FORESTRY

Exploring the Basis of Stand Density

Thomas J. Dean, Professor

This summer marks the midpoint of a project funded by the National Institute of Food and Agriculture investigating the role water plays in the development of stand structure in loblolly pine plantations. The project has a greenhouse component and a field component conducted by Co-principal investigators Dr. Volker Stiller at Southeastern Louisiana State University and Thomas J. Dean at the Louisiana State University Agricultural Center's School of Renewable Natural Resources. The number of trees of a given diameter that can coexist within an acre of forest is a standard for calculating tree density, which is a useful index for silviculturists. While it is well known that stem diameter is adversely affected by close spacing between trees, stem diameter is a secondary response to space restrictions on crown size: horizontally by proximity of neighboring crowns and vertically by shade.

In trees, the stem physically supports the crown and is the conduit for water and nutrients to move from the soil to the foliage. This function seems to be coordinated by the mechanical properties of the trachieds and their effect on the resistance to water flow through the sapwood. Across species and even within a species, lower specific gravities reduce the resistance to water flow through the stem but require more cross-sectional area to maintain mechanical support. The downside of reduced resistance to water flow through the stem is increased vulnerability of the water column snapping. The hypothesis being tested by Dr. Stiller is whether environmentally- induced changes in specific gravity simultaneously affects stem diameter and cavitation vulnerability and is one mechanism for affecting the number of trees of a given diameter that can exist on an acre.

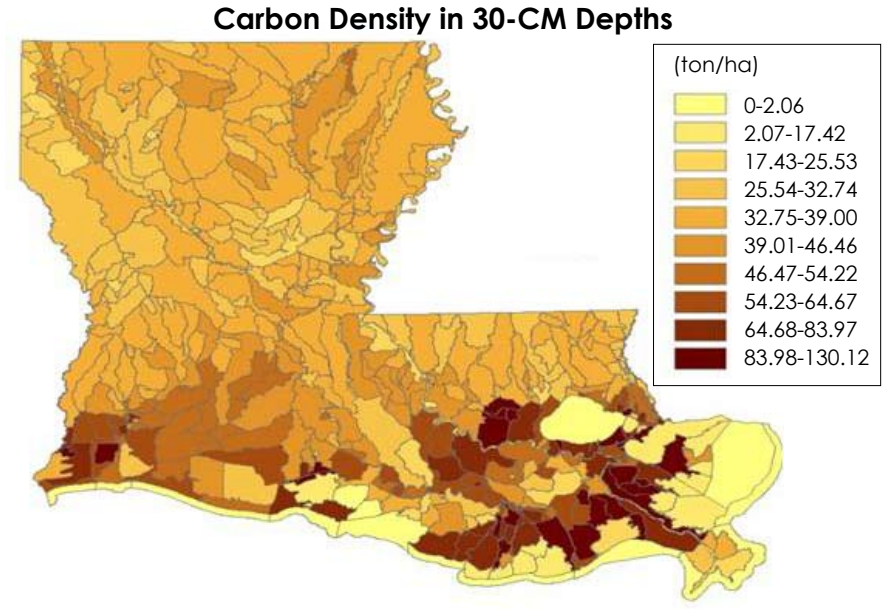
The dominant mechanical force that a tree stem must withstand is wind. The bending force is countered by the stem diameter and is proportional to the amount of leaf area the tree supports and the height to the center of the leaf area. The height to the center of leaf area is not only determined by shading but also by how easily lower branches can draw water from the main stem. With increasing water stress, lower branches suffer from both light and water deficits, which can lead to their death. The experiments being conducted by Dr. Dean at Lee Memorial Forest are attempting to manipulate the resistance to water flow in the main stems of young loblolly pine trees to increase the likelihood of death of the lower branches (Figure 1). By changing the height to the center of the live crown, we hypothesize that we can change the stem diameter without changing average tree spacing. Nathan Prince, a graduate research assistant with Dr. Dean, is following the effects of changing water conductivity through the stem on branch demographics in the lower crown.

Figure 1. Injecting air into the stem of a young loblolly pine tree to reduce water flow through the stem.

Projecting Climate Change Effect on Soil Carbon Storage across Louisiana's Watersheds

Biao Zhong, Post-Doctoral Researcher, University of Florida and Y. Jun Xu, Associate Professor

Soils store a large quantity of carbon, whose dynamics plays a significant role in the global carbon cycle. In the recent decade, there have been increasing studies on predicting the potential effect of climate change on soil carbon storage, but little research has focused on addressing the possible impact of climate change on terrestrial carbon in the United States at a large scale. We have recently completed an assessment on soil organic carbon storage in Louisiana's watersheds and their future change under changing climate conditions. First, we used the U.S. Soil Survey Geographic (SSURGO) database and geospatial techniques to estimate carbon stored in different soil layers. Then, we applied spatial modeling to predict future soil carbon change under different land cover and land use types across Louisiana at the watershed scale.



Distribution of soil organic carbon stored in Louisiana's watersheds, demonstrating that wetland soils in southeast Louisiana contain a large quantity of carbon.

On average, soils of Louisiana contain 44, 86, and 122 tons of organic carbon per hectare in their upper 30-cm, 100-cm, and the maximum depths, respectively. The stage average of carbon density of maximum depth (122 t/ha) is nearly 50% higher than the average reported for the conterminous United States and Alaska (88 t/ha). There is a decreasing trend of soil carbon density from the southeastern coastal region to the northwestern upland region in the state. Overall, alluvial river corridors and wetlands show much higher soil carbon densities when compared to upland regions.

In the climate change modeling, we considered three commonly-used greenhouse gas emission projections: B2 (low emissions), A2 (moderate emissions) and A1FI (high emissions). We found that, under the future climate change scenarios for the next 100 years in Louisiana, monthly mean temperature in spring would increase the most. Monthly precipitation would typically decrease. Generally, temperature and precipitation changes from the least to the most will be in the order of low, moderate, and high emissions. From a land use standpoint, row crops have been found to have the largest carbon loss.

DIRECTOR'S COMMENTS

Allen Rutherford

Greetings from the LSU AgCenter's School of Renewable Natural Resources! This has been a good year as we continue to expand our research and extension programs as we strive to achieve national and international prominence. Our research and extension faculty continue to excel in competing for grants and contracts from a diverse range of federal, state, and private partners (see listing on the back page of this document). As most of you know, all institutions of higher education are suffering from budgetary constraints and our situation is no different. We have undergone several rounds of budget cuts over the last two years and will likely have additional cuts in the near future. During this period we have lost several faculty and staff positions, which have posed a challenge to all School programs. However, we have been fortunate to add Dr. Julie Anderson as a new extension / Sea Grant research faculty member with research expertise in decapod crustacean biology. We have also strengthened our association with Dr. John Supan who has recently joined RNR as an adjunct faculty member. Dr. Supan is a well respected Sea Grant oyster researcher that has recently increased his extension activities. In the face of declining recourses our continued success is a tribute to the quality of the faculty, research associates, graduate students, and support staff in the School.

We know that the current economic challenges are short term and there are many reasons to be positive about the future of all RNR programs. We believe that RNR will emerge from these challenging times poised to improve all programs in the School, but would certainly use and appreciate any financial support you could provide for our ongoing efforts. We would also solicit your help in making potential students aware of the unique career opportunities we offer to students interested in outdoor careers in forestry, wildlife, and fisheries. If you have any questions, comments, or would just like to come by to visit, please feel free to contact me (drutherford@agcenter.lsu.edu; 225-578-4187).

D. Allen Rutherford

School of Renewable Natural Resources
Research Matters
Summer 2009

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FORESTRY

Satellite Images for Estuary Salinity Prediction

Fugui Wang, Post-Doctoral Researcher, University of Wisconsin
and Y. Jun Xu, Associate Professor

Estuaries are among the most productive ecosystems on earth, and salinity plays an important role in their ecological functions. Salinity in estuaries fluctuates in response to tides, wind, and freshwater discharges. Seasonal freshwater input affects salinity structure in large estuaries to a greater degree throughout the year, but storm surges associated with tropical weather systems can abruptly disturb salinity gradients. The altered salinity could remain for several months, negatively influencing estuarine ecosystems. Monitoring and prediction of salinity variations are essential for managing estuary ecosystem sustainability, understanding hydrodynamic processes, and assessing immediate effects of extreme weather events on estuarine ecosystems.

Remote sensing techniques have been increasingly used in surface water quality studies. Satellite images, such as Landsat, provide information on solar radiation at various wavelengths reflected by surface water, which can be correlated to water quality parameters. The use of satellite images for determining estuarine salinity was pioneered in the 1980s, but these images often perform poorly at predicting salinity levels. No at-

(continued on page 3)

Prediction of Tree Annual Growth from Periodic Measurements

Quang V. Cao, Professor

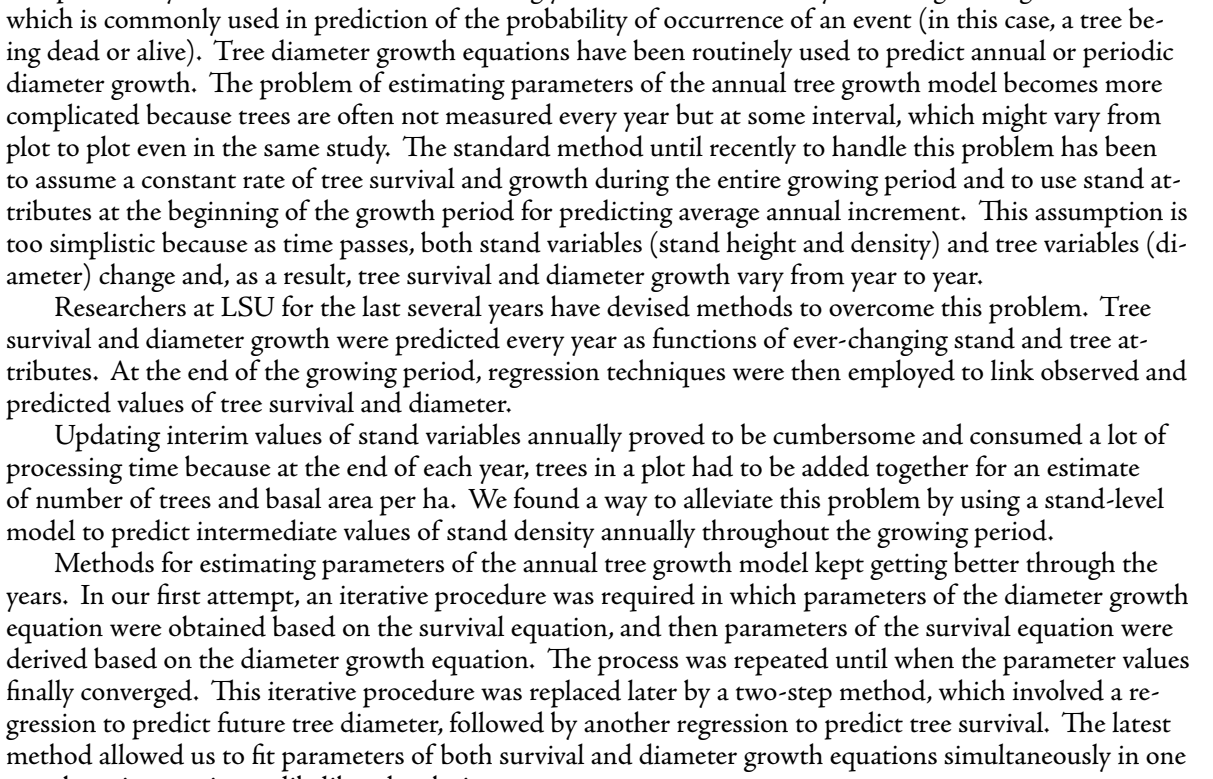
Tree growth models often describe annual changes in terms of survival and growth of individual trees. The probability that a tree survives the following year has been modeled by use of logistic regressions, which is commonly used in prediction of the probability of occurrence of an event (in this case, a tree being dead or alive). Tree diameter growth equations have been routinely used to predict annual or periodic diameter growth. The problem of estimating parameters of the annual tree growth model becomes more complicated because trees are often not measured every year but at some interval, which might vary from plot to plot even in the same study. The standard method until recently to handle this problem has been to assume a constant rate of tree survival and growth during the entire growing period and to use stand attributes at the beginning of the growth period for predicting average annual increment. This assumption is too simplistic because as time passes, both stand variables (stand height and density) and tree variables (diameter) change and, as a result, tree survival and diameter growth vary from year to year.

