answer exists, the center is likely to locate it in its extensive print and digital library. If the answer's not known, the question could become a research topic for the center's ecologists, chemists, biologists, geographers and others who study threatened wetland ecosystems and investigate how to stabilize, restore and manage the coastal landscape. The center conducts research through three branches:

Research focus areas include
- accretion, subsidence and sea level rise
- coastal marsh die-back
- marsh and coastal prairie management and restoration
- global climate change
- nutrient dynamics and biogeochemical cycling
- plant community dynamics
- submerged aquatic vegetation

NWRC

The **Wetlands Ecology Branch** focuses on the sustainable management and restoration of coastal saltwater wetlands, coastal and inland freshwater wetlands, submerged aquatic ecosystems, and coastal prairies.

The **Forest Ecology Branch** studies the ecology and restoration of forested wetlands and uses computer modeling techniques to predict conditions under various changing circumstances. Research focus areas include
- physical, chemical and biological functions of forested wetlands

assist ecologists in understanding the phenomenon in New England," says Hester. "What we learn about the effects of climate variability in our wetlands will help people develop strategies to deal with the consequences of climate change worldwide."

As data on the results of Louisiana's restoration projects accumulate, the exchange of information among scientists and engineers is constant.

"There's a continuous loop between research and implementation," says Rick Raynie, a coastal resources senior scientist with the Louisiana Department of Natural Resources. "Research suggests how a project should be built and managed. Data collected on project results indicate where uncertainties lie and point to topics requiring further research."

"We have the opportunity in Louisiana to create a model for integrating life sciences with physical engineering and socioeconomics to deal with global issues like climate change and sea level rise," says Hester. "This synergistic and interdisciplinary approach will be the key to success in managing and restoring coastal ecosystems worldwide." WM

- conservation genetics
- dendroecology
- fire science
- reforestation and restoration methodologies

The **Spatial Analysis Branch** uses computerized analysis techniques and state-of-the-art technology to provide the spatial data necessary for making informed decisions about natural resource management. Research focus areas include

- ecosystem analysis
- environmental electronics engineering
- geographic information systems (GIS)
- GIS-based ecosystem assessment and modeling
- photo interpretation and cartography
- population ecology
- remote sensing

Administered under the Department of the Interior as an agency of the U.S. Geological Survey, NWRC employs about 80 scientists working at the center's facility in Lafayette, Louisiana, at two field stations in Texas and Louisiana, and at a project office in Florida. Founded in 1975 as the National Coastal Ecosystems Team, the center mapped coastal Louisiana land loss and played a leadership role in raising awareness about the extent of the problem of wetland loss.

"Every CWPPRA project incorporates analyses of historical wetland changes into its planning," says Greg Steyer, an ecologist at NWRC and co-chair of the CWPPRA Monitoring Workgroup. "By addressing key scientific uncertainties, the center's investigations increase the likely success of our efforts to restore a degrading environment."

Learn more about the National Wetlands Research Center by visiting its Web site at www.nwrc.usgs.gov.

NWRC

Dr. Robert Lane, LSU

Opposite left: From marine sea grasses to bottomland hardwoods in forested wetlands, NWRC scientists conduct field and laboratory research to provide the ecological knowledge and insight necessary for making sound decisions about vital wetland resources.
Above right: In addition to providing offices and laboratories for the center's research scientists, NWRC's facility in Lafayette, Louisiana houses the center's library and information center, which provides services to manage, store, retrieve, translate and present scientific information.
Above: Ultimately the answers to all ecological questions reside in the field. Wetland secrets are unlikely to be revealed without dedicated researchers willing to get hot, wet, sweaty, sandy, muddy and cold.

RESEARCH EXPANDS UNDERSTANDING OF WETLAND ECOSYSTEMS

Louisiana Scientists Lead the Way in Coastal Restoration

Picking his way through dense marsh grass, a hydrologist collects water samples to investigate the impact of a sediment diversion on estuarine water quality.

