WILDLIFE

Duck harvest shifts later in Louisiana and elsewhere

Frank Rohwer, Associate Professor, and Bruce Davis, Graduate Student


Ring-necked ducks and other migratory waterfowl that spend winters in Louisiana are arriving later each year.

Waterfowl managers in Louisiana often hear hunters talking about the late-season arrival of mallards – often spiced with colorful stories about their grand size or red legs.

Hunting tales aside, a substantial number of wildfowlers believe ducks are staying north longer and arriving here later than they used to "back in the day." We examined this issue in some detail.

The ideal data set to evaluate shifts in the timing of migration would be systematic waterfowl counts down the flyways over a period of decades, but that comprehensive data doesn't exist. The U.S. Fish and Wildlife Service has collected detailed duck harvest data for half a century, however, and the data includes the date, location, species, sex and age for millions of ducks harvested between 1961 and now. We took advantage of those records to examine the timing of fall migration of waterfowl.

With more than 4 million data points, we clearly needed to simplify it to see patterns, so we generated an average harvest date for each species in each state for each of the 49 years of data. We found a striking pattern where harvest dates of mallards have gotten progressively later through time.

For example, the mean harvest date for mallards in Louisiana for the 2008-2009 hunting season was Dec. 24. In contrast, the mean harvest date for mallards in Louisiana back in 1962 was Dec. 9. Figure 2 on page 2 shows the trend of average harvest dates for mallards in Louisiana over all years. Later harvest dates in more recent years were common in most states, with only a few northern states not showing this pattern (Figure 1). Further, the later harvest dates are occurring for most other commonly harvested ducks – pintail, gadwall, ring-necked ducks, green-winged teal and wigeon.

The remarkable pattern of harvest dates getting later for migratory ducks in most states leads to the question: Why? One possibility is that migration hasn't changed and that the later harvest dates in more recent years simply reflect shifts in the hunting season dates. Our statistical tests confirm hunting season dates influence the timing of harvest for migratory ducks, but the same analyses also tell us season dates simply cannot completely explain the delayed harvest.

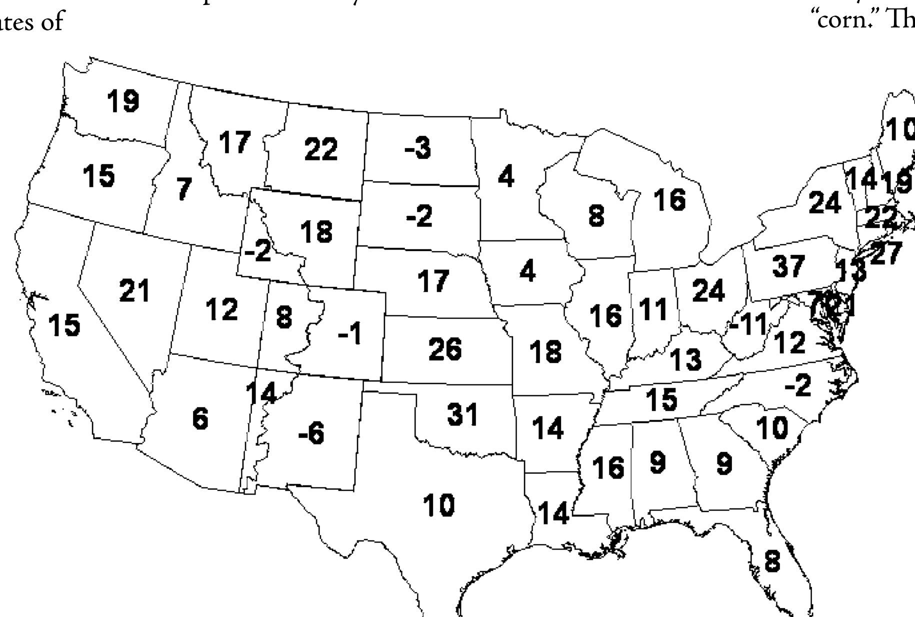


Figure 1. Total change of mean harvest dates (in days) in each state, for Mallards, from 1961-2009. Positive numbers indicate a change to later mean harvest dates; negative numbers indicate a change to earlier mean harvest date.

If regulations – that is season dates – are the driver of the pattern for later harvest dates, then a nonmigratory species, like mottled ducks, should show the same pattern of later harvest dates as mallards, which migrate. That did not happen. Mottled ducks do not show a substantial shift in harvest date over time. This suggests the later harvest for mallards is a migration effect rather than just a season date effect.

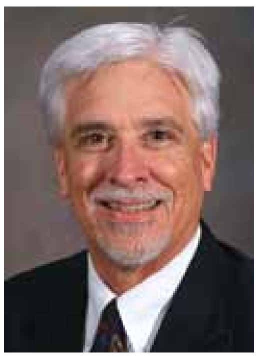
We also note that season dates and duck harvest dates are much like the chicken-or-egg argument about which came first. Season dates affect harvest dates, but we suspect hunting season dates are getting later because ducks are migrating later. Later migration prompts hunters to ask for later seasons. State policymakers are likely to accommodate requests for shifts in harvest dates because they typically consider it their job to maximize hunter opportunities within the federal guidelines established to protect the resource.

So the punchline is that we believe migration dates are getting later. Again the question is: Why? Many hunters believe a potential answer is "corn." The corn hypothesis holds that the expansion of corn into the northern U.S. prairies in recent decades has provided a more highly preferred food and held the ducks up north much longer.

We did a simple test by looking at duck data, and the corn hypothesis was not supported. To examine this, we contrasted harvest information for species that extensively use corn in northern states, such as mallards and pintails, with species that do not feed in dry corn fields, such as gadwall and ring-necked ducks. The two pond-feeding species (gadwall and ring-necked) would not be affected by agricultural crops. The shifts in harvest dates were similar for all four species, which suggests something operating on a bigger scale is the driver of the delayed harvest and migrations.

(continued on page 2)

DIRECTOR'S COMMENTS



Allen Rutherford

Another year has passed since our previous research update, and during that year we have sustained our research and extension programs in the School of Renewable Natural Resources.

Our faculty members continue to focus on scholarly productivity despite continued budget reductions, and I believe we continue toward our goal to improve all aspects of research and extension. We are grateful to our funding sponsors that include federal, state and private partners. In the face of declining resources, our continued success is a tribute to the quality of the faculty members, post-doctoral researchers, research associates, graduate students, student workers and especially the support staff in the School.

The articles in this issue give an excellent look at the diversity of ongoing research in the School of Renewable Natural Resources. All of the 13 research summaries in this issue are related to our strategic missions of 1) wetland landscapes and communities, with an emphasis on the ecology, hydrology and restoration of floodplain and coastal wetland ecosystems; 2) wildlife populations, habitats and landscapes, with emphasis on wetlands, waterfowl, rare and declining species and important game species; 3) coastal and freshwater fisheries, with emphasis on water quality, biodiversity and fisheries production; and 4) forest resources and ecology, with emphasis on coastal forests, hydrology of forested watersheds and the sustainable economic development of forest and wood products. This issue also highlights the research programs of Dr. Quang Cao, Dr. Jun Xu, Dr. Andy Nyman and Dr. Sammy King, as well as the award-winning graduate students from the school.

We continue to be positive about the future of all the School of Renewable Natural Resource's programs and we do appreciate your continued financial support of our ongoing efforts. We also ask that as you interact with potential students, please make them aware of the numerous natural resource career opportunities. Each of you is uniquely qualified to help us in this way.

If you have any questions or comments, or if you would like to come by for a visit, please feel free to contact me (drutherford@agcenter.lsu.edu or 225-578-4187).

ON THE COVER: *The 2011 Mississippi River flood forced the opening of the Morganza Spillway and provided a rare opportunity to study hydrologic connectivity of the Mississippi River with the wetlands of the Atchafalaya Basin floodway system.*

School of Renewable Natural Resources
Research Matters - Summer 2012
Director: Allen Rutherford
Editors: Tom Dean
Melinda Hughes
William Kelso
Frank Rohwer
Sabrina Taylor
Sammy King
Designer: Barbara Groves Corns

School of Renewable Natural Resources
Louisiana State University
Baton Rouge, LA 70803-6200
Tel 225-578-4131 Fax 225-578-4227
www.rnr.lsu.edu
www.lsuagcenter.com

Louisiana State University Agricultural Center
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Faculty Profile - Sammy King

Dr. Sammy King, leader of the Louisiana Cooperative Fish and Wildlife Research Unit and adjunct associate professor, was born in Baton Rouge, La. He received his bachelor's degree in biology from Nicholls State University and a master's degree in zoology and wildlife sciences from Auburn University, where he worked in the area of cottontail rabbit responses to prescribed fire. He developed a passion for wetland ecosystems at Auburn and moved to Texas A&M University for a doctoral degree in wildlife and fisheries sciences, studying plant succession in bottomland hardwood forests.

He subsequently held positions with the U.S. Forest Service, the U.S.G.S. National Wetlands Research Center and the University of Tennessee before assuming his current position as unit leader here in 2003.