Researchers at LSU for the last several years have devised methods to overcome this problem. Tree survival and diameter growth were predicted every year as functions of ever-changing stand and tree attributes. At the end of the growing period, regression techniques were then employed to link observed and predicted values of tree survival and diameter.

Updating interim values of stand variables annually proved to be cumbersome and consumed a lot of processing time because at the end of each year, trees in a plot had to be added together for an estimate of number of trees and basal area per ha. We found a way to alleviate this problem by using a stand-level model to predict intermediate values of stand density annually throughout the growing period.

Methods for estimating parameters of the annual tree growth model kept getting better through the years. In our first attempt, an iterative procedure was required in which parameters of the diameter growth equation were obtained based on the survival equation, and then parameters of the survival equation were derived based on the diameter growth equation. The process was repeated until when the parameter values finally converged. This iterative procedure was replaced later by a two-step method, which involved a regression to predict future tree diameter, followed by another regression to predict tree survival. The latest method allowed us to fit parameters of both survival and diameter growth equations simultaneously in one step, by using maximum likelihood techniques.

Compared to the Constant Rate approach, the new Variable Rate method reduced bias in predicting tree survival by 79 and 35% for short and long projections, respectively. It also reduced bias in predicting tree diameter by 92 and 45% for short and long projections, respectively. A simulation study further revealed that the Variable Rate method reduced bias in estimating the model parameters by an astounding average of 90% as compared to the Constant Rate method. These results confirmed that the Variable Rate was indeed superior to the old method because it accounted for the ever-changing values of stand and tree variables.



Projections of tree diameter (1) and survival probability (2) over time based on measurements taken at different intervals. Parameters of the diameter growth equation were obtained from (a) the Constant Rate method, and (b) the Variable Rate method. The Variable Rate method produced reliable annual predictions: curves from measurements taken six years apart are still similar to curves from annual measurements.

Satellite Images

(continued from page 2)

tempts have been made to use a salinity model to predict salinity change in estuaries for situations where "ground truth" measurements are unavailable, such as after extreme weather events.

Storm surges associated with hurricanes push saltwater deep into estuaries, causing both an immediate and sustained increase of salinity in the coastal estuarine and riverine systems. Information on saltwater intrusion following hurricanes is needed to assess short-term and long-term effects of the extreme weather on other coastal resources. To explore the feasibility of using satellite imagery to develop an estuarine salinity prediction model, we collected historical salinity data near-shore from Lake Pontchartrain, the largest estuary in the northern Gulf of Mexico. We also conducted cross-lake measurements to gain information on salinity and suspended solids in deeper waters. Using these field data and water-leaving reflectance derived from satellite images, we developed a salinity prediction model. Ultimately, we successfully reconstructed and analyzed the spatial characteristics of salinity across Lake Pontchartrain following four major hurricanes in the recent decade (Figure 1).

Our study is the first published attempt to have successfully mapped salinity distribution with Landsat TM images for a large estuary along the coast of Gulf of Mexico. Our work demonstrates the usefulness of remote sensing techniques for predicting large-scale estuarine salinity. Beyond the methodological assessment, the study reveals that the close relationships between salinity and water reflectance from various wavelengths in Lake Pontchartrain may have been a combined result of suspended solids and colored dissolved organic matters from freshwater discharge. Further study is needed to determine which, if either, of the factors can best explain salinity distribution for other large estuaries with satellite images.

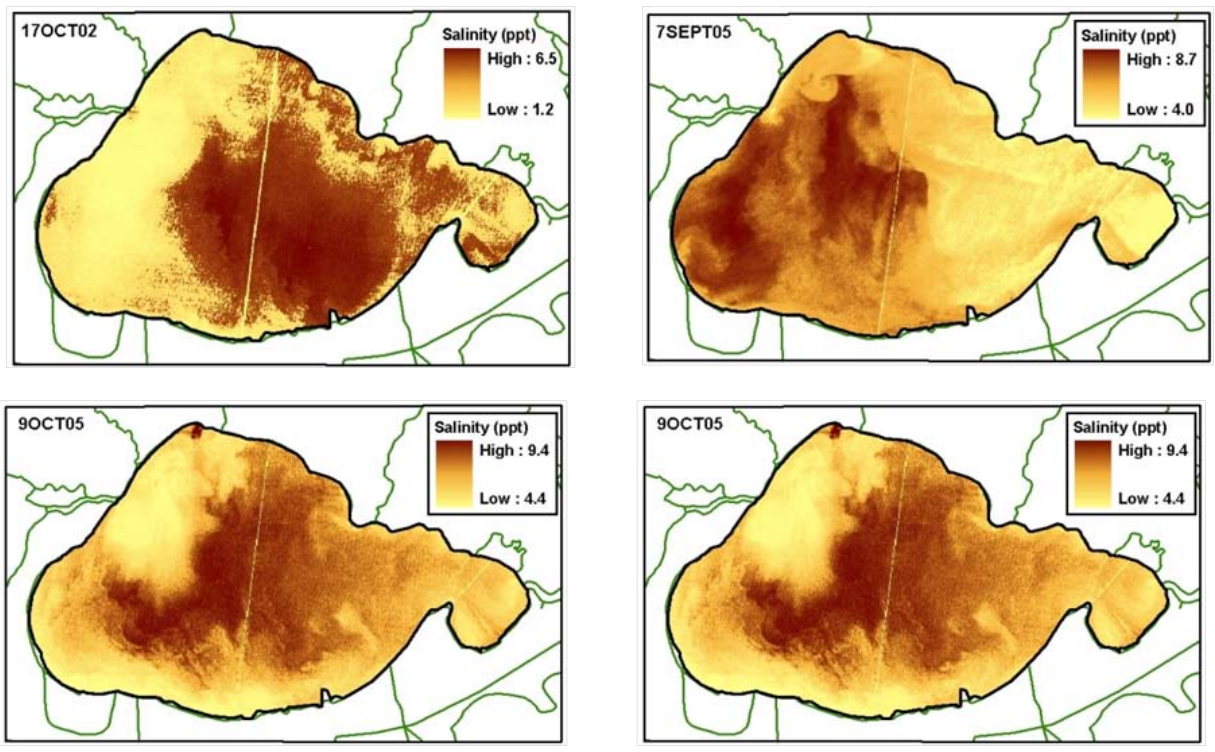


Figure 1. *Reconstruction of salinity distribution in Lake Pontchartrain after disturbance of hurricanes Lili (3 Oct. 2002), Katrina (30 Aug. 2005), Rita (24 Sept. 2005), and Gustav (1 Sept. 2008).*

Dr. Thomas J. Dean

Dr. Dean, a native of Tulsa, Oklahoma, began his academic career with a B.S. in Agriculture from Oklahoma State University. He received his M.S. in Forestry from the University of Missouri-Columbia, and he received his Ph.D. in Forest Ecology from Utah State University. He started his career with the School of RNR nearly 20 years ago, coming from a research faculty position at the University of Florida where he directed a project funded by the National Acidic Precipitation Assessment Program. As a quantitative silviculturist, Dr. Dean's primary research focuses on quantifying biological processes responsible for forest structure and function and how to apply this knowledge in directing stand development. His research draws heavily from plant population biology, tree physiology, and biometrics. Dr. Dean directed the School's only industry-university-Forest Service research cooperative, Cooperative Research in Sustainable Silviculture and Soil Productivity, taking over its originator, Dr. Mason Carter. The cooperative lasted from 1994 to 2009. Current research investigates the limits of the growing space in which forest stands grow. The most recent project under this umbrella is investigating the role of xylem anatomy in water movement through tree stems and how this effect may cascade to the number of trees a site can support at a given age.

TOPSAW:
A Training and OPtimization System for SAWing logs

Sun Joseph Chang, Professor

At the Advanced Sawing Technology Laboratory of the School of Renewable Natural Resources, we have developed TOPSAW, a training and optimization system for sawing logs into lumber. It is the only working system for internal defect based sawing optimization in the world, making the School the leading institution in the world in sawing optimization research. The goal of the project is to maximize the value of lumber produced from every log.

As the schematics (Figure 1) shows, the concept of TOPSAW is to first scan the log for internal defects with an x-ray CT scanner to acquire its cross-sectional images. With these acquired images, a virtual log can then be built which not only shows the external profile but also the type, size, and location of various internal defects of the log. TOPSAW then cuts the virtual log on the computer to generate the cut face, box the defects, and grade the board. As a training system, the advantage of TOPSAW is that the same virtual log can be cut as many times as necessary to allow the sawyer to explore the implications of various sawing methods before the real log is cut. With the optimization system, TOPSAW finds the best way to cut the log to maximize the value of lumber produced.

Recently, through cooperation with Purdue University, we had the opportunity to scan 30 logs of 5 different species, consisting of black cherry, hard maple, yellow poplar, red oak, and white oak. These logs varied in Forest Service grade and after these logs were scanned, they were cut at a sawmill to the best ability of the sawyer. We then contrasted the lumber value based on TOPSAWs performance versus the actual mill production.

The gains by TOPSAW averaged an impresive 46%. Comparisons of the results for each species indicate a gain of 42% for black cherry, 33% for hard maple, 24% for red oak, 60% for white oak, and 83% for yellow poplar. Within a particular log grade, the over-all gains are 27%, 47%, and 97% respectively for Grade 1, 2, and 3 logs. The gains for Grade 3 logs are 194% for black cherry, 75% for hard maple, 67% for red oak, 46% for white oak, and 221% for yellow poplar.

Once an internal defect based sawing optimization becomes commercially available, sawmills could realize significant gains in lumber value recovery from lower grades of logs. Given the abundance of Grade 3 logs and the much lower prices paid for these logs, sawmills could increase their profit significantly. At the same time, the more efficient conversion of low grade logs into lumber could reduce the amount of timber harvested, thus leaving more trees in the woods to mature and improve log quality. At the same time, the better quality of lumber produced as a result of knowledge of the internal defects in logs would result in more satisfied consumers.