Working with sophisticated software, an oceanographer models the impact of storm surge moving across a south Louisiana wetland. Using cloning technology, a plant biologist researches a means to improve aerial propagation of smooth cordgrass.

In high-tech facilities and the living laboratory of the state's coast, Louisiana scientists conduct research that broadens our understanding of wetland and deltaic ecosystems, helping shape restoration projects locally and globally.

"The state's scientists were pioneers in developing wetland science as a discipline and the world's understanding of how a river delta works," says Robert Twilley, professor of oceanography and coastal sciences at Louisiana State University (LSU). "Today Louisiana's scientific community remains a global leader in understanding coastal and deltaic ecosystems."

Wetland Decline Spawns Scientific Community

Crumbling shorelines, drowning marshes, vanishing barrier islands: In the 1960s, scientists began to observe the ill effects of human intrusion on the state's once-pristine wetlands. Louisiana Sea Grant (www.laseagrant.org) was founded in 1968 to research the problems facing the coast.

"Out of a need to understand what was happening to our own wetlands, we built a community of world-renowned scientists," says Chuck Wilson, Sea Grant executive director. Based at LSU, Louisiana Sea Grant fosters collaboration among scientists at 15 universities and institutes. Recent Sea Grant research studied the effects of oil spills on marsh vegetation, examined the roles of wetland vegetation and cypress forest in abating storm surge, and investigated the impact of river diversions on adjacent wetland processes.

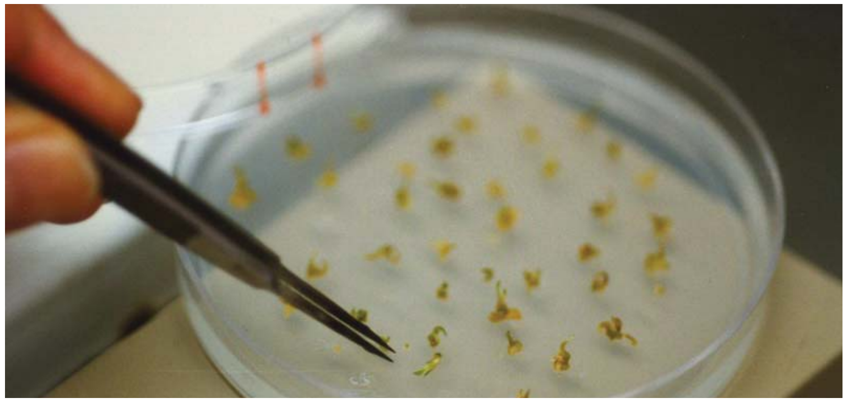

Louisiana Sea Grant College Program

To predict the impact of future climate change on the state's wetlands, scientists studied how elevated carbon dioxide levels affected marsh vegetation in a Louisiana wildlife refuge.

"Sea Grant research encompasses social as well as natural sciences," Wilson says. "How do we protect human life and property while restoring natural processes? How do people respond to natural events such as land loss and hurricanes? As we study ways to preserve and restore wetlands, we also seek ways to make coastal communities as resilient as possible."

Remote Lab Provides Access to Wetlands

In a vast expanse of salt marsh at the southern edge of Terrebonne Parish sits the launch pad for wide-ranging marine and wetland research: the



Louisiana Sea Grant College Program

Above: In Calcasieu Lake, a team of researchers tagged spotted seatrout to track how the species uses different types of habitat. "The information will help identify restoration practices that provide the most beneficial habitat for our fisheries," explains Chuck Wilson, Louisiana Sea Grant executive director.
Above right: Developed in an LSU lab, new strains of common marsh plants could one day allow quick, economical aerial seeding of remote wetland restoration sites.

sprawling W. J. DeFelice Marine Center, the primary facility for the Louisiana Universities Marine Consortium (LUMCON). Here, LUMCON facilitates the study of coastal ecosystems by providing laboratories, a library, and two research vessels to visiting scientists and the consortium's own research staff.