Dr. King's current research is broadly focused on wetlands and floodplain forests. He has conducted several studies on secretive marshbirds in Louisiana with a particular focus on king rails. He also leads the research and monitoring efforts for the reintroduction of whooping cranes to southwestern Louisiana. Several of his students are working on floodplain issues in both the Mississippi River Valley and the Middle Rio Grande, where they are studying the response of floodplain forests and/or birds to altered hydrologic conditions.

Duck harvest shifts later in Louisiana and elsewhere

(continued from page 1)

We consider climate change to be a plausible explanation for shifts in the timing of migration. Of course, that is simply conjecture from this analysis. Climate change certainly is well documented, but we have no data to directly link climate change to duck migration chronology. Climate change is our speculative, but favored, explanation for why migration patterns may have changed.

What we know for sure is that duck harvest has shifted to later dates in more recent times. What is surprising is that we appear to be the first researchers to have documented this strong pattern of later harvest – despite the importance of waterfowl harvest in Louisiana and many other states.

This research was supported by the Bipartisan Policy Center, Washington, D.C., and the Delta Waterfowl Foundation, Bismarck, N.D.

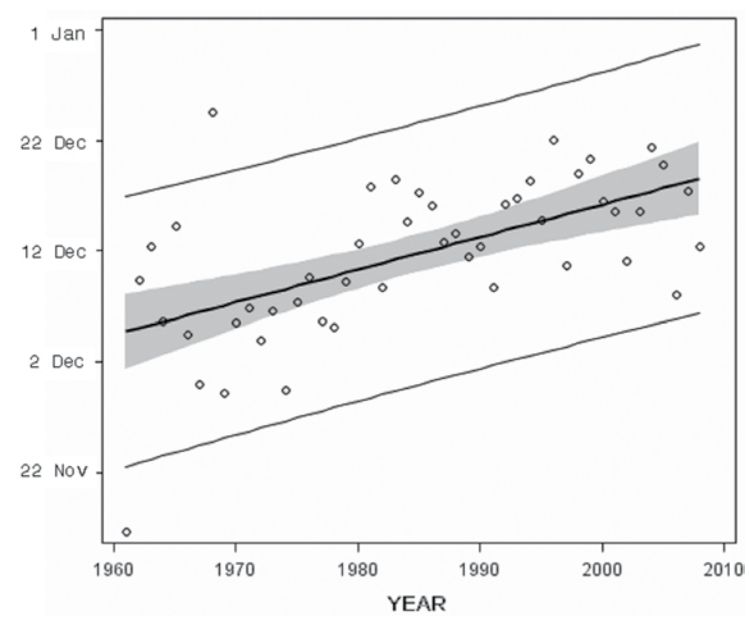


Figure 2. Each hollow circle represents the mean Mallard harvest dates for each hunting season in Louisiana from 1961-2009. The solid dark line shows the best fitting trend line of later harvest dates in more recent years. The grey interval represents the confidence intervals and the thin lines represent prediction limits.

Graduate Student Bruce Davis

Bruce Davis is a native of Iowa and a graduate of Iowa State University. He earned his Master of Science degree at Louisiana State University in 2007 under the guidance of Dr. Al Afton. In 2008, Bruce began working on a project to estimate habitat use by mottled ducks in coastal Louisiana and Texas under the direction of Dr. Frank Rohwer.

Throughout his career, Bruce's research efforts have focused on several waterfowl species and include studying the breeding ecology, spring and fall migration periods and wintering ecology of ducks and geese in North America. Bruce has spent hundreds of hours radio tracking ducks from airplanes.

Chang wins Fulbright

Professor Sun Joseph Chang *has been awarded a* Fulbright specialist *grant to conduct a summer school program at Saint Petersburg State Forest Technical Academy in Saint Petersburg, Russia. The Fulbright Specialist Program promotes linkages between professors in the United States and their colleagues at more than 100 host institutions. Project activities focus on strengthening and supporting the development needs of host institutions. Dr. Chang's program of study is designed for about 20 doctoral degree students from Russia and eastern European countries.* Congratulations to Dr. Chang!!

Seaside sparrows in contaminated marshes

Tracing the signal of the Deepwater Horizon spill into terrestrial vertebrates

Phil Stouffer, Associate Professor

We've seen the tragic effects of the 2010 BP/Deepwater Horizon spill in the form of oiled carcasses strewn on Gulf of Mexico beaches. Most of these animals died after being massively contaminated, either from immersion in oil or by ingesting oil directly. But is that the whole story?

In the absence of dead animals, are we to assume that all is well? A new project by School of Renewable Natural Resources faculty members Dr. Sabrina Taylor and Dr. Philip Stouffer and post-doctoral associate Stefan Woltmann will determine whether contamination from the spill makes its way into birds that never enter the water directly. If so, this would reveal a link into terrestrial systems that also could occur in other species that use the marsh.

An adult seaside sparrow.

The research project focuses on the seaside sparrow, a species whose name tells the story of its extreme habitat specialization. These birds are found only in the Everglades and in salt marshes on the Atlantic and Gulf coasts.

Although the species can be plentiful in its habitat, its long-term viability is precarious even in the absence of oil spills due to loss of salt marsh as climate changes raise sea levels, among other threats. One subspecies in Florida already has gone extinct due to marsh conversion, and the Everglades subspecies is listed federally as endangered. The birds eat insects, spiders and seeds, as well as small snails and crustaceans. If these prey items are contaminated, which seems especially likely for detritus feeders like crustaceans, the birds could, in turn, ingest the toxins.

The sparrow research team has established plots in marsh areas that were known to be contaminated and those that were not. They are collecting standard population measurements, such as the density of birds, the number of nests and nest success. They also are radio-tracking birds to determine how often the birds use the marsh edges, where the birds would have had the chance to encounter the most contamination.

The research team's main tool to determine directly whether individual birds are stressed by oil will be to look at presence of an enzyme associated with detoxifying petroleum products. In contaminated birds, the gene cytochrome P4501A (also called CYP1A) is turned on (upregulated), producing a message (messenger RNA) that then instructs a cell to make the protein needed for detoxification. The researchers will be able to identify the presence and quantity of the message in seaside sparrow cells. This technique has been used effectively following other oil spills, particularly to show that ducks in Alaska are still responding to contamination 20 years and multiple duck generations after the Exxon Valdez spill.

The sparrow project is part of a consortium grant funded through BP via the Gulf of Mexico Research Initiative. The Louisiana Universities Marine Consortium spearheaded the massive proposal, which includes some 25 principal investigators from multiple institutions. Renewable Natural Resources researchers will be working in a subset of the overall project addressing coastal processes, including condition of marsh plants and soils, status of oysters and marsh fish and food web effects on creatures such as arthropods and birds.

The bird project will be particularly linked to the research of LSU AgCenter entomology professor Linda Hooper-Bui, who has been sampling marsh arthropods at some of the same sites since before the spill made landfall.

Lessons from history suggest that sublethal effects of the spill will be BP's legacy to Louisiana's coast for many years. We may have little hope of mitigating many of these effects, but we do have the tools to identify and evaluate how contamination is affecting our coastal biodiversity. It is hoped this ongoing research will track a pattern of recovery for seaside sparrows and will integrate these important marsh residents into our understanding of coastal processes. ■

A seaside sparrow nest with newly hatched young.

Dr. Linda Hooper-Bui catching insects in the marsh.

A member of the research team collects snails and crabs on oiled site.

Amazonian understory birds and second growth

Karl Markos and Luke Powell, Graduate Students

The Biological Dynamics of Forest Fragments Project was founded in 1979 with a captivating idea: Since deforestation driven by agricultural practices in the Brazilian Amazon is practically inevitable, why not set up an experiment where forest patches are isolated to understand the effects of land use on Amazonian biodiversity?

The project kicked off with the first forest fragments isolated by an open landscape of felled trees and burnt debris that few animals were willing to cross. Pastures were established and more than 7,000 Nelori cattle were brought in.

An unexpected turn took place a few years later when government subsidies for land conversion in the Amazon were revoked. The poor soils did not sustain livestock, and the economic activity became unsustainable. Within a few months, the ranches were abandoned and the cattle quickly dwindled. The small herds that remain today still manage to survive on the little remaining pasture that has not yet been engulfed by the surrounding tropical forest.

Over time, the forest fragments were intensively studied and helped create rich literature on the dynamics of forest fragmentation. But the abandoned pastures changed, and in a few years, thick vegetation surrounded the forest patches.

Systematic bird surveys have been conducted inside the fragments since the beginning of the project, which allowed us to track changes in population abundance as regeneration took place in the former pasture. The adverse matrix gradually became less hostile, and many forest understory species that were extinct in the fragments managed to return.