Current efforts of the TOPSAW project focuses on building a dedicated CT log scanner for the sawmill industry that is powerful -- with enough X-ray power to penetrate a 30" log; strong -- capable of handling logs over 1 ton in weight; durable -- lasting for years; and, inexpensive -- costing between $500,000 and $1 million per scanner. Once the log scanner is built, TOPSAW will increase the profit for the individual sawmills, strengthen the global competitiveness of the American sawmill industry, enhance the conservation of the timber resource in this country, and improve the satisfaction of lumber consumers.

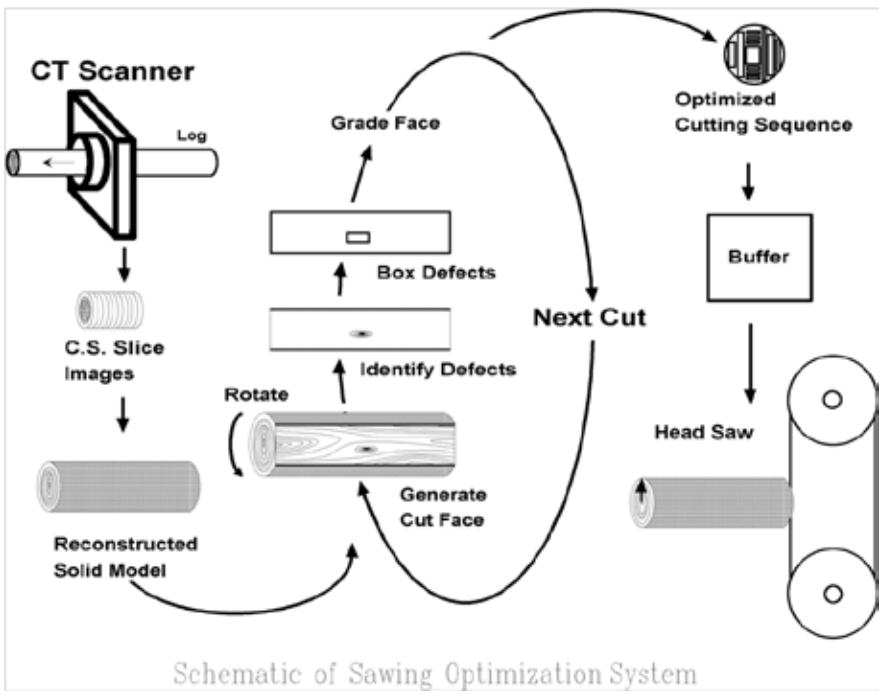


Figure 1. Schematic of TOPSAW optimization system.

FORESTRY

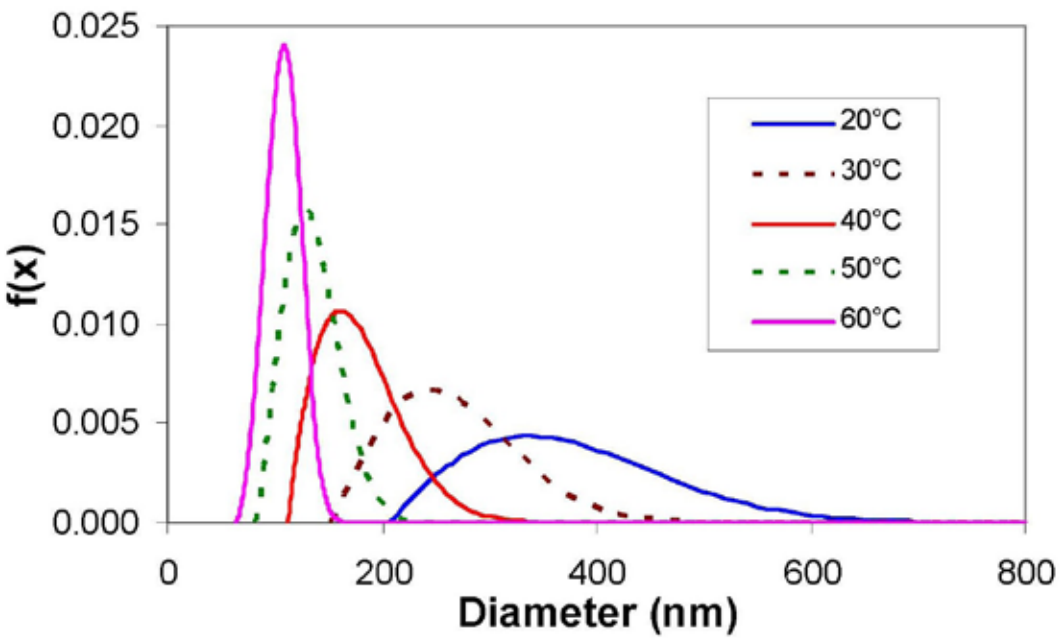
Particle-size Distributions of PNIPAAm Nanoparticles Depend on Temperature

Quang V. Cao and Qinglin Wu, Professors

Poly(N-isopropylacrylamide) (PNIPAAm) is a thermo-responsive polymer. A polymer is a giant molecule formed by chaining together simple molecules. PNIPAAm-based particles are called nanoparticles because they are often less than 700 nanometer (or 700 x 10-9 m) in diameter. These nanoparticles have shown great potential for applications in drug delivery. Specifically, they are useful for developing targeted and regulated drug delivery systems to multiple stimuli within a reasonable time.

Modeling the diameter distribution of PNIPAAm nanoparticles is important so that it can be predicted under variable temperatures. A Weibull distribution fits the diameter distribution for these nanoparticles, because as temperature increases the nanoparticles shrink in size. The distribution does not really change its shape as temperature increases, but becomes tighter and closer to zero, causing both its mean and variance to decrease.

The properties of nanoparticles and the performance of the products made with nanosized precursors depend significantly on the shape of the particle-size distribution. The controlled adjustment of particle size is of immense interest due to size-dependent physical and chemical properties of nanoparticles. Because particle-size distributions of PNIPAAm nanoparticles greatly depend on temperature, modeling changes of these distributions due to temperature is important for many practical applications.



Predicted diameter distributions of PNIPAAm nanoparticles at various temperatures. Note particles shrink that in size as temperature increases.

FOREST PRODUCTS

Microwave-assisted Organic Acids Extraction of Chromate Copper Arsenate (CCA) Treated Southern Pine

Todd Shupe, Professor

Chromated copper arsenate (CCA) was the most commonly used waterborne wood preservative in the world until its removal from the U.S. residential market at the end of 2003. However, large volumes of CCA-treated wood remain in service and accordingly, large amounts will continue to be decommissioned in coming years. Traditionally, CCA-treated wood has been primarily disposed in construction and demolition debris landfills, with municipal solid waste landfills as alternative disposal options. It is estimated that about 3 to 12 million tons of treated wood will be removed from service in the United States and Canada in the next 20 years. Disposal of treated wood is often referred to as the "Achilles Heel" of the wood preservation industry. Recycling of this material presents tremendous economic and environmental benefits.

We have been testing the efficacy of organic acids such as acetic acid and oxalic acid in removing CCA from treated wood. Our current work has been evaluating the effects of acid concentration, reaction time, and temperature in a microwave reactor. Wood is converted to sawdust and mixed with a diluted acid or mixed acid solution 1 g to 20 ml. A reaction vessel was sealed and placed into the microwave reactor. The solution was filtered after the reaction then diluted to 100 ml in a volumetric flask. Samples were then digested and analyzed for elemental copper, chromium, and arsenic. Oxalic acid was effective in removing 100 % of the chromium and arsenic at 160°C and 30 min. reaction time. Acetic acid could remove 98 % of the copper and arsenic at the same condition. Oxalic acid significantly improved the extraction efficiency of arsenic and chromium when time was extended from 10min. to 30min. The advantage of this approach is the reduced extraction time and one-step method to achieve the complete recovery of CCA metals.

Microwave extraction unit.

Todd Shupe and his children.

Todd Shupe

Dr. Todd Shupe, a Professor of Wood Science in the Louisiana Forest Products Development Center, began his career at the LSU AgCenter in 1996 with the Louisiana Cooperative Extension Service after completing his doctoral degree at Louisiana State University. He obtained a B.S. degree in Forestry and M.S. degree in Wood Science from the University of Illinois in 1992 and 1994, respectively

During his tenure in the School, his research emphases have included wood quality, wood durability, closed-loop recycling of decommissioned, preservative treated wood, and development of environmentally friendly wood preservatives. Dr. Shupe has received numerous honors and peer recognition including election as a Fellow to the International Association of Wood Scientists. He has also been elected as a Board Member and President of the Society of Wood Science and Technology. Locally he was the 2005 merit award winner for research from the LSU Chapter of Gamma Sigma Delta. He has also received the USDA Award for Individual Extension Program Excellence. Shupe has directed two doctoral students to first place winners of the prestigious Wood Award from the Forest Products Society.

Opportunities Exist for Forest Sector Companies to Participate in the Wood-Based Bio-Revolution

Richard P. Vlosky, Professor

The forest sector is significant to Louisiana's future economic viability. According to the Louisiana State University Agricultural Center, the forest sector's contribution to Louisiana's economy averaged $4.4 billion annually from 2004-2008, or approximately 2% of Louisiana's Gross State Product each year. The forestry sector has historically been a major economic engine in rural parishes, providing 15,000 jobs in 2008 that included timber production, logging, transportation, sawmilling, and value-added processing. However, starting in 2008, a continuing severe recession has had a huge negative impact on the forest sector nationally. In Louisiana, sector employment has declined 14% from peak levels during 2004-2008, and the annual economic contribution to the state's annual gross product has fallen by 38%.

According to the 25 X '25 Vision Statement, U.S. farms, forests and ranches will provide 25% of the total energy consumed in the United States by 2025. On May 5, 2009, President Obama issued a presidential directive to the heads of the Department of Energy, Department of Agriculture and the Environmental Protection Agency to form a working group to aggressively accelerate biofuel investment and production. Agriculture Secretary Thomas Vilsack will lead an unprecedented interagency effort to increase America's energy independence and spur rural economic development.

As a source of biomass energy, wood has several economic and environmental advantages over fossil fuel. It is significantly less expensive, renewable, carbon-neutral, and locally available when compared to most fossil fuels. In combustion, wood produces 90% less carbon dioxide (CO_2) than fossil fuels with minimal emissions of sulfur, heavy metals and particulates. In addition, the cellulosic content of wood makes wood a viable candidate biomass input for transportation fuel production. U.S. forests are expanding with an annual net forest biomass increase of 3%. This creates new opportunities for the forest products industry, especially in bio-energy sectors. Wood residue is an important low-cost source of renewable biomass energy in regions where forest cover forms a major portion of land area. Nearly all of biomass fuel used for energy production today comes from wood wastes and residues.

Forest products residue for biomass energy can be broadly categorized based on their origin. Figure 1 indicates the current distribution of forest residues in the U.S., and it should be noted that Louisiana has one of the highest concentrations of forest residues in the South.

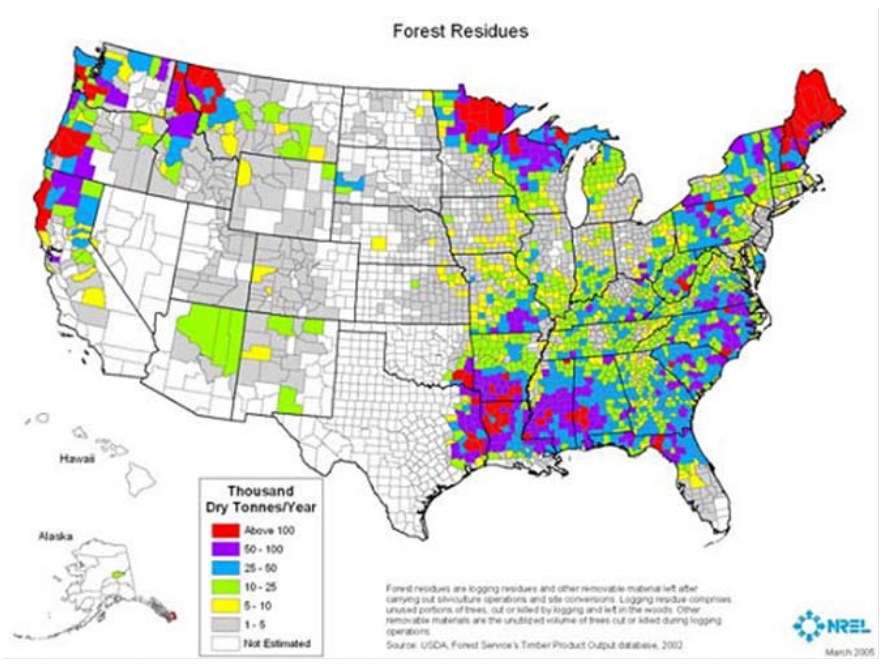


Figure 1: Estimated Forest Residues by County

The emerging biomass market is expected to significantly strengthen the demand for wood fiber in the South. This in turn could create price incentives for forest residuals as the U.S. turns to alternative fuels for energy. Emerging forest biomass demand will be primarily driven by wood-burning power companies that produce and sell electricity to public utilities, as well as an increasing amount of wood pellets that are used domestically and exported to Europe energy markets. Conversion of biomass into cellulosic ethanol for transportation fuel will also impact the structure of the forest sector.

Dr. Richard Vlosky is the Principal Investigator on a $409,000 USDA – funded integrated research and extension effort to identify high potential alternative bio-based revenue and profit streams for small and medium agricultural producers and forest landowners (SMAPFL) with forest land holdings in Louisiana and Mississippi. Working closely with Dr. Vlosky are Dr. Michael Blazier (LSU AgCenter, Hill Farm Research Station), Dr. Glenn Hughes (Extension Professor, Mississippi State University), and Dr. Dek Terrell (Director-Division of Economic Development, E.J. Ourso School of Business, LSU).

Small agricultural producers/forest landowners are those having between 10-139 acres and medium producers as having 140-999 acres. Forest residues and dedicated forest biomass production are the focus of the project. The research component will survey SMAPFLs to identify current and potential business position and identify willingness to participate in new forest bio-based business arrangements. In addition, Input-Output models will be constructed to estimate economic opportunities for participants and contributions of different new product/new process scenarios at the regional and state-level in Louisiana and Mississippi.

The extension outreach component consists of focus group scoping meetings that are currently being conducted with key stakeholder representatives. Eight workshops will occur towards the end of the project period in each state (Louisiana and Mississippi) that will increase target SMFLAP understanding of options and opportunities, provide guidelines and advice on how to proceed if they are interested in pursuing alternative business strategies, and provide matchmaking links to potential business partners in forest-based bio-based ventures. We will provide market, infrastructure, economic, risk, taxation, and financial information through the workshops on the back-end but also through dissemination of extension-oriented publications, briefs and web site postings throughout the course of the project.

Three study regions, each with unique characteristics, were identified as locations to execute the study (Figure 2). The first is the Mississippi Delta Region, a significant agricultural area that spans both Louisiana and Mississippi. The second study region is Southwest Louisiana which has considerable forest resources but a low intensity of forest utilization. The third area is a five-county region in mid-Mississippi where we will be targeting chicken growers that also are forest landowners. It is our intention that the protocols and processes we develop for this project will be transferable to other Gulf Coast states with similar agricultural and forest resource bases.

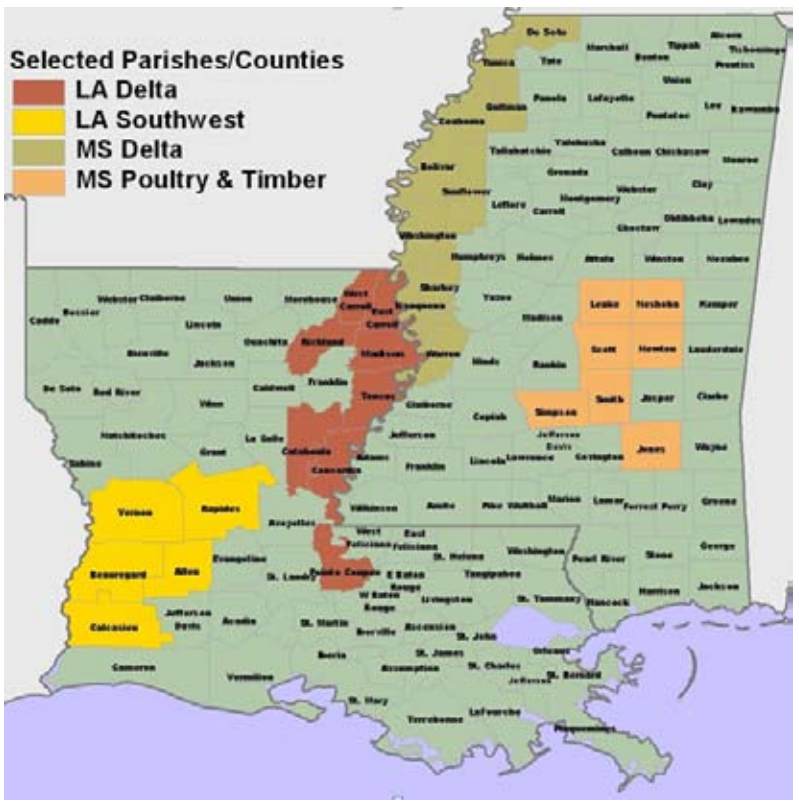


Figure 2. Study Regions

Research matters: New Zealand rock wren pilot study Nov 2009 – Jan 2010

Sabrina Taylor, Professor

One of my research topics addresses the genetic population structure of New Zealand rock wren. This is a collaboration with Drs. Bruce Robertson and Ian Jamieson at the University of Otago, New Zealnd, that will use genetic tools to identify genetically at-risk or healthy populations and to facilitate management of this threatened but understudied species.

New Zealand rock wren are small (< 20 g) passerines that thrive in the harsh alpine habitat of the South Island. The birds are threatened by introduced mammalian predators, and more recently, climate change: as climate warms, treeline rises and alpine habitat declines. We propose to examine genetic population structure in rock wren throughout the South Island to identify populations with high and low levels of genetic variation, populations that are genetically similar, and any genetically unique populations. Our analyses will identify genetically isolated populations that may be particularly vulnerable to extinction, areas of high diversity that may merit special protection, and potential source populations for translocations. We are also interested in exploring options for assisted migration in conjunction with climate change. Rock wren populations are at risk of extinction in isolated areas at low elevations because their short, stubby wings may hamper their ability to disperse across large stretches of inhospitable habitat to reach the mountain ranges that retain alpine habitat . Isolated, low altitude populations could require assisted migration to genetically similar, high altitude populations. Such high altitude refuges (in conjunction with predator control) may be necessary to ensure the long-term persistence of rock wren.

During the Louisiana winter (New Zealand summer), we successfully completed a pilot study in the Gertrude Saddle and Homer Tunnel area of the Darran Mountains. The pilot study was undertaken to ensure safe bleeding procedures for DNA sampling of rock wren and to obtain an initial sample, which we will use to identify genetic markers and begin our study of population structure. In future years, we plan to expand our study sites to include most populations on the South Island.

Filename: Taylor Rock wren photo 1
Dr. Sabrina Taylor points out a rock wren nest.
Filename: Taylor Rock Wren photo 2.jpeg
Caption: The mighty rock wren (picture B. Robertson).

Expected and unexpected benefits of hurricane disturbance for grassland birds

Phil Stouffer, Associate Professor

We humans have good reason to fear hurricanes. But what about plants and animals in disturbance-dependent ecosystems? Can hurricanes be to their advantage?

Vast areas of the southeastern US were once covered by longleaf pine savannas, a system dependent on disturbance, typically by fire, to remove woody plants. Fire limits the canopy trees in this system mostly to longleaf pine (Pinus palustris), whose seedlings and saplings can tolerate fire. The sparse pine canopy in turn permits a luxurious and extremely species-rich ground layer of plants. Many specialist animals are associated with this system, including the federally threatened gopher tortoise (Gopherus polypemus) and federally endangered Red-cockaded Woodpecker (Picoides borealis), but many other less charismatic animals are also dependent on these ecologically unique ecosystems.

When Hurricane Katrina ripped through Mississippi and Louisiana, it damaged tens of thousands of acres of forest, including most of the mature stands in De Soto National Forest. Most of the older stands with damage were salvage logged, and the combination of the hurricane and subsequent logging led to massive changes to the structure of the forest. Working with the U.S. Fish and Wildlife Service, Dr. Philip Stouffer designed a project to determine impacts of the combination of hurricane damage, salvage logging, and De Soto's standard fire management program on grassland birds.

For two field seasons in summer and winter, Stouffer's graduate students and technicians surveyed De Soto for grassland birds, describing the topography, stand history, and vegetation structure and composition where birds were and were not found. Prior to the hurricane, many stands had been too dense to provide the open midstory and dense herbaceous vegetation preferred by grassland birds. In many upland stands, the hurricane thinned the canopy, and careful salvage logging left the herbaceous layer in adequate condition to improve habitat for breeding birds, particularly the finicky Bachman's Sparrow, a species that cannot tolerate dense stands typical of pine silviculture. In addition to the expected advantage of thinning, researchers also found that the root balls of trees that had been blown over provided a tangle of roots used by Bachman's Sparrows as cover; in fact, the birds preferred stands with root balls. Of course, typical tree harvesting would not provide similar cover opportunities, so this benefit is unique to stands damaged by wind.

Unfortunately, the hurricane and subsequent salvage provided no habitat improvement for the even-more-finicky Henslow's Sparrow (Ammodramus henslowii), a species that can tolerate even less woody intrusion in the ground vegetation layer than Bachman's Sparrows. Henslow's Sparrows only occurred in pitcher plant bogs in De Soto. These bogs had relatively less damage than upland stands, and their sensitive hydrology and plant communities precluded them from salvage logging. Even after thinning, salvage, and fire, upland stands were not suitable for Henslow's Sparrows, although the birds packed into bogs. Thinning by the hurricane was a step in the right direction for upland stands, as revealed by the results for Bachman's Sparrows. Hopefully, continued management will improve upland stands, allowing Henslow's Sparrows eventually to use these areas as well. Researchers have found high densities of Hesnlow's Sparrows in Louisiana grasslands that recovered from woody encroachment through good management. Unfortunately for Henslow's Sparrows, they are dependent on management not only here in the southeast, but also on their breeding grounds further north.

The growing consensus among climatologists is that global climate change will increase the risk of serious hurricanes along the Gulf coast. Although we think of hurricanes as rare disasters, they are part of the evolutionary history of our forests. That's no comfort for humans who face loss of life and property, but we need to recognize that hurricanes may have both detrimental and beneficial effects on coastal ecosystems. At least for grassland birds, the hurricane news is mostly good.

Filename: Stouffer Hurricane Photo1
Caption for the root ball:
Hurricane Katrina created numerous upturned pine tree root balls in De Soto National Forest. Recent research has shown that these storm-induced landscape features may benefit Bachman's Sparrows by serving as predator escape refugia.
Filename: Stouffer Hurricane Photo 2
Caption for pitcher plant bog:
A pitcher plant bog in De Soto National Forest. Wintering Henslow's Sparrows prefer these bogs over the more abundant upland longleaf pine habitat in the forest because of greater ground-layer herbaceous cover.
Filename: Stouffer Hurricane Photo 3
Caption for Bachman's Sparrow:
Bachman's Sparrow, a species of concern endemic to the southeastern U.S. Recent work has shown that this species may have benefited from forest disturbance caused by Hurricane Katrina. Picture was taken by Erik Johnson

Linking Birds and Habitat in Amazonian Rainforest

Phil Stouffer, Associate Professor

For many groups of plants and animals, Amazon rainforest houses the world's greatest diversity of species. For example, within 1 km^2 of forest, some 200 species of birds might be permanent residents. With a tool like Google Earth, we can see that this diversity can occur without major habitat variation; from above, this hyperdiverse forest is just a sea of green. How can so many species coexist in what appears to be structurally homogeneous forest? Recent advances in GPS technology and remote sensing are enabling RNR researchers to link forest structure, topography, and bird locations to determine how birds select habitat at a scale that seemed impossible just a few years ago. The results should help us to understand how species vary in their use of space, and how this variation might help maintain biodiversity.

For 20 years, RNR Wildlife professor Philip Stouffer has been working at the Biological Dynamics of Forest Fragments Project, a research site in central Amazonian Brazil administered by Brazil's National Institute for Amazonian Research and the Smithsonian Institution. Together with his students and collaborators, Stouffer has accumulated thousands of location datapoints where hundreds of species of birds were sighted or captured. Unfortunately, mapping these locations onto a GIS has been difficult, because GPS coordinates have been extremely hard to acquire under the dense canopy. This has all changed, however, with new hand-held GPS units that can resolve locations to <10m accuracy even under dense rainforest canopy.

Thanks to support from the National Science Foundation, RNR PhD student Karl Mokross has returned to his native Brazil to use this technology to map the tracks of individual birds as they move through the forest. Karl studies permanent mixed-species flocks, a group of about 20 species that move through the forest together and can be followed for hours at a time. Karl now has the tracks from hundreds of hours of flock movements, all mapped to within a few meters accuracy.

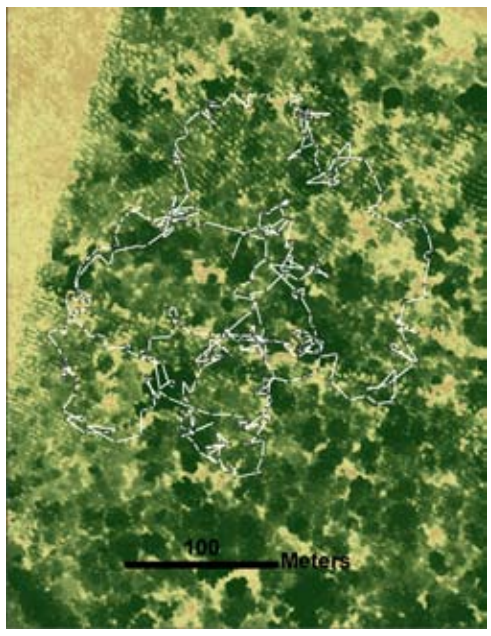
To get at the habitat choices made by birds, Karl has combined his bird data with remote sensing data from LiDAR (Light Detection and Ranging), which reveals canopy height and topography at a scale of 1 meter/pixel. Based on analyses so far, flocks avoid gaps, low areas, and forest edges. Additional analyses will be able to show bird association with much more subtle cues, such as degree of slope or slight differences in canopy cover or height. Other researchers are using LiDAR from the same sites for similar questions for dispersion of tree species and woody biomass. Look for exciting results from this research in coming years.

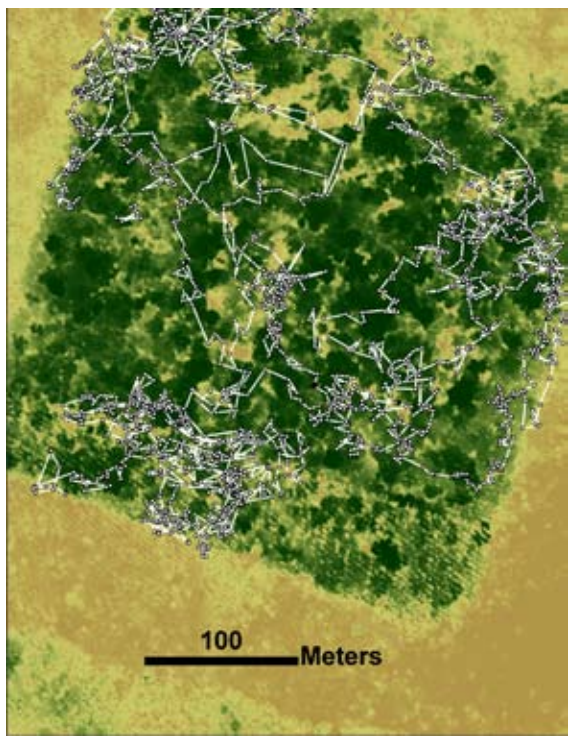
Images were provided by Dr. Scott Saleska and post-processed by the Center for Ecological Applications of LiDAR at Colorado State University under Dr. Michael Lefsky.

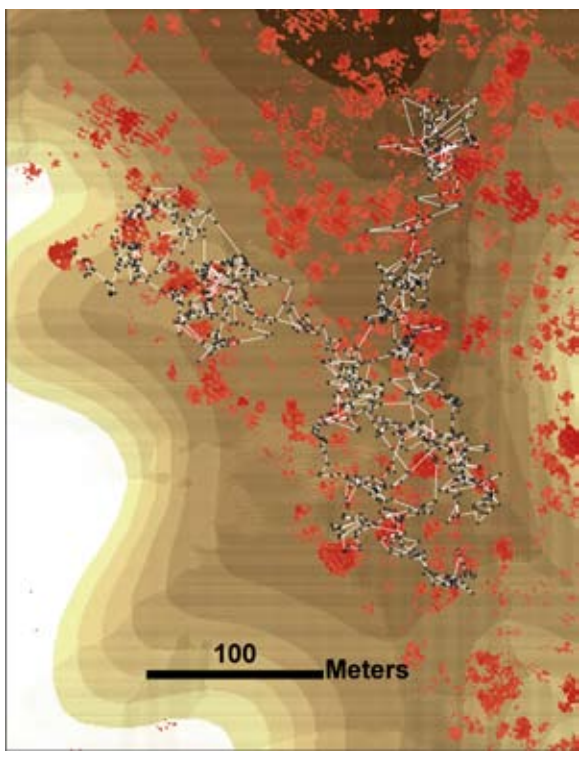
Figure (photos) 1 and 2: (Need to place side by side)
File names: Stouffer fig 1 Amazon and Stouffer fig 2 Amazon
Mixed-species flock movements, indicated by white lines. Each point is a location taken every 30 seconds. Tracks are overlaid with canopy height models for 100-ha and 10-ha fragments, at the Biological Dynamics of Forest Fragments Project in Brazil. Yellow and brown colors indicate low vegetation (4 to 15 m tall), green represents vegetation ranging from 15 to 40 m tall.

Figure (photo) 3:
File name: Stouffer fig 3 Amazon
Tracks of understory mixed-species flock (in white) juxtaposed to digital elevation model in the Biological Dynamics of Forest Fragments Project, in Brazil. The gradient from white to dark brown is the topography in the study area; darker shades represent higher elevations. Red indicates trees that are above 25 meters of height, whereas the remaining vegetation under that threshold is set to transparent.

Photo 4:
File name: Stouffer fig 4 Amazon
The antshrike Thamnomanes ardesiacus, one of the species that leads Amazonian mixed-species flocks (photo by Erik Johnson).







Dr. Philip C Stouffer

Dr. Stouffer, an Associate Professor in Wildlife at RNR, grew up in rural Lancaster County, Pennsylvania. He obtained a BS in Biology from Bucknell University in 1983, and a PhD in Ecology from Rutgers University in 1989. Following a post-doc in Amazonian Brazil, he settled in Louisiana. His research centers on ecology and conservation of birds, particularly forest and grassland songbirds. He and his graduate students have studied populations and communities of birds in a variety of systems, including longleaf pine savannas, pine plantations, cypress swamps, and bottomland hardwood forests. Most recently, they completed a project examining the impact of hurricane damage and salvage logging on pine savannah birds. He has also maintained a long-term, internationally famous research program with birds in Amazonian rainforest fragments.

Filename: Stouffer profile.jpeg

Seabirds on the Coast – Nest Predators Appear to Dictate Island Use

Cecilia Leumas, Graduate Assistant and Frank Rohwer, Associate Professor

The Isles Dernieres Barrier Island Refuge consists of four islands (formerly one long island called Isle Derniere, "Last Island") located about 13 miles out toward the gulf from Cocodrie, Louisiana. It is protected by the State of Louisiana, but is a popular destination for anglers attracted by the good fishing. Two of the islands host thousands of pairs of colonially nesting waterbirds, including pelicans, gulls, terns, skimmers, and wading birds. The other two islands are conspicuously lacking in waterbird colonies. Along with our collaborators at Nicholls State, we hoped to answer the question "why do seabirds nest on some islands and not others?" Seabirds are highly gregarious, and like to nest where other seabirds are already established. Researchers in other areas have capitalized on this property and used decoys and calls broadcast to attract birds to nest in desirable areas. Such projects have helped birds recolonize former nesting sites and spread out their breeding effort, and have even moved overabundant birds away from salmon fisheries that the birds were decimating.

We began or research project in the spring of 2008 and focused on three species: Royal Tern, Sandwich Tern, and Black Skimmer. After building two island field camps (Ike consumed one), sinking our boat (just once) in rough water, constructing 256 skimmer and tern decoys, digging 4,800 feet of predator fence into the ground, and spending 446 hours watching seabirds, we have some results! We tested whether social facilitation or predation risk were more important in seabird colony site selection on Isles Dernieres.

Our test involved the decoys and electronic seabird calls, which we played in an attempt to attract birds to eight sites on Trinity, the largest island in the chain with no nesting skimmers or terns. At half of the sites we erected fences to protect colonizing birds. Then we sat in blinds to watch the birds' reactions.

Although we saw terns and skimmers show interest in our decoys and the calls we broadcasted, only one pair of Black Skimmers was induced to nest at any of our plots. This weak response meant we had no ability to test for differences between fenced and unfenced colonies! Luckily, we also conducted predator surveys on all four islands. We learned that the two islands that had no seabird colonies had an abundance of predators – countless raccoons and rats and even some coyotes. Interestingly, the two islands with abundant nesting seabirds had no mammalian nest predators.

An interesting side project also supported our hypothesis that predators rather than social issues were limiting establishment of seabird colonies. In 2008, we found Least Terns nesting in a newly-restored area of Trinity Island. These small seabirds do not nest in dense colonies but tend to spread out and remain fairly inconspicuous. In 2008, nest success for Least Terns was low - 20%. However, after Hurricanes Gustav and Ike swept over the island in fall 2008, Least Terns nested in greater numbers and with much higher nests success - 53%! Our predator surveys suggest this enhanced nesting success was due to a reduction in the number of mammalian predators that managed to ride out the two hurricanes. Interestingly, although waterbird numbers declined by 36% after the storms (possibly due to adult mortality), the birds may be able to rebound more quickly than the predatory mammals, allowing at least a few years of improved nesting success. Unfortunately, the islands all lost elevation and area after the storms, and it will be important for future shorebird nesting to continue to restore these islands with dredged material.

Photo name: Rohwer seabird BLSK pair with decoys.jpeg
Photo caption:
Black skimmers, a Louisiana bird of concern, checkout the skimmer decoys on Trinity Island.

Using Global Positioning Systems to Better Understand Wild Turkey Movements

Michael J. Chamberlain, Associate Professor And Michael Byrne, Graduate Research Assistant

For decades, researchers studying wild turkeys have relied on radio-telemetry to reveal various aspects of turkey behavior, such as movements and habitat use. Historically, Very High Frequency (VHF) telemetry has been all that was available to researchers. Requiring field staff to track individual birds during the day, this method of telemetry is labor intensive and by default results in a modest amount of locations on individual birds per the amount of effort and cost expended.

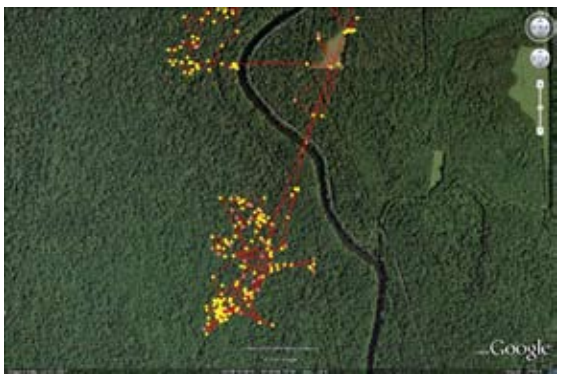
Recently, we have cooperated with researchers from Texas A&M University and Sirtrack (a radio-telemetry company) to develop and test a global positioning system (GPS) unit that can be attached to wild turkeys similar to how the VHF transmitters are attached. The initial testing was designed to determine whether the small GPS units could acquire locations under the dense forest canopy found throughout Louisiana's forests. Likewise, the accuracy of the locations needed be evaluated to assess whether the GPS units were collecting exact enough data. To date, the results have been encouraging.

Initial testing revealed that the average error associated with each location was within 20 meters, which is considerably less than with VHF telemetry. In early March, 3 adult males were fitted with the new GPS units to evaluate their performance on the birds (Photo 1). To retrieve the data, the radio package had to be recovered, requiring that either the bird be recaptured or harvested during hunting season. One of the three birds fitted with a unit was harvested on the Sherburne Wildlife Management Area. The data recorded from that particular bird in only a few weeks time, was amazing (Figure 2). Nearly 560 locations were recorded, which is approximately three times what one would expect to record using VHF telemetry in an entire year.

One of the most unique aspects of collecting data using GPS is the ability to detail daily movements of individual birds. The movements of the bird depicted in Photo 2 showed a clear daily pattern, with the bird leaving the roost in the morning and returning to the same area to roost in the evening. However, one particular day the bird completely abandoned the area he'd been using and traveled nearly one mile to the north, crossing the Atchafalaya River levee and several waterways. A few days later, the bird was harvested in this same area. Without use of the GPS transmitters, his movement patterns would be very vague!

Now that we know that GPS units can be used successfully on wild turkeys, we intend to begin a large-scale research project during 2011 that will focus on evaluating movements of male turkeys. Specifically, we want to focus on determining how males respond to disturbances associated with hunters during the spring hunting season. We look forward to working with the Louisiana Department of Wildlife and Fisheries and the National Wild Turkey Federation to answer questions about how males move during spring and how hunting affects their behavior.

Photo 1 Filename: Chamberlain Sherburne photo1
Photo 1. Dr. Mike Chamberlain and Michael Byrne attach a Global Positioning System transmitter to a male wild turkey on Sherburne Wildlife Management Area, 2010.
Photo 2 Filename: Chamberlain Sherburne photo2
Photo 2. Locations and movement paths of an adult male wild turkey fitted with a Global Positioning System transmitter on Sherburne Wildlife Management Area, 2010.



White-tailed Deer Research Moves to North Louisiana

John Henry Harrelson, Graduate Research Assistant and Michael J. Chamberlain

Associate Professor

After the completion of a successful 2-year study in south Louisiana, the LSU Deer Telemetry Study moved to several study areas in north Louisiana owned by Plum Creek Company. The south Louisiana study was focused on evaluating survival and movements of deer in a herd managed under Quality Deer Management (QDM) guidelines. These guidelines include intensive harvest of females (to reduce herd density) and restrictions on harvest of males to allow all males in the herd to age in the interest of harvesting higher quality males. Much of Louisiana is not managed under the QDM framework, hence the need to study these same characteristics of deer populations in other areas. Thus, the telemetry study moved to a pine-dominated forest managed for wood fiber production, with a resident deer herd that was under no specific management regime. This particular scenario is typical of many situations throughout central and northern Louisiana.

The past two springs, graduate student John Henry Harrelson has captured, ear-tagged, and radio-collared 52 white-tailed deer (25 bucks, 27 does) in Union Parish. Since radio-marking the deer, John Henry and his crew have been tracking the collared deer 3-5 times a week to quantify the area deer use on a seasonal basis and to better understand survival patterns throughout the year. Thus far, buck home ranges are noticeably larger than doe home ranges. Average annual home range size for bucks is 450 acres and 197 acres for does. During the south Louisiana study, results indicated considerably smaller home ranges for bucks (300 acres) and does (135 acres).

Many factors can affect the survival of white-tailed deer, but the most common mortality factor is harvest. To date, 7 bucks and 2 does have been harvested during hunting seasons, whereas 3 deer (2 bucks, 1 doe) died of natural causes (disease, predation). The observed harvest equates to an approximate 28% harvest rate for bucks and 7% for does, much lower than the harvest rates observed in the south Louisiana study for both sexes. Despite the fact that there are no restrictions on the quality of bucks that can be harvested, the overall harvest rate is quite low. Likewise, the harvest rate of does is very low and is likely inadequate to control herd density.

Figure 1: Filename: Chamberlain deer fig1.jpeg
Caption:
Graduate student John Henry Harrelson with a male white-tailed deer captured and radio-collared in Union Parish, Louisiana.

Bats, Bridges, and Guano: the Real Poop on Stream Impacts

Bill Kelso, Professor

Catherine Murphy is working with Drs. Mike Kaller and Bill Kelso to assess the effects of bat guano on stream communities downstream of bridge roosts on Fort Polk Army Base, Vernon Parish, Louisiana. Bat colonies produce large amounts of guano, which appears to elevate nitrogen levels in adjacent streams, but impacts from these nutrient inputs on aquatic ecosystem structure and function are unknown. At Fort Polk, two bridges constructed of concrete with narrow expansion joints along the underside serve as roosting areas for fairly high densities of Mexican free-tailed bats (*Tadarida brasiliensis*) and Rafinesque's big-eared bats (*Corynorhinus rafinesquii*). Other colonial, insectivorous species known to inhabit the lowland deciduous forests of Louisiana's coastal plain, such as big brown bats (*Eptesicus fuscus*), southeastern myotis (*Myotis austroriparius*), and evening bats (*Nycticeius humeralis*), may also use the bridges as roosts

This study will examine the potential impacts of bat guano on water quality and aquatic community structure in Whiskey Chitto Creek, a headwater stream of the Calcasieu River in the West Gulf coastal plain. Paired seasonal samples (i.e., upstream and downstream of bridges) of fishes, macroinvertebrates, and periphyton will be collected along with physical habitat and water quality measurements at each bat site for two years. Because the main impact involves nutrient additions, multiple indicator groups will provide information about potential bottom-up effects on the aquatic food web, and water quality parameters will characterize ambient nutrient levels. These data will be compared with data collected below two control bridges (i.e., without bats) to determine whether downstream changes attributable to guano exceed natural variation within the system.

Based on studies of bat guano in cave streams and similar investigations of impacts from feces of other mammals, one of three possible outcomes is expected: 1) nutrient enrichment from bat guano will degrade water quality and reduce biotic diversity downstream via bottom-up food web effects; 2) organic material from bat guano will provide nutrients that will increase production of algae, aquatic insects and other invertebrates, and some species of fishes; or 3) nutrient inputs from bat guano will not significantly differ from ambient nutrient levels and impacts to aquatic communities will be negligible. In warmwater streams of Louisiana's coastal plain, nutrients are seldom limited and we expect that these data will demonstrate evidence of decreased biodiversity at bat sites. If impacts are evident, the downstream extent of these impacts will be addressed in a subsequent study.

Photo Name: Kelso bat quano.jpeg
Photo caption: Bat guano beneath expansion joints of bridge crossing the upper fork of Whiskey Chitto Creek in fall of 2008.

An Integrated Approach for Providing Marine Baitfish to Louisiana Anglers

Christopher Green, Assistant Professor

Live baitfish for saltwater angling in Louisiana is often a seasonally available commodity due to the reliance on wild-caught fish. Of particular importance is the cocahoe minnow, Fundulus grandis, which is popular for redfish, speckled trout, flounder, and many other species. Cultured cocahoe minnows could help supplement the wild-caught baitfish supply and could provide an additional source of revenue within Louisiana and the surrounding coastal region. Year-long availability of this species would be well received, and propagation of this marine baitfish could provide coastal anglers in Louisiana with a consistent supply of highly valued live bait and increase overall angler satisfaction.

Dr. Christopher Green's Fish Physiology Lab at the Aquaculture Research Station is heading up research on a variety of topics on growing cocahoe minnows. Dr. Green's team consists of Research Associate Craig Gothreaux, Master's student Charles Brown, who is studying the embryogenesis of the cocahoe minnow, and Ph.D. student Josh Patterson, who is researching improvements of brood stock and reproductive efficiency. Extension professor Dr. Julie Anderson and Extension Associate Sunny Brogan are coordinating extension efforts in conjunction with research efforts. Integrating extension and applied research for this project will provide input and direction from stakeholders followed by research on practical production techniques. The collaborative work will result ultimately in the transfer of applied research back to stakeholders. This new program will provide education, research, and extension activities that lead to the consistent production of cocahoe minnows by Louisiana baitfish producers.

The development of an industry centered on the culture of marine baitfish represents a promising new economic market within Louisiana and the surrounding coastal region. A 2004 survey showed that 47 % of Louisiana coastal anglers considered the seasonal availability of live bait to be a significant problem. The survey also indicated that the cost of live bait was not an important issue for anglers. The majority of research in this field has focused on traditional large-scale facilities where infrastructure to produce bait would require a large capital investment. However, this project will use input from interested parties to direct research and technology transfer for both small and large operations. Demonstration of practical techniques such as pool spawning and grow-out phase production should make marine baitfish available year round to anglers in Louisiana.

Photo 1 file name: Greene cocahoe photo1.jpeg
Photo 1 caption: Graduate students Charles Brown and Joshua Patterson.
Photo 2 file name: Greene cocahoe photo 2..jpeg

Photo 2 caption:
Male and female cocahoe minnows are easily distinguished. Males (bottom) are colorful with iridescent green, yellow, blue and red spots. Females (top) are a uniform drab grey-green color.
Photo 3: Filename: Greene Cocahoe photo 3.jpeg
Photo 3 caption: The lab investigates the use of tanks for high density culture of this popular marine bait fish.
Photo 4: Filename: Greene Cocahoe photo 4.jpeg
Photo 4 caption: Cocahoe eggs incubated out of water to synchronize hatching.

Developing tools to improve management and restoration: using plant tissue to identify causes of marsh loss

Vanessa Tobias, Graduate Research Assistant

Louisiana is losing coastal marshes at an alarming rate, with some estimates of coastal land loss approaching 90 km2 per year. Marsh loss occurs for a variety of reasons, including subsidence, sea level rise, and human activities that alter hydrology. These factors increase stress on marsh plants by increasing salinity, reducing nitrogen availability and/or increasing flooding. Stressed plants grow less than healthy plants, which ultimately leads to less stable and less resilient marshes.

Coastal resource managers and restoration professionals implement strategies designed to combat marsh loss and increase marsh stability. However, the causes of marsh loss must first be identified, and currently there are no simple, inexpensive tests available that allow marsh managers to identify causes of reduced plant growth. In agricultural systems, farmers can submit samples of leaf tissue from their crops to agricultural extension offices, where the tissue is analyzed using ICP and CHN analysis. Extension personnel compare the leaf tissue chemistry to standard values that indicate deficiency or toxicity of particular elements, and they make recommendations to adjust fertilizer applications to improve crop yields.

We applied the idea of using tissue analysis to identify causes of limited productivity to Spartina patens, which is the most common plant in Louisiana's coastal marshes. In order to construct indicators or common stressors for S. patens, we conducted two experiments where we controlled the levels of nitrogen, salinity, and flooding that S. patens plants received. We compared the biomass of plants that received different treatments, and then harvested tissue samples from the plants that were tested by the LSU AgCenter's Soil Testing and Plant Analysis lab to determine leaf chemistry. We used these concentrations to develop chemical signatures in the leaf tissue that can be used to diagnose nitrogen starvation, salinity stress, and flooding stress. We also conducted a field experiment where we collected samples of S. patens from across the coast of Louisiana to determine whether the signatures we developed could be used under natural marsh conditions and whether there are seasonal changes in leaf tissue chemistry.

Results from our experiments showed that the concentrations of elements in S. patens leaf tissue can be used to identify factors that limit marsh productivity. For example, sodium concentrations are higher in leaf tissue of S. patens plants that grow in more saline conditions, the ratio of carbon to nitrogen is higher in plants that grow where less nitrogen is available, and concentrations of manganese and calcium are lower in plants that grow in more flooded conditions. Some elemental concentrations change seasonally as nutrient demands change within the plants. The effects of high salinity are most pronounced in leaf tissue during the spring and the effects of low nitrogen availability are most evident during the summer.

Results of this research will allow marsh managers to analyze leaf tissue samples from their marshes and compare the resulting leaf chemistry to guidelines we are developing. This will give them information about how to improve productivity, much like the information given to farmers to improve yield in their crops. For example, if analysis of a sample of S. patens revealed low sodium concentrations and a high carbon to nitrogen ratio, managers would know that low nitrogen availability rather than salinity would likely be limiting productivity. Lowering salinity alone would therefore not increase production, and management activities could focus on increasing nitrogen availability. We also envision these tools being used to make maps of marshes that reflect limiting factors to marsh plant growth at many spatial scales. Such maps would be useful on a small scale for managers to build management plans, and on a regional scale for policy makers to allocate funding to the most effective large-scale restoration projects.

Photo Name: Vanessa Marsh loss.jpeg
Photo Caption: Kelsey Daroca and Vanessa Tobias collect a sample of marsh grass in an intermediate marsh near Lake Calcasieu, LA.

Oyster Reefs: Supporting Coastal Restoration and Habitat Enhancement

Megan La Peyre, Adjunct Professor, Austin Humphries, Graduate Assistant, Steve Beck, Graduate Assistant And Shea Miller, Research Associate

The Nature Conservancy recently reported (http://www.nature.org/initiatives/marine/shellfish/) that oyster reefs are one of the most imperiled marine habitats on earth, with 85% of worldwide reefs lost. Remaining reefs are often in poor condition and many have become functionally extinct. However, oyster reefs are a common estuarine landscape feature in Louisiana that help fuel the coastal economy and provide numerous ecological services, such as protection of coastal shorelines and support of secondary production. Sea level rise, subsidence, levee construction, direct removal, and mineral extraction all threaten the integrity and functional services provided by oyster reefs, or at a minimum, cause oyster reef areas to shift across the coast. Since 2001, researcher in my lab group have been working on projects examining the role of oyster reefs in supporting estuarine fish and crustacean communities, as well as testing whether man-made oyster reefs can help combat shoreline erosion.

In initial studies, we discovered that oyster reefs placed alongside eroding marsh edge can be effective in protecting against shoreline erosion in low energy environments, even withstanding a direct hit of a tropical storm. These oyster reefs, whether natural, created, or harvested, supported unique and abundant resident fish and crustaceans communities, although this support may be affected to some degree by the complexity, or three dimensional structure of the reef. For example, a recent experimental field study found that the reef community changed as a reef became more structurally complex.

Most recently, several studies, including one funded by the Louisiana Department of Wildlife and Fisheries, have been initiated with the overall goal of increasing our understanding of the role that oysters, and the habitat they create, play in influencing secondary production and community dynamics, and in protecting marsh in near-shore estuarine environments. Current on-going projects include documenting the rate of shoreline erosion in areas adjacent to bio-engineered oyster reefs, examining the development of reef communities over time and examining more explicit questions related to the role of reef complexity in providing refuge for fish (Austin Humphries, MS student), documenting the food web support provided by created, harvested and un-harvested reefs (Steve Beck, MS student), quantifying the variation in oyster recruitment, growth and mortality along a salinity gradient (Ben Eberline, MS student), and examining how reef location and design may affect some of these services provided by oyster reefs.

Photo 1
filename: LaPeyre Oyster Reefs Fig1
Oyster reef being built with shucked oyster shell in Caillou Lake, Terrebonne Bay, Louisiana.
Photo 2
filename: Lapeyre Oyster Reefs Fig 2.JPG
Austin Humphries (MS Student RNR) and Gary Decossas (America's Wetland Conservation Corps Member) remove a bull shark from a gill net surrounding one of the newly created oyster reefs.

Restoring Degraded Brackish Marsh With Sediment Enhancement Techniques

Megan La Peyre, Adjunct Professor Bryan Gossman, MS graduate Bryan Piazza, The Nature Conservancy of Louisiana

As sea level rise is becoming a reality, many coastal plain marshes are literally drowning as vertical accretion fails to keep up with changes in water levels. One new approach to assist coastal marshes in keeping their heads above water is to directly increase marsh elevation by adding a thin layer of dredged sediments to the deteriorating marsh or interior pond surface. Over the last 10 years, this approach has been increasingly used to enhance degrading saline and brackish marshes in coastal Louisiana.

In a recently completed study of six sites in the Mississippi Delta, sediment enhancement of both brackish marsh and degrading interior pond sites had positive immediate and long-lasting (8

years) impacts on physical soil properties and nutrients. Furthermore, marsh vegetation was found to increase over time in interior pond sites. These data suggest that sediment enhancement may prove to be a valuable approach for restoration of brackish marsh.

Photo Marsh 1:
Caption:
A low-pressure hydraulic dredge is used to pipe a slurry of dredged material over 1, 373 acres of degrading brackish marshes along the south edge of Little Lake, Lafourche Parish, Louisiana in 2006. The sediment slurry consists of a high water to solids ratio (> 80% water) piped over the marsh so that sediments sheet flow and settle across the marsh and pond surfaces (Photo credit: National Marine Fisheries Service, 2006).
Photo: Marsh 2: Brackish marsh and interior pond sites along the south edge of Little Lake, Lafourche Parish, Louisiana, immediately after addition of a thin-layer of sediment from dredged material from nearby waters. This addition of a thin layer of sediment to deteriorating marsh and interior ponds has been suggested as a means to increase elevation and create soil conditions conducive to increasing marsh productivity and resilience (Photo credit: National Marine Fisheries Service, 2006).
Photo: Marsh 3 La Peyre:
Top: Brackish marsh located near Bayou Dupont, Jefferson Parish, Louisiana after receiving a thin-layer of dredged sediments over its surface in order to restore elevation and increase marsh productivity and resilience. This enhancement occurred in 2000 and targeted 160 acres of degrading marsh. (Photo credit: Quin Kinler, Natural Resources Conservation Service, US Department of Agriculture).

Megan La Peyre

Originally from Ottawa, Canada, Megan La Peyre began her career at LSU AgCenter as the Assistant Unit Leader –Fisheries with the USGS Louisiana Fish and Wildlife Cooperative Research Unit in 2001. Before joining the USGS and LSU AgCenter, Megan completed a B.A. degree in Biology and Political Science from Duke University in 1992, an M.A.degree in Marine Science from the Virginia Institute of Marine Sciences, College of William and Mary in 1995, and a Ph.D. from the Department of Oceanography at Louisiana State University. She also worked as a post-doctoral fellowship at the USGS National Wetlands Research Center in Lafayette, LA. Along the way Megan also worked for the National Park Service's southeast regional office in support of their resource management activities. At RNR, La Peyre's research has focused primarily on the fish and invertebrate communities that use shallow coastal marsh habitats, including examining relationships among marsh habitats, oyster reefs and the use of these habitats by fish and invertebrate communities. She maintains a coastal ecology laboratory that includes undergraduate and graduate students who study community and trophic ecology of oyster reef communities, and the community response of fish to restoration activities.
Photo filename:
Megan.jpeg

How Will Habitat Change in the Atchafalaya River Basin Affect Nutrient Availability in Coastal Waters?

Amy Scaroni, Graduate Research Assistant and J. Andy Nyman, Associate Professor

Photo 1 Caption: Some of the baldcypress swamps in the Atchafalaya River Basin
Photo 1 filename: Amy Scaroni Atchafalaya 1

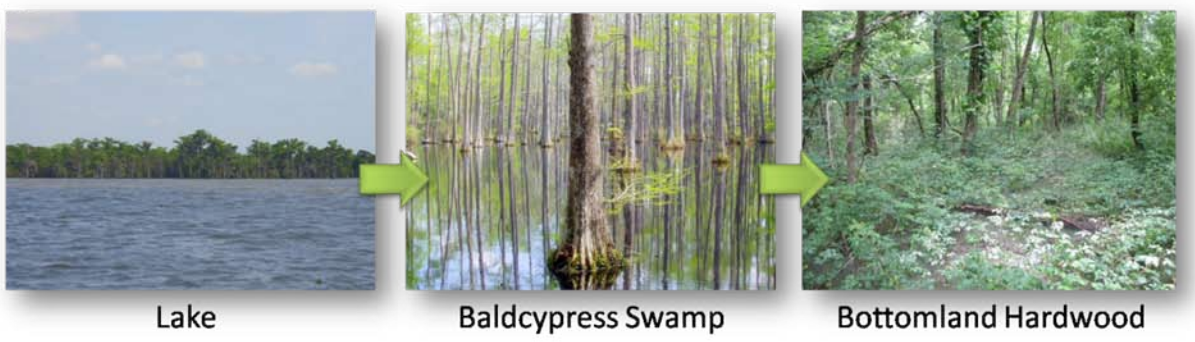
The Atchafalaya River Basin is an excellent field site for scientists who are interested in studying both biogeochemical and successional processes in wetlands. Considered the largest deepwater swamp in North America, the Atchafalaya River is fed by the Red River and approximately 30% of the discharge of the Mississippi River. Formed as part of the larger Mississippi Delta system, the Atchafalaya deltaic lobe would be growing much faster if not for human intervention and hydrologic alteration. As the Mississippi River began to switch course and capture the Atchafalaya River, engineers built the Old River Control Structure to prevent the natural delta switching process. The Atchafalaya Basin is now used to mitigate high flows; levees are set back from the river to increase the size of the floodplain, and channels are dredged to prevent sedimentation.

The Atchafalaya River Basin (ARB) includes the Atchafalaya River and the surrounding floodplain. The river itself has a high sediment load, and transports around 84 x 10^6 metric tons of sediment annually. While much of this sediment discharges into Atchafalaya Bay and contributes to delta formation, a portion is deposited on the floodplain within the ARB. This deposition within the ARB leads to natural habitat change, and is transitioning the Basin from a lake-dominated ecosystem to a predominately bottomland hardwood forest ecosystem.

What are the implications of this habitat shift?

Photo 2 Filename: Amy Scaroni Atchafalaya 2
Photo 2 caption: Sediment deposition within the ARB leads to natural habitat change, and is transitioning the Basin from a lake-dominated ecosystem to a predominately bottomland hardwood forest ecosystem. During the 1900's, this process greatly reduced the area of lakes and increased the area of baldcypress swamps. During the 2000s, this process is expected to reduce the area of baldcypress swamps and increase the area of bottomland hardwoods.

The Atchafalaya River carries a high load of nutrients, but as water passes through the



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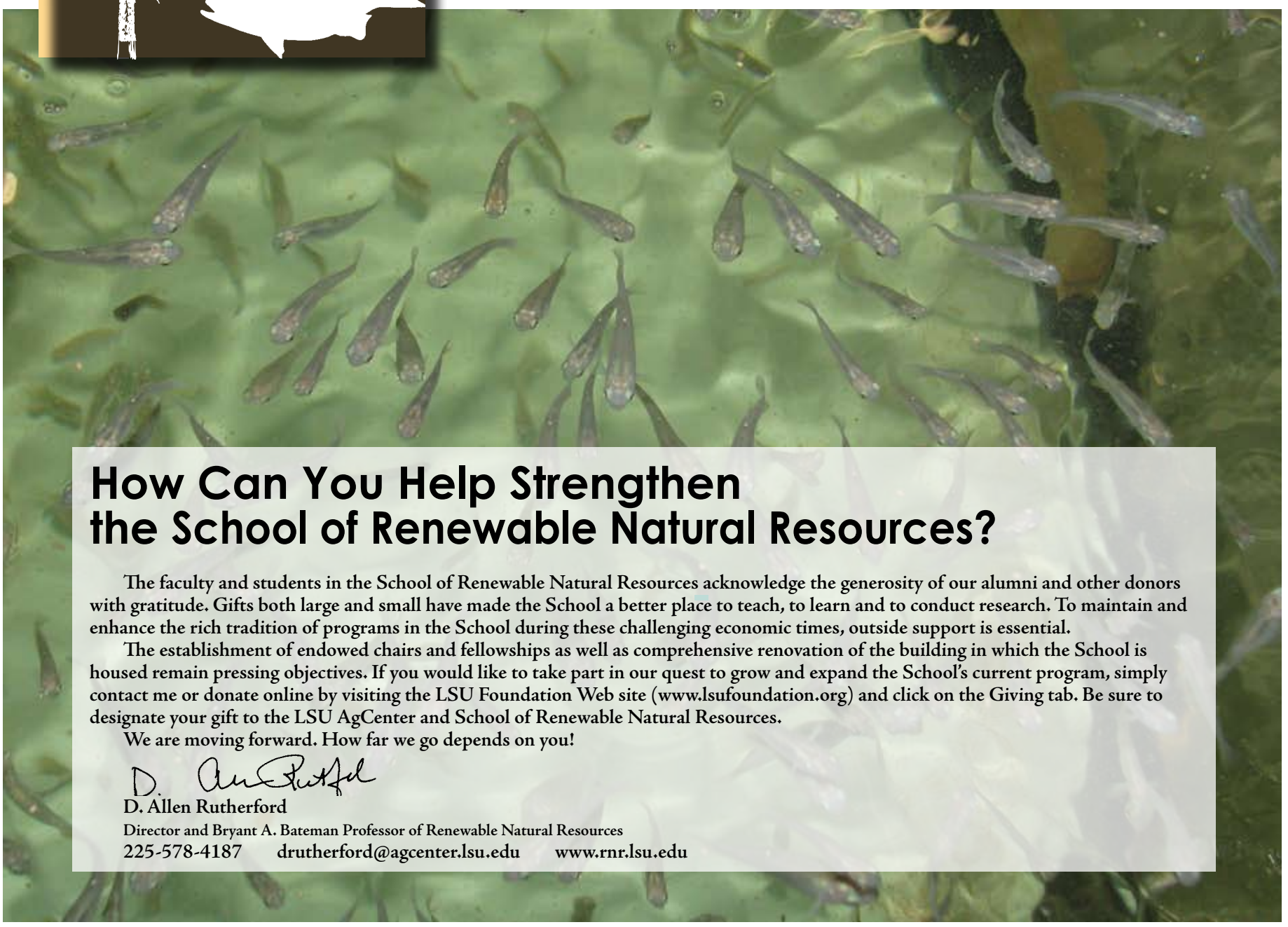

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The faculty and students in the School of Renewable Natural Resources acknowledge the generosity of our alumni and other donors with gratitude. Gifts both large and small have made the School a better place to teach, to learn and to conduct research. To maintain and enhance the rich tradition of programs in the School during these challenging economic times, outside support is essential.

The establishment of endowed chairs and fellowships as well as comprehensive renovation of the building in which the School is housed remain pressing objectives. If you would like to take part in our quest to grow and expand the School's current program, simply contact me or donate online by visiting the LSU Foundation Web site (www.lsufoundation.org) and click on the Giving tab. Be sure to designate your gift to the LSU AgCenter and School of Renewable Natural Resources.

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D. Allen Rutherford

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Atchafalaya Basin there are numerous opportunities for removal of these nutrients. Plants take up nutrients to fuel their growth and productivity. When water slows and spreads across the floodplain, sediments drop out of suspension and trap nutrients within accreting layers. Chemical processes in the flooded soils, such as denitrification, also aid in removal of nutrients. As habitats in the Basin change, so will the potential for nutrient removal. We are investigating how changes in the Atchafalaya River Basin affect the export of nutrients to the Gulf of Mexico. An increase in nutrients will exacerbate the large hypoxic area in the Gulf of Mexico. A decrease in nutrients could help to reduce the extent of this Dead Zone.

There are no data that can be used to compare the relative effects of natural succession and management activities within the Basin on nutrient discharge to the Gulf of Mexico. In order to build a model capable of predicting future trends in nutrient removal, accurate data must be collected from the Atchafalaya Basin itself. Current data collection is focused on answering the following research questions:

What are the major sinks for nutrients in the Atchafalaya River Basin?

How do rates of nutrient removal differ between the three different habitat types?

How will nutrient cycling in the Atchafalaya River basin respond to habit change?

Quantifying removal rates in the Basin will not only establish a baseline for nutrient removal in specific habitats, but it will also allow us to model how removal rates will change in light of habitat change. The ability to predict nutrient removal, or lack thereof, will allow coastal managers to compare how different hydrologic management regimes will ultimately affect nutrient discharge into coastal waters.

Photo 3: Amy Scaroni Atchafalaya 3
Photo 3 caption: Andy Nyman (left, Associate Professor) and Amy Scaroni (right, Ph.D. Candidate) collecting a soil core from a baldcypress swamp. The sediment core will be used to measure nutrient accumulation since the early 1960s. Similar cores were collected from lake and bottomland hardwood areas.

Julie Anderson

Dr. Anderson is a new assistant professor in RNR specializing in crustacean fisheries and marine ecology. Her research interests include the various chemical signaling between marine organisms and their environment. For example, at the University of Delaware, she studied how the settlement of a juvenile invasive crab and conservation of the horseshoe crab were affected by alternative baits. She tries to combine field-based research with laboratory analysis to understand how chemical signals are affecting organisms.

In Louisiana, Dr. Anderson is excited to put previous experiences to work to help the fisheries in the region with several collaborative projects. The first will examine the creation of cost-effective and environmentally friendly bait for the blue crab commercial fishery. By using a generic base and adding a blue crab attractant, the bait could be easy to handle, resist fouling, and reduce pressure on baitfish. Ideally, an individual bait could be fished multiple times in crab pots, require minimal refrigeration, and have a long shelf life. This project will utilize laboratory based research as well as field research collaborating with local fishermen to find the best product for their use. Successful alternative bait could reduce overhead costs of buying and maintaining baitfish for area fishermen. Future work could look for variation in bait recipes for use in other fisheries such as crawfish.

Additionally, other projects will look at the chemical cue ecology of our marine fishery species such as shrimp. Most invertebrates need certain chemical cues to signal that it is time to molt to the next life stage, migrate to a new area, avoid a predator, or even time to mate. By understanding these signals, Dr. Anderson hopes to understand why organisms pick certain habitats at different times in their lifecycle. These results could be useful in coastline restoration and conservation by knowing what cues are the most important to protect to promote sustainable populations of the fishery species.

Chemical-cue research can be useful with invasive species as well. Conservation managers can try to limit invasion of exotic species such as Asian carp by understanding what cues allow invasive species to thrive. The research can be used to prevent their spread by modeling potential new habitat where they are likely to invade.

Photo filename: Julie Anderson.jpeg