"If you want to do research in the wetlands, this is the perfect place to do it," says Nancy Rabalais, LUMCON's executive director. "Our location provides access to barrier islands, beaches, coastal cheniers, and salt, brackish and freshwater marshes."

LUMCON also administers funding for the Coastal Restoration and Enhancement through Science and Technology (CREST) program, a consortium of 12 institutions in Louisiana and Mississippi that sponsors small research projects with the potential to make big discoveries. Since the program's inception in 2002, CREST has funded more than 30 projects, including research that explored ways to improve vegetative plantings on barrier islands, analyzed the impact of state law on coastal restoration, and located rich deposits of sand suitable for rebuilding barrier islands.

In addition to providing funds for research, CREST organizes conferences on restoration topics. "Our aim is to introduce new ideas into coastal restoration," explains Piers Chapman, CREST's executive director. "We hope to improve science by stirring debate."

Modeling Program Provides Predictive Tools

Within the Coastal Louisiana Ecosystem Assessment and Restoration program (CLEAR), based at LSU and funded by the Louisiana Department of Natural Resources, scientists from LSU, the University of Louisiana at Lafayette, the University of New Orleans and the U.S. Geological Survey develop sophisticated modeling and forecasting tools to help project planners predict how the coastal ecosystem will respond to restoration projects, major storms and other changes. In one project, CLEAR investigators are working with the National Center for Earth Surface Dynamics to create a cutting-edge land-building model.

"Project planners want to know how much land a particular technique will build, where it will be and what will grow on it," explains Twilley, CLEAR's principal investigator. "Whether it's rebuilding an island or determining how multiple projects will work in synergy, decisions about restoring an ecosystem are complicated. CLEAR's goal is to ensure good science is the first consideration in every decision made for the future of our coast." WM

Louisiana Sea Grant College Program

WaterMarks Interview with Denise Reed

Denise Reed is professor of earth and the environment at the University of New Orleans. In this interview Dr. Reed shares some of her observations about the role of scientists and the goals of coastal restoration in Louisiana.

WaterMarks: From a scientific point of view, is restoring Louisiana's coast really possible?

Reed: We can make Louisiana look like it used to, but it wouldn't be sustainable — it would continue to deteriorate. To make it look like it used to look 80, 50, even 20 years ago denies that it's a system that's been in constant change for the last five to six thousand years.

If the goal is to return the ecosystem to a level of sustainability so that land loss is slow and balanced by gain — that goal can be achieved.

WaterMarks: How do scientists contribute to that goal?

Reed: Scientists might say to an agency sponsoring a project, "If you want marsh in this area to grow these plants, to support this particular fish, to do these things and be sustainable, we can tell you 1) if it's achievable and 2) how to get there."

And we would tell them the conditions they would need to provide — the salinity, flooding regime, land to water ratio, water depth — to support that kind of vegetative community, or that particular organism.

Or we may say, "You can't get there; you might want to modify your vision to make it something you can actually achieve."

WaterMarks: Do restoration projects promote the proper outcomes?

Reed: It's not the scientists' role to articulate what the outcome should be, what the vision is; that's a decision for the community to make.

One of the challenges we face right now is that our various restoration programs don't have well-articulated goals, a clear vision of what we want the coast to look like and how we want it to work in the future.

We have a map of what the coast will look like if we take no action, but no map of what it will look like as a result of actions we could take. We have a map for 2050 saying what we're going to do, but not what the outcome of doing it will be.

WaterMarks: What is the difference between project goals and a vision?

Reed: Project goals address changing conditions in a discrete piece of real estate, a specific geography. A vision for Louisiana's coast considers the entire system. It points the way ahead and helps to set reasonable expectations. A vision for coastal Louisiana must describe specifically what kinds of things will be where and what the consequences of actions will be.

When we set a very general goal, everybody understands it in a slightly different way. When they see what is done in the name of that goal, they don't always see what they expected. If the problems in their area don't get addressed, people are disappointed. This is the result of lacking a clear statement of what the vision is, of what our priorities are, of what we can expect the outcome to be. If your goals are very general, people always expect their problems to be solved — first!