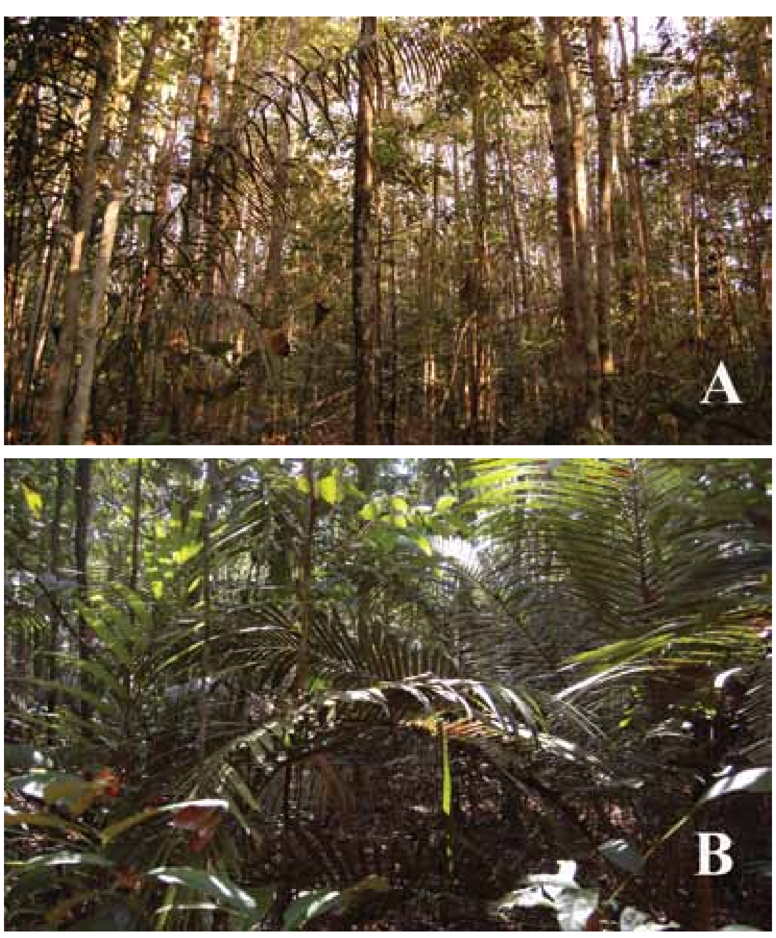
But the question remained: What is happening outside of these fragments? And how are forest understory birds facing this new environment?

Two students from Dr. Phil Stouffer's lab currently are conducting their dissertation work with understory bird species and their movements between forest fragments and secondary forests.

Luke Powell has been studying the recovery of the understory bird community as secondary forest establishes itself in abandoned pasture. After about 13 years, rainforest birds start to make use of secondary growth, with the young and the restless leading the way. By 34 years after abandonment, about 90 percent of the bird community is regularly crossing the border into secondary forest. It's not until about 60 years that terrestrial insectivores, with their awkwardly long legs and stubby wings, are predicted to hop their way across the forest floor into the secondary forest. With the vast areas of secondary forest now established in the Amazon, it is encouraging that most species return in less than 34 years after abandonment of pasture. On the other hand, terrestrial insectivores are particularly reluctant to return to secondary forest, making them good indicators of ecosystem health.

Karl Mokross has followed understory mixed-species flocks and geo-referenced their movements as they move through their territories. Flocks exhibited a conditional behavior in relation to edges with second growth. In general, birds avoided crossing but foraged consistently near fragment edges. When crossing, the birds would pick an area where canopies of understory trees and the secondary growth connected over the trail. Not all species were as prone to enter second growth. Some did, while others were reluctant to leave the old growth. When inside the second growth, the movement patterns seem to change as well. Flocks cover more area in less time. Second growth does not seem to be a completely adverse environment, since flocks also will settle territories there, but territories seem to be larger as a result of needing more area to cover their foraging needs.

Evidence suggests the configuration of the vegetation plays a great role. While birds are now able to move through secondary forest, differences are still noted after three decades. The viability of this forest physiognomy to sustain forest species still needs to be carefully assessed from a multi-angle approach. More findings are expected to be reported.



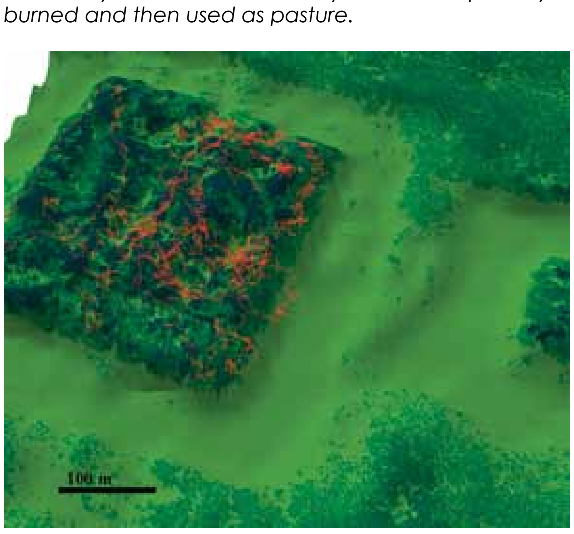
Comparison between second growth (A) and primary forest (B). Despite the vegetation height being close to 20 meters after a few decades, the understory structure is noticeably different, especially in areas that were burned and then used as pasture.

Graduate Students Karl Mokross and Luke Powell

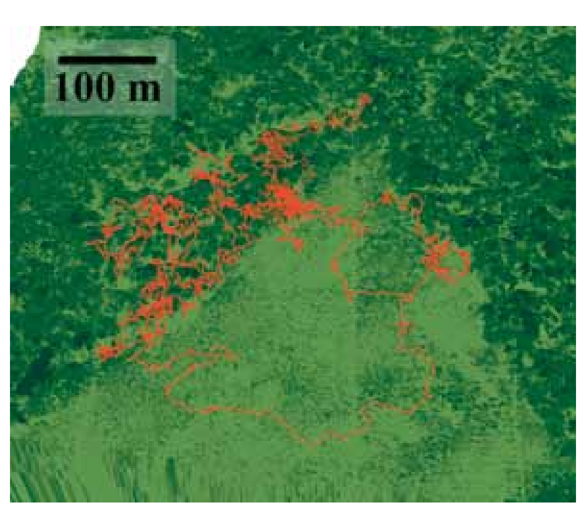
Karl Mokross completed his bachelor's and master's degrees in his native country of Brazil and joined Dr. Phil Stouffer's lab in the spring of 2009. He currently conducts his dissertation project on the effects of degraded landscapes on the movement patterns and species composition of understory mixed-species flocks in the central Amazon. He is interested in animal movement and effects of vegetation structure on forest-dependent organisms. In the fall of 2011 he finished field data collection at the Biological Dynamics of Forest Fragments Project after a 14-month campaign.

Luke L. Powell, originally from Long Island, N.Y., joined Dr. Phil Stouffer's research group in 2009 after obtaining a bachelor's degree from Tufts University and a master's degree at the University of Maine. Powell's research focuses on the recovery of tropical secondary forest for the understory bird community. Brazil has more secondary forest than all other tropical countries combined. Yet the value of those secondary forests for wildlife is poorly understood. Using radiotelemetry and mark-recapture techniques, Powell seeks to understand when secondary forests are old enough to become valuable to wildlife.

Research for these two projects is being supported by a grant from the National Science Foundation. Mokross and Powell are conducting their dissertation work with understory bird species and their movements between forest fragments and secondary forests.



Geo-referenced movements of understory mixed-species flocks (in red) in a 10-hectare fragment surrounded by second growth. Mixed-species flocks used the forest edge but rarely crossed into the surrounding secondary forest. LIDAR images were provided by Scott Saleska (University of Arizona) and post-processed by the Michael Lefsky Research Lab (Colorado State University).



Geo-referenced movements of understory mixed-species flocks (in red) in a primary forest adjacent to second growth. Mixed-species flocks used the forest edge but rarely crossed into the surrounding secondary forest. Notice altered movement patterns in second growth. LIDAR images were provided by Scott Saleska (University of Arizona) and post-processed by the Michael Lefsky Research Lab (Colorado State University).

A 10-hectare fragment (left) and a 1-hectare fragment (right) seen at Dimona ranch in 2007. Both fragments are surrounded by a nearly three-decade-old second-growth vegetation that, in turn, is surrounded by primary forest. Image credits: Google Earth and Digital Globe© 2012.

Faculty Profile - John Andrew Nyman

Andy Nyman earned a bachelor's degree with a major in biology from the University of New Orleans in 1984 where he focused on field biology. He soon began work with the Louisiana Department of Wildlife and Fisheries.

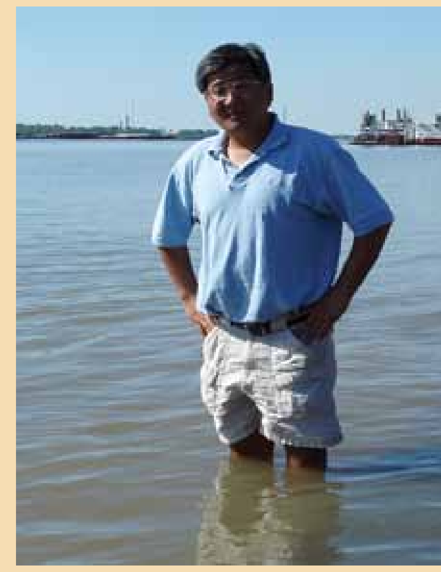
Knowing that a master's degree would further his career opportunities, he became a graduate student in the LSU School of Renewable Natural Resources in 1987. His master's research was directed by Dr. Bob Chabreck, an expert on coastal marsh ecology. Nyman earned the master's degree with a major in wildlife in 1989 and began working on a doctoral degree with a major in oceanography and coastal sciences under the direction of Dr. William Patrick, who was an expert on wetland soil chemistry. Dr. Nyman was awarded the Ph.D. in 1993 and went to work for the University of Louisiana at Lafayette.

He returned to LSU in 2001 as an assistant professor and assumed the position vacated when Dr. Chabreck retired. He was promoted to associate professor in 2006 and to professor in 2012. He has authored or co-authored more than 50 peer-reviewed publications. His most cited papers address marsh vertical accretion and the response of wetlands to oil spills and oil spill response options (including dispersants). He has been awarded for his work with governmental agencies and nongovernmental organizations regarding coastal wetland restoration in Louisiana over the past two decades.

Faculty Profile - Jun Xu

Jun Xu joined the School of Renewable Natural Resources in 2002. Born in China, he started his college career in Kunming in southwest China and then completed his bachelor's degree work at Beijing Forestry University. He taught soil science and silviculture with a focus on forest soils at Sichuan Agricultural University. He studied in Freiburg at the Goethe Institute and in Göttingen where he completed both his master's and doctoral degrees at Georg-August-Universität Göttingen.

After working in Germany for six years, he moved to Virginia Tech, and then to LSU in 2002. Dr. Xu works primarily on the hydrology of watersheds and has participated in about 30 research projects conducted in North America, West Europe and East Asia. His research centers on two dominant themes: water resources and environmental quality. A constant goal in his work is to understand and quantify the effects of anthropogenic activities on water and the environment.



Listed in Who's Who in America (2009) and Who's Who in Science and Engineering (2010), Xu serves as associate editor for Journal of the American Water Resources Association, as well as on the editorial boards of Riparian Ecology and Conservation and The Scientific World Journal.

Calibrating mixed-effects taper equations

Quang Cao, Professor, and Jing Wang, Associate Professor, School of Public Health, Saint Louis University

Upper-stem diameter measurements now can be obtained by use of better and more affordable laser dendrometers in a manner that was not possible previously. These measurements can be used to calibrate predictions from a taper equation.

When a taper equation is constrained such that its curve passes through a measured upper-stem diameter, the result should be improved prediction of tree taper anywhere on the trunk.

There has been a growing interest in applying mixed-effects models to solve forestry regression problems. Specifically, mixed-effects models have been applied to predict tree taper because they take into account the correlation among multiple diameter measurements on an individual stem. These models contain both fixed-effects parameters that are common to all trees in the sample and random effects that are specific to each individual tree.

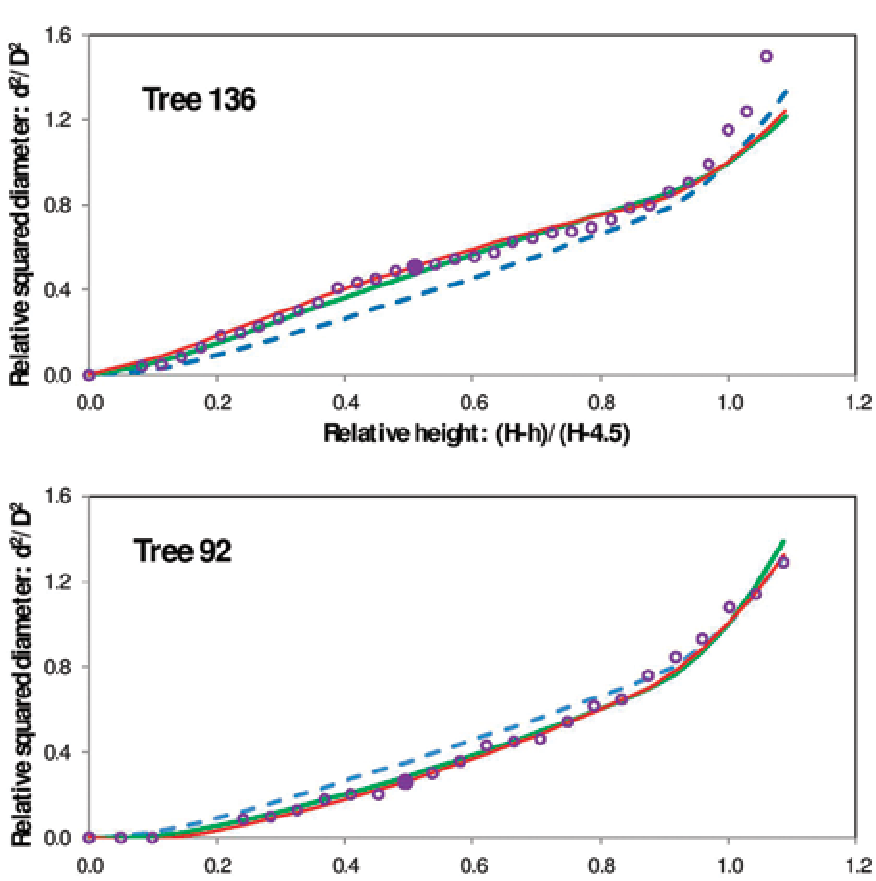
The objective of this study was to evaluate the use of the midpoint upper-stem diameter in calibrating and localizing mixed-effects taper models.

Previous research showed that best results were obtained when the diameter for calibration was measured at the midpoint between the tree tip and breast height (4.5 feet). We found that a model is calibrated when it was obtained by constraining the predicted diameter to equal to the measured diameter at this relative height. On the other hand, a model is localized when its regression coefficients are adjusted by adding the random effects for that tree, computed from the midpoint diameter.

Results showed considerable improvement when the taper curve was either calibrated or localized, as compared to the unadjusted model. The gain in accuracy and precision varied between 20 percent and 70 percent, depending on the evaluation statistic.

Both the calibrated and localized models used the measured diameter at midpoint to adjust the taper curve. The difference between the two approaches is that the calibrated curve passes through the observed midpoint diameter, whereas the localized curve does not. The precision of these two models was similar, with the calibrated model producing lower average error, which is the difference between observed and predicted values.

The added information of measured midpoint diameters was shown to improve prediction of tree taper. Although the calibrated and localized models produced similar results, the calibration technique is much simpler, produced less-biased prediction of diameters and is therefore recommended.

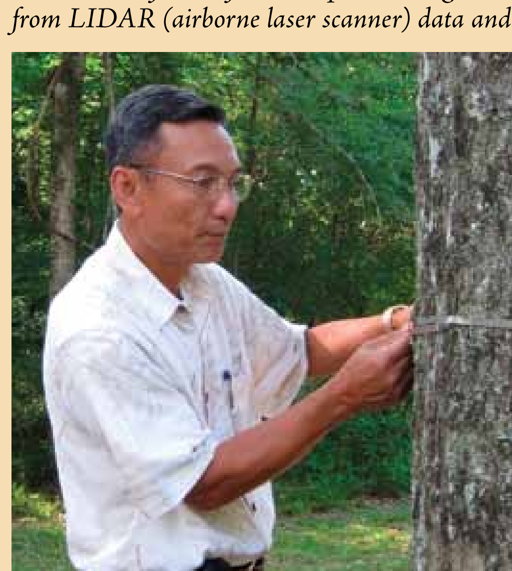


Observed tree diameters (empty circular dots) and unadjusted taper curves (dashed blue lines) for two sample trees. The calibrated curves (red) and localized curves (green), which are based on the midpoint diameters (solid circular dots), improve taper prediction for these two trees compared to the unadjusted curves.

Faculty Profile - Quang Cao

Born and raised in a suburb of Saigon, South Vietnam, Quang Cao received a bachelor's degree in forestry from the National Institute of Agriculture, Vietnam, and came to the United States as a refugee in 1975. After a few months in a refugee camp, he was admitted to graduate school at Virginia Tech and later obtained master's degrees in forestry and statistics and a doctoral degree in forest biometrics. Dr. Cao has been with LSU since 1981 and is now a professor of forestry.

He is interested in applying mathematical and statistical techniques to solving diverse forestry problems, such as predicting diameter anywhere on the tree bole, projecting a diameter distribution through time, characterizing the distribution of wood fiber and particle length, constructing crown structure from LIDAR (airborne laser scanner) data and modeling the self-thinning process in forest stands. He is currently working on linking various models for predicting growth and yield of forest stands at scales ranging from the whole stand to individual trees.



In addition to conducting research, Cao also teaches classes in measurements and forest biometrics. He was the recipient of the 2000 Excellence in Teaching Award from the LSU College of Agriculture.

Investigating Shifts in vegetative communities at Catahoula Lake

Catahoula Lake with encroaching water elms in the background.

Karen Doerr, Graduate Student, Richard Keim, Associate Professor, and Sammy King, Leader, LSU Cooperative Fish and Wildlife Research Unit

Catahoula Lake is a seasonally flooded lake in the Mississippi River floodplain, northeast of Alexandria. It is a wetlands of international importance that serves as one of the largest waterfowl staging areas in the United States.

Seasonal fluctuations in water levels at Catahoula Lake make it ideal for moist soil plants that serve as high-energy food for waterfowl. Woody plants like water elm and swamp privet are encroaching on the lake and out-competing the herbaceous vegetation. In cooperation with the Louisiana Department of Wildlife and Fisheries, we are quantifying the woody encroachment and investigating how it has responded to past management strategies. The state Department of Wildlife and Fisheries has been using bush hogs, roller choppers, burning and herbicides to reduce the woody vegetation, but these management efforts are increasingly expensive and difficult to conduct.

Catahoula Lake has been subject to hydrologic changes over at least the past century. Navigation projects on the Black River raised the level of the river, which would have permanently flooded the lake. To prevent this from happening, a diversion canal was built by the Corps of Engineers and is now the main outlet for the lake. The lake also is affected by backwater flooding from the Mississippi, Red and Black rivers.

We began this investigation by collecting historical aerial imagery of the lake from the U.S. Department of Agriculture and the U.S. Geological Survey from several years between 1940 and 2004. We then geo-referenced the imagery and analyzed it using aerial photo interpretation for density of cover. We created polygons for woody growth between 20 percent and 100 percent cover. These polygons were analyzed to identify and quantify encroachment over time.

Preliminary analysis of aerial imagery shows that water elm, swamp privet and other woody vegetation encroached on Catahoula Lake by about 1,040 ha (30 percent of the lake area) between 1940 and 2007. The analysis between 1940 and 1966, before the diversion canal was built, suggests a 5 percent encroachment of 160 ha. This means an increase in rate of encroachment to 0.4 percent per year from the pre-canal rate of 0.2 percent per year. These estimates do not include attempts at removal, however.

The encroachment also appears to be occurring largely in the northeast near the input of Dry River and in the southwest at the input of Little River. These results could be exaggerated by the 1940 imagery, which was acquired during high water at the lake.

For future research, we hope to obtain more aerial imagery of the lake, particularly at low water and after the diversion canal was built in 1972. We also will investigate the amount and rate of sedimentation at Catahoula Lake. We will locate old survey markers placed in 1942 to give us an idea of deposition or erosion amounts. In addition, we will test 10 core samples for ^{137}Cs, which is a fallout product from nuclear testing in the early 1950s to early 1960s that has become a valuable tool for dating sediments. By locating the sediment layers that contain ^{137}Cs, we can determine the rate of accretion for the lake.

We also are beginning work using sediment chemistry to trace the origin of sediments in and around the lake. Soil cores are being taken from around the lake and also from sites near significant inputs and outputs of water. We will analyze the cores for their elemental composition using the X-ray fluorescence technique in collaboration with Dr. David Weindorf in the LSU AgCenter School of Plant, Environmental and Soil Sciences.

Research was funded by the Louisiana Department of Wildlife and Fisheries

Graduate Student Karen Doerr

Karen Doerr is a master's degree student with a concentration in watershed science. She is a student of Dr. Richard Keim and plans to graduate in 2013. Doerr received her bachelor's degree in journalism in 2001 from the University of Florida with a concentration in photojournalism.

Spatial variability in response of deltaic baldcypress forests to hydrology and climate

Som Bohora, Graduate Student, Richard Keim, Associate Professor, and Jim Chambers, Weaver Brothers Distinguished Professor of Forestry

Cypress-tupelo forests of south Louisiana are globally significant. These forest ecosystems provide a number of services including hurricane protection, water quality improvement, timber production, aesthetic value, floodwater storage, carbon storage, coastal storm surge protection, nutrient cycling and wildlife habitat.

These swamp forests are affected by hydrologic and climatic changes in the deltaic plain of Mississippi River. Although responses of these swamps to hydrology are relatively well understood at a local scale, ecological responses to broad-scale hydrologic and climatic processes have been limited by the lack of site-specific hydrologic and ecological data. Therefore, forecasting of broad-scale ecological response of the deltaic wetland forests to hydrology and climate is needed to enhance restoration plans for these deltaic systems.

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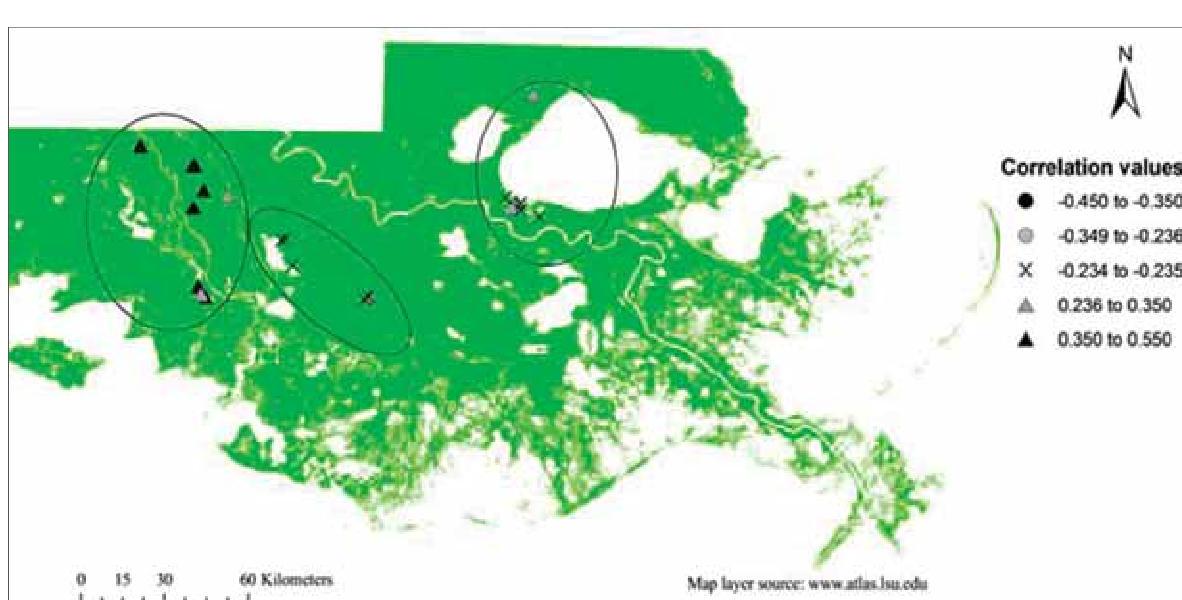

Figure 1. Tree radial growth at Atchafalaya Basin sites was positively correlated with current-year June river stage.

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We conducted a regional analysis of baldcypress tree rings to provide a new understanding of the spatial variability of processes driving this deltaic ecosystem. The general objective was to understand the spatial variability in the response of deltaic coastal swamp forests to environmental factors. Specifically, this research evaluated hydrology as a potential driving factor in radial growth of baldcypress swamp forests and investigated the relationships between radial growth of trees and climate and hydrology at a regional scale.

We used tree-ring data previously collected from 22 sites (three basins – Atchafalaya, Lake Verret and Lake Pontchartrain) in Louisiana. Annual ring widths were measured, cross-dated and verified using standard dendro-chronological methods. We evaluated relationships among growth and several environmental variables, including climate (monthly temperature, precipitation and drought), stage of the Mississippi River and coastal water level.

River stages and coastal water levels were mostly positively correlated with baldcypress radial growth as has been observed previously. Overall, broad-scale measures of deltaic hydrology (Mississippi river stage at Baton Rouge and coastal water level at Grand Isle) had higher correlations with tree radial growth than did climatic variables. Tree radial growth responses to hydrology (both river stage and coastal water level) and climate varied spatially by individual sites and basins (Figure 1).

Basin-level effects probably are related to hydrological and biogeochemical processes that vary by basin. A strong relationship between coastal water levels and river stages suggests river stages control or influence coastal water levels at some times of the year so that even sites not directly hydrologically connected to the river experience the broad-scale effects of annual variability in river stage. Therefore, even though the river is leveed, river hydrology appears to influence forest productivity through linkages with coastal waters.

Dr. Richard Keim takes a core sample from a baldcypress tree. Annual ring widths were measured, cross-dated and verified using standard dendro-chronological methods.

This project was supported by McIntire-Stennis Research Funds.

Graduate Student
Som Bahadur Bohor

Som Bahadur Bohora completed his master's degree in forestry this spring. He also is pursuing a dual degree in experimental statistics at LSU. Bohora is from Nepal, where he completed a bachelor's degree in forestry from Tribhuvan University Institute of Forestry in Pokhara. He has authored or co-authored a number of papers on wildlife and conservation including one as co-author in the Journal of Wetland Ecology.

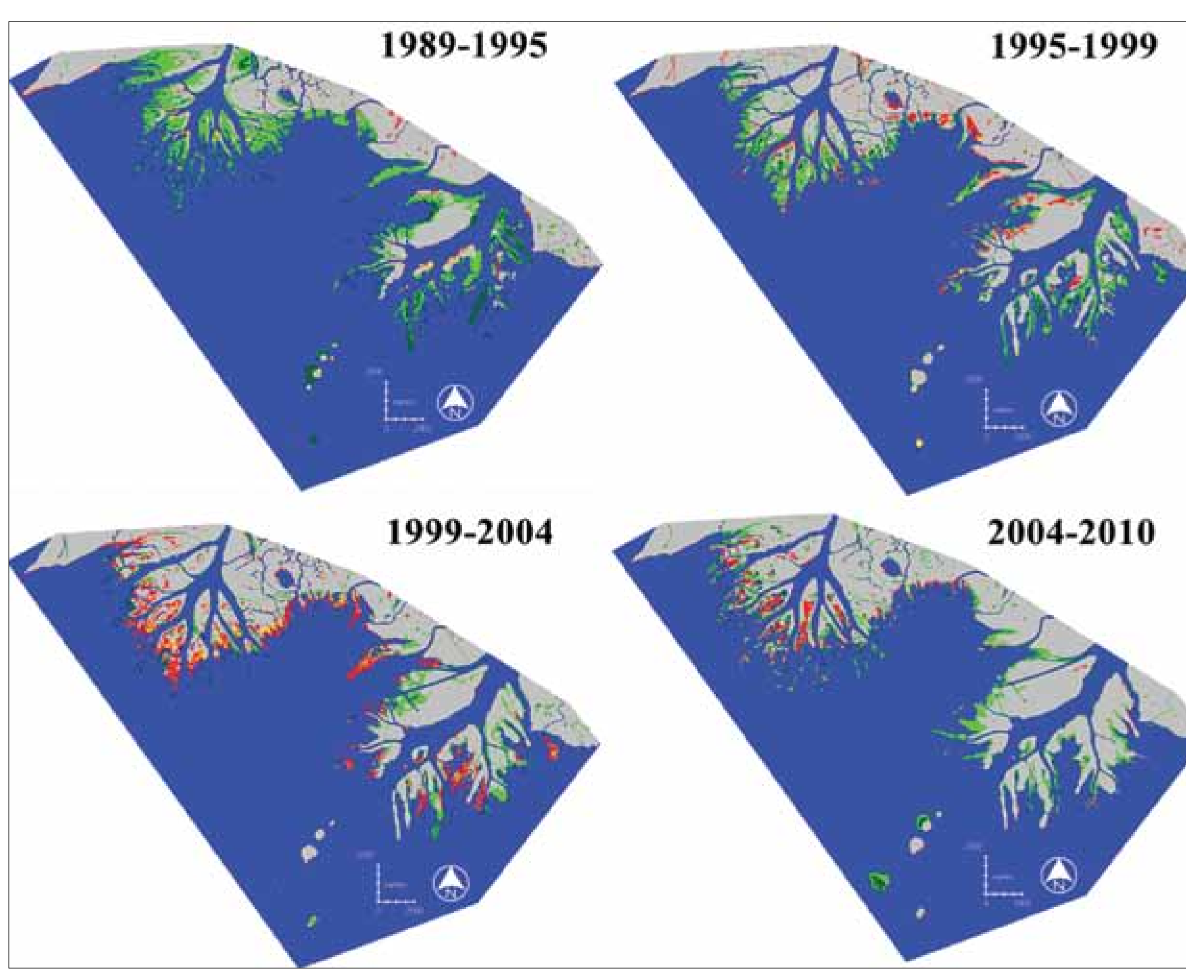
Riverine sediment to coastal Louisiana

Timothy Rosen, Graduate Student, and Y. Jun Xu, Professor

Extending from the Louisiana Chenier Plain at the Texas border to the Mississippi River Bird Foot Delta, coastal Louisiana is a maze of bayous, fresh and salt marshes and barrier islands. These coastal areas are home to more than 2 million people, support a quarter of the U.S. energy supply and provide vital habitat for wildlife and fisheries. But they also have experienced one of the highest rates of land loss globally, and so their restoration is a top priority in Louisiana.

Until recently, one of the largest underused resources for coastal restoration was sediment from rivers that drain into the Gulf of Mexico. Although there has been much research on the quantity and trend of sediment discharge from the Mississippi River and three major river diversion projects in the past 20 years, none has been successful in creating new land or maintaining disappearing wetlands. In particular, the total amount of sediment and the amount of sediment that can be diverted for coastal restoration without affecting other river functions is unknown. Furthermore, there is little documentation on the amount of sediment carried by other Louisiana coastal rivers.

To address these issues, we quantified the amount of suspended sediment in major coastal rivers in Louisiana. We also completed a spatial analysis incorporating Atchafalaya River sediment loading with Atchafalaya Basin inundation and land growth at the Atchafalaya River delta.



We found that the Louisiana Chenier Plain Rivers – Sabine, Calcasieu, Mermentau and Vermilion – provide on average 342,950 metric tons of suspended sediment annually. The Sabine River, the largest of the rivers that intersect the Chenier Plain, accounts for more than 60 percent of this sediment resource, while the remaining rivers account for approximately 14 percent (Calcasieu), 12 percent (Mermentau) and 13 percent (Vermilion). All rivers showed a decreasing trend in the amount of sediment carried over the past two decades from decreases in discharge.

The two most important rivers, the Mississippi and Atchafalaya, produced respectively 127 and 55 million metric tons of suspended sediment annually (1980-2010). The Mississippi

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River has a slight increasing trend in suspended sediment yield since 1989, while the Atchafalaya River has a decreasing trend.

We estimated land accretion rates in the Atchafalaya Basin to range between 23.2 to 56 millimeters per year, depending on elevation, sediment bulk density and cover type. The Atchafalaya Delta has had a decreasing sediment load from the Atchafalaya River. This might be influencing the slower growth observed over the period 1989-2010, although years with large floods seem to ameliorate some of the land loss caused by tropical systems.

Funding support for this project was provided by the Louisiana Coastal Protection and Restoration Authority and the Louisiana Sea Grant College Program. The U.S. Army Corps of Engineers provided part of the long-term river discharge records; the U.S. Geological Survey provided part of the long-term river discharge and sediment records; and the Louisiana Department of Environmental Quality provided part of the long-term riverine sediment records.

Graduate Student Profile
Timothy Rosen

Timothy Rosen, a native of Maryland and a graduate from Mount St. Mary's University, joined Dr. Jun Xu's research group in 2009 with a coastal science assistantship awarded by the Louisiana Coastal Protection and Restoration Authority. Rosen's research focuses on riverine sediment transport to Louisiana's coast. In 2011, Rosen traveled to the Yellow River Delta, supported by an NSF EAPSI internship, and worked with researchers from Peking University to explore what can be learned from river engineering and sediment management of the Yellow River delta. Rosen has authored or co-authored four peer-reviewed journal articles and has presented his studies at several conferences.

Hydrology of vegetated hummocks in a swamp

Yu-Hsin Hsueh, Graduate Assistant, Jim Chambers, Weaver Brothers Distinguished Professor of Forestry, and Richard Keim, Associate Professor

Coastal wetlands are degrading due to subsidence and sea level rise. Long-term flooding and salinity have become major threats to wetland forests.

Baldcypress (*Taxodium distichum* L. Rich) and water tupelo (*Nyssa aquatica*) are the primary swamp species in coastal forests in Louisiana. Although both species are among the most flood-tolerant tree species, they are susceptible to salt-water intrusion that accompanies subsidence in coastal locations.

The responses of baldcypress to acute and chronic saltwater intrusion are not well understood. Baldcypress is known to react to salinity in its rooting environment by adjusting osmotic pressure of roots, biomass or leaf morphology, which reflects intraspecific genetic variation. Avoidance of salt stress may be possible because subsurface hydrology is heterogeneous. An improved understanding of the mechanisms on some trees at the brackish margin to survive would improve our ability to design management plans to conserve coastal wetland forests.

An important geomorphic feature of many subsiding coastal sites in Louisiana is hummock and swale topography. Such topography is common at the transition of forested wetlands and freshwater marshes. Trees survive on locally elevated terrain. Examples are observed in Georgia and South Carolina on hummocks, in Florida on tree islands and in Louisiana on hydric hummocks.

Hummocks function as oxygenation islands and nutrient sinks. Plant communities on isolated terrains can persist in tidal areas or in river systems. Also, hydrographs of hummock ecosystems are similar to those found in mixed forests and upper parts of freshwater swamps. Thus, we hypothesize that hummocks in degraded swamps may have less salinity than hollows due to fast turnover patterns in hydrology, which may be beneficial to trees.

To understand the hydrological cycle of hummocks, we are working in the Barataria Unit of Jean Lafitte National Historical Park and Preserve south of New Orleans. In coastal areas of Louisiana, wetland loss rate was about 5,700 acres per year between 1974 and 1990, and the Barataria Basin particularly has a higher rate than any other basin in Louisiana. The study site has four sources of water as potential reservoirs: the nearby estuary, rainfall, groundwater and local surface runoff.

To distinguish between water sources, we are using three tracers: two naturally occurring isotopes in water (^{18}O and ^{2}H) and salinity (as measured using electrical conductivity, EC). Isotopes are elements with the same protons but different numbers of neutrons that determine their atomic weight. Weight differences make lighter isotopes such as ^{16}O react slightly faster than ^{18}O. As water vaporizes, comparative amounts of $^{2}H2^{18}O$ remain as liquid while increasing amounts of $H2^{16}O$ become vaporized. Stable isotopes absorb different wavelengths of light and can be detected using laser absorption spectroscopy. Composition of stable isotopes thus varies spatially and temporally according to energy acting on source waters. Stable isotopes serve as tracers in water cycles in a hydrologic system.

We measured isotopic composition and salinity of groundwater in several experimental hummocks to learn hydrological processes, particularly as those pertain to salinity.

In this study, we also are applying stable isotopes to trace plant water use by baldcypress growing on hummocks. By sampling water in the trees, we will determine whether they are using water differentially from within the hummock or from the free water in the swamp. By sampling the soil water and tree water multiple times following rainfall and between events, we will be able to determine whether the hummocks are hydrologically distinct in an advantageous way for tree growth.

The mechanistic understanding of hummock hydrology in a degraded forest derived from this study will enhance our understanding of the hydrologic cycle of the swamp system. From a restoration perspective, this study will inform restoration management plans on degraded forested wetlands. More specifically, applying hummock hydrology may suggest creating or maintaining microtopographic features to maximize tree survival.

Sponsors for this project include the Gilbert Foundation Fellowship and the National Park Service George Melendez Wright Climate Change Fellowship.

Graduate Student
Yu-Hsin Hseuh

Yu-Hsin Hseuh is from Chingshuei, Taiwan, and a graduate of National Taiwan University. Yu-Hsin currently is conducting research for a doctoral degree in forestry. While conducting her field research on baldcypress water use at the Jean Lafitte National Wildlife Park and Preserve (south Louisiana), she was attacked by an alligator. Dedicated to her education and research, she is back in the swamps, more cautious, but still wading with the alligators and working to complete her field research efforts.

A note from Yu-Hsin:

On July 29, 2010, I was collecting water samples at the visitor's center boardwalk at Jean Lafitte National Park when a 6-foot alligator grabbed my arm. After a few terrifying moments, the alligator surprisingly released my arm. I spent five days in the hospital, endured two surgeries and spent 16 months in physical therapy. Amazingly, I retain my fingers on my right hand. Somehow, I have already forgotten the intense pain and I can only remember the cards, blessings, donations and encouragement from Renewable Natural Resources colleagues, international friends, Baton Rouge friends, Taiwanese groups and my family! I revised my experiment and revisited my study sites a year later. The field trips helped me regain the awe and appreciation of nature. I would not be able to embrace life without the help from all of you! Thank you!

Floodwater Connections between the Atchafalaya River and its floodplain during the historic 2011 flood

Brandon Edwards, Research Associate

Unlike the Mississippi River, which has long been channelized along its length, the Atchafalaya Basin Floodway System contains many secondary channels and large backswamps. Hydrological processes in the system drive ecosystem form and function, and water exchange between the main channel and backswamp areas is an important driver of biogeochemical processes.

Among other things, this exchange has the potential to remove harmful agricultural nutrients and mediate water quality, particularly during high water periods when overbank flow allows mixing of nutrient laden river water with in situ waters. Flow paths and connectivity within the basin are poorly understood, however, which limits the potential to quantify nutrient retention capacities and project the degree of water quality mediation by managing connectivity.

In 2011, we did a series of synoptic surveys of water chemistry to examine flow paths and connectivity in two water management units in the Atchafalaya Basin Floodway System – Henderson Lake and Buffalo Cove. We measured naturally occurring stable isotopes of water (^{18}O and ^{2}H) because they are useful tracers of input, flow, and mixing.

Variation in the evaporation and precipitation histories of natural waters causes variations in the concentrations of these isotopes. For example, strongly evaporated backswamp samples become enriched in the heavier isotopes, while Mississippi River water is relatively depleted.

We also collected collocated nutrient samples, which allows identification of both hydrological and water quality pathways with respect to river stage and season.

This study coincided with the historic Mississippi River flood of 2011 and the opening of the Morganza Spillway. This once-in-a-lifetime event presented an exciting opportunity to extend our efforts to incorporate both the effects of this substantial additional source of water and a much larger spatial footprint in our investigation of nutrient retention within the Atchafalaya Basin. This was an unusual opportunity to observe the mixing of river and backswamp waters that are normally insulated from one another, which may allow some projection of potential for water quality management via management to increase water flows to backswamps.

The 2011 Mississippi River flood forced the opening of the Morganza Spillway and provided a rare opportunity to study hydrologic connectivity of the Mississippi River with the wetlands of the Atchafalaya Basin floodway system.

We worked with researchers from several institutions and state and federal agencies to conduct a comprehensive sampling effort to document this event. Water quality data, flow data and isotope and nutrient samples were collected weekly for more than 40 sites in the two months following the spillway opening. Samples were collected biweekly through the summer and monthly in September and October. Analyses were conducted at the School of Renewable Natural Resources, LSU Chemistry, the Louisiana Geological Survey and by colleagues at Virginia Tech. Overall, the suite of data collected represents one of the most comprehensive sample sets of data collected in the Atchafalaya Basin Floodway System to date.

There were interesting differences in the way the Henderson and Buffalo Cove Water Management Units behaved hydrologically. Essentially, isotopically identical river water was ubiquitous during peak flood stage in the Buffalo Cove area, but the area became almost completely isolated from main channel flow after the peak of the flood. In contrast, the Henderson area exhibited more spatial variability in isotopic content and water quality and a much lower degree of connectivity to main stem flow during peak conditions.

This data means that, even though the flow was the highest in several decades, there was still not complete occupation of the floodplain by floodwaters, and there remains the opportunity to increase flood processing by changing management.

This project was funded by the National Science Foundation.

Research Associate Brandon Edwards

Brandon Edwards, originally from Alexandria, La., is a research associate working with Dr. Richard Keim. Brandon received his master's in geography from LSU in 2006, and plans to complete a doctorate in geography this fall. Brandon's main area of expertise is coastal and aeolian geomorphology, but he also has strong research interests in surficial processes, remote sensing, wetland hydrology, and instrumentation and environmental monitoring.

Southeastern blue suckers in the Pearl River forgotten, but not gone

Devon C. Oliver, Graduate Student, and William E. Kelso, Professor

Riverine fisheries management programs don't often focus on commercially and recreationally unimportant fish such as suckers (family *Catostomidae*), but these species may be important as bio-indicators of declining habitat quality.

Unfortunately, many suckers have become threatened or endangered throughout river systems in the United States because of sedimentation, dam construction and pollution. In the Pearl River, the southeastern blue sucker (*Cycleptus meridionalis*) has declined to very low levels compared to historic catches and is now a species of concern in both Louisiana and Mississippi.

During electro-fishing surveys in 2010 and 2011, we observed significantly lower catch rates for southeastern blue suckers compared to three other common benthic Pearl River fish, including smallmouth buffalo (*Ictiobus bubalus*), channel catfish (*Ictalurus punctatus*) and flathead catfish (*Pylodictus olivaris*). Southeastern blue sucker catch rates were similar, however, to historically common quillback (*Carpiodes cyprinus*) and highfin carpsucker (*Carpiodes velifer*), suggesting river modifications have affected the entire catostomid assemblage in the lower Pearl River system. River redhorse (*Moxostoma carinatum*) also may have been extirpated from this portion of the river over the past century.

Based on low catch rates and a mark and recapture study, we believe the Pearl River currently supports an extremely small population of southeastern blue suckers. Because there are still large numbers of other bottom-feeding fish in the river, it is unlikely a lack of food is limiting the sucker population. Most of the abundant species are habitat generalists, however, occupying many different parts the river.

We hypothesized that southeastern blue suckers are much more limited in their habitat requirements and that these preferred habitats have declined in abundance in the Pearl River due to sedimentation, dam construction, riparian development and flow modifications. To investigate this hypothesis, we combined radio-telemetry and habitat mapping to determine where

Figure 1. Southeastern blue suckers were fitted with external radio tags to follow their movements in the Pearl River.

the suckers currently are found, as well as the characteristics of these "preferred" habitats, such as bottom composition, river morphology, woody debris, water velocity and several water quality variables.

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We radio-tagged 11 southeastern blue suckers in the Pearl River and have tracked their movements periodically over the past year. Each time a fish was located the position was marked with a GPS unit and the water quality and habitat characteristics were recorded. Data indicates the suckers moved very little over the year, even during the spawning period. In addition, they have a strong affinity for deeper outside river bends with accumulations of large woody debris and gravel bottoms (Figure 1).

We used an extensive bathymetric survey to assess the extent of suitable sucker habitat in the Pearl River from summer 2010 through 2011. We mapped 116.6 kilometers of river and took 56,484 depth readings. Using the program and ArcMap statistical interpolation, we were able to create a bathymetric profile of the major portion of the Louisiana section of the Pearl River. Based on this map we are able to predict with approximately 98 percent accuracy any depth value within the mapped region.

We hope to perform side-scan bathymetry mapping of the river to further quantify the availability of apparently preferred habitats, to identify the highest quality stream reaches that currently support southeastern blue suckers and to identify reaches where management activities could improve habitat conditions for this species. ■

Figure 1. Locations of three southeastern blue suckers in the Pearl River. Outside bends of the river appear to be preferred habitat, perhaps due to higher flow velocities in these habitats.

Graduate Student Devon Oliver

Devon Oliver, a New York native and a graduate of SUNY Cobleskill, joined the fisheries group to work on his master's degree in 2009. His interest in the Pearl River evolved into a research project dealing with movement and habitat selection of southeastern blue suckers, as well as an extensive mapping effort to quantify habitats in the southern portion of the river. Oliver has presented results of his research at several conferences. He will be graduating this summer.

Long-term success of artificial oyster reefs along the northern Gulf of Mexico

Laura A. Brown and Jessica N. Furlong, Graduate Students

Creation of an artificial reef typically involves barges that transport the reef material to the construction site.

Oyster reefs are critical to Louisiana's coastal ecosystems. Oysters can filter up to 20 gallons of water a day, reducing turbidity and harmful nutrient loads, and oyster reefs provide a wave break along marsh edges and shorelines, reducing shoreline erosion.

Oyster reefs not only provide food and habitat for many adult fish and invertebrates that contribute to recreational and commercial fish harvests but also provide important refuges that help reduce predation on their larvae and juveniles. Despite these valuable services, shellfish reefs are facing increasing threats from natural stressors and human activities and are considered one of the world's most at-risk coastal ecosystems.

Along the eastern Atlantic coast, oyster reefs are declining from overharvesting, disease outbreaks and harmful harvesting methods that completely destroy the vertical structure of the reef. Oyster populations along the northern shore of the Gulf of Mexico remain relatively productive, although these stocks continue to be affected by hurricanes, pollution and high levels of harvest.

In an attempt to increase oyster populations and enhance the ecosystem services they provide, government, private and nonprofit organizations have created more than 400 artificial oyster reefs along the northern Gulf of Mexico (Texas to Florida) in the past 25 years. The two most common methods of creating an artificial oyster reef involve placing oyster shell or rock (limestone or concrete) on the bottom as settling habitat for juvenile oysters. These reefs hopefully will build sustainable oyster populations over time and provide the ecosystem services described above. Despite the historic and ongoing reef creation and restoration activities in the northern Gulf, however, there has been little monitoring or assessment of the best reef construction techniques or the relative success of these created reefs in providing a sustainable habitat for a diversity of fish and invertebrate populations.

We picked rock, shell and natural reefs in eight bays located from Texas to northern Florida and sampled five times during 2011 to determine which artificial reef construction methods offer the highest levels of ecosystem services over time. We compared natural and artificial reefs to assess the ability of created reefs to (1) sustain a living, growing oyster reef community, as evidenced by the oyster population characteristics and density and (2) provide quality habitat for a diversity of fish and invertebrates. To characterize the long-term viability of the reef, we used scuba gear to sample oyster density, size composition and reef substrates (shell, rock, mussels, etc.). We then used a diversity of gear, including gill nets, otter trawls, cast nets, crab pots, commensal bag collectors and settlement tiles, to determine reef use by resident fish and invertebrates.

Results of our study indicate that the ability of created reefs to sustain a living, growing oyster reef community varies by location and reef material. Salinity, and hence site location, was critical for oyster recruitment, determining whether oysters would recruit to the provided habitat and whether the location would build a sustainable reef over time. Reef material also strongly influenced reef success, with live oysters found in less than half of the created shell reefs. Shell reef failure was related to burial by sediment, which could have been due to poor site location (high sedimentation), reef subsidence and/or inadequate vertical stacking of the shell during construction.

Overall, mobile fish and invertebrates used all reef types (natural, shell, rock) to the same extent, given similar locations, indicating that variations in water quality and other environmental factors over time may be most influential in determining habitat choices by these organisms. For sedentary invertebrates, created reefs with more structure (i.e., rock reefs with living oyster populations) tended to support greater numbers and diversities of organisms compared to the shell reefs. Of the

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Graduate Students Jessica Furlong and Laura Brown

Jessica Furlong (left), a native of Iowa, joined Dr. Megan LaPeyre's research group in 2010 to study the development of artificial oyster reefs as habitat for fish and decapod crustaceans.

Laura Brown (right) is originally from Asheville, N.C. After working on oyster reefs along the coast of North Carolina, Brown moved to Louisiana in 2010 to work with Dr. Ken Brown and Dr. LaPeyre, studying oysters and blue crab use of oyster habitat.

Furlong and Brown's studies have taken them from Texas to Florida along the Gulf Coast, and they have presented results of their studies at several scientific conferences.

FISHERIES

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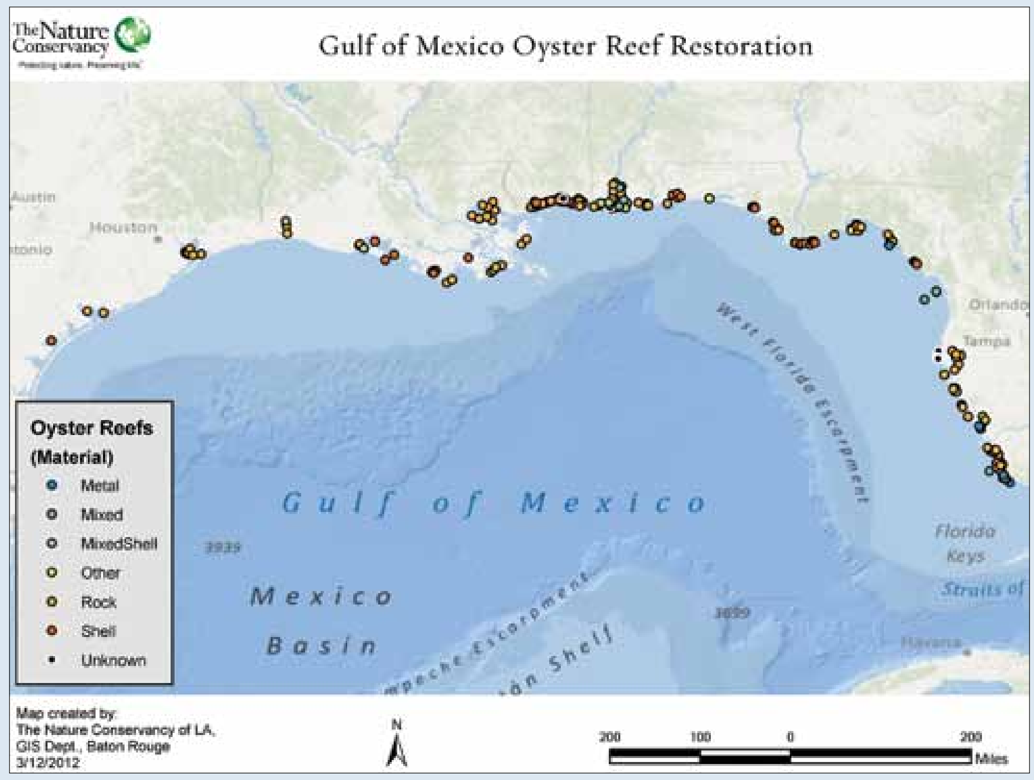
created reefs that did recruit oysters and maintain structure, fish and invertebrate use was similar to that of the nearby natural reefs.

Ultimately, placement of a reef and its design elements, including materials, relief and size (area), will affect a reef's ability to restore ecosystem services to areas that are experiencing declining oyster populations. Ideally, rock-based reefs should be located in areas that provide optimal conditions for oyster growth, with full consideration of water depth, local water velocities, sedimentation potential, shore proximity and nearby pollution sources. In particular, more research is needed on the relative effects of reef architecture (i.e., size, vertical relief) on the sustainability of ecosystems services through time.

This research was completed with Drs. Megan LaPeyre (Renewable Natural Resources) and Ken Brown (LSU-Biological Sciences) and funded by The Nature Conservancy of Louisiana and the Louisiana Department of Wildlife and Fisheries through the U.S. Geological Survey's Louisiana Fish and Wildlife Cooperative Research Unit.



FOREST PRODUCTS

New wood/plastic blends fix problems for the oil and gas industries

Qinglin Wu, Professor

Drilling fluids, often referred to as drilling muds in the oil industry, are used in well drilling operations. The drilling fluid, which may be a water-, oil- or synthetic-based formulation, circulates within the well bore, carries cuttings to the surface, lubricates the drilling equipment and acts as a cooling agent.

Circulation within the well bore can be lost if drilling fluids enter porous or fractured substrate rather than returning to the surface for recycling and reuse. Many drilling hazards such as hole collapse and even blowout have been the result of lost circulation. Lost circulation costs the industry about $1 billion per year in the United States alone. Therefore, various materials that help to maintain circulation have been developed to address the problem. These are known as lost circulation materials.

TigerBullets®, a recently patented composite lost circulation material by the LSU AgCenter, is made of a thermoplastic polymer, wood fibers and other additives for reducing lost circulation in drilling wells. The materials are economical and seal fissures and cracks more rapidly, more efficiently and at higher temperatures than is typical of most commercially available lost circulation materials. They can be mixed with water, aqueous mixtures