Denise Reed

WaterMarks: What challenges to coastal restoration lie ahead?

Reed: Climate change is clearly something we have to consider a lot more explicitly in our restoration planning. We need to think through how solutions we're building would perform under different scenarios. We don't have to wait until we know how the climate has changed to incorporate it into our thinking.

We need to take into account the complexities of economic dynamics as well as of environmental dynamics. I don't deny that solutions need to move along as fast as possible, but as energy costs rise we may reconsider some of our choices. For example, we've got the river to do it, we've got gravity, but we're using pumps running on fossil fuel to deliver sediment because we're impatient.

Sometimes we give people the impression we can do things we can't do with the resources — the sediment and fresh water — that we have available. We can't be serious about restoring the coast while ignoring the fact that year after year we're dumping one of our most valuable resources into the deep water of the Gulf of Mexico. This is not to say we have to do a lower river diversion, but if we continue to talk restoration on the coast of Louisiana while not addressing this issue, we have to be much more honest with people about what the consequences are.

If restoration really is a problem of the magnitude that we keep telling the rest of the country and world that it is, then surely we should really take a look at how to use the river to solve it. Some say we can't go there; I say we have to go there.

USACE

WaterMarks: What are the issues involving a lower river diversion?

Reed: The river is not merely an ecological asset. It presents the largest water resources management project this country's ever undertaken. We haven't yet addressed it because it's a very complex study that involves not just ecosystem science, but hydrologic engineering, river management, economics, international trade — all these kinds of things. It affects the entire country, not just Louisiana.

We have to decide if we're going to manage the river, the navigation, the same way we've been doing it for 150 years, or if we're going to come up with a new plan for managing the water resources of the lower river that provides for navigation, provides for flood control and provides for ecosystem restoration. If we're not going to do that, our vision of restoration must be much more modest.

WaterMarks: Do we need more studies?

Reed: There's a frustration about needing action, not studies. But we can't afford any major unintended consequences, not in the way of the past. We have a responsibility to show clearly thought-out processes and a reasonable assurance of the outcome. We have to do studies, and we can do them efficiently, in focused ways, so the outcome is to make a decision, not to do another study.

Some things we'll never know. But we'll have to go ahead in spite of that. WM

BUILDING LOUISIANA'S FUTURE

Coastal Roots Teaches Wetland Science from the Ground Up

Braving the coldest weather of the year, eighth-graders from Pierre Part Elementary planted nearly 300 cypress seedlings at a state park.

Coastal Roots

Students from Lafayette Middle School spent a damp winter day on Grand Isle gathering black mangrove seeds to grow in their school nursery. To prevent erosion on the Morganza-to-the-Gulf hurricane protection levee, Montegut Middle School students planted 500 smooth cordgrass plants in Terrebonne Parish.

Coastal Roots

Left: At Fairview Riverside State Park, students from Baton Rouge's St. Joseph Academy plant loblolly pine and baldcypress seedlings with guidance from Coastal Roots program coordinator Pam Blanchard.
Right: At Luling Elementary School's nursery, students start baldcypress seeds in yellow "conetainers."

These students — and hundreds more from 18 south Louisiana elementary, middle and high schools — participate in Coastal Roots, a program designed to cultivate awareness of conditions in the state's wetlands.

The LSU Coastal Roots Program helps schools establish and maintain their own nurseries, where students grow native trees, shrubs and grasses to plant in habitat restoration projects. "In class and on planting field trips, Coastal Roots teaches kids about horticulture, ecology and wetland restoration," says Pam Blanchard, Coastal Roots' program coordinator. "Because they're directly involved in restoring the coast, they develop a sense of responsibility for the wetlands."

Coastal Roots is supported by the Louisiana State University Department of Educational Theory, Policy and Practice; the LSU School of Plant, Environmental, and Soil Sciences; the Louisiana Sea Grant College Program and the LSU Ag Center. For more information about Coastal Roots, visit http://coastalroots.lsu.edu/ WM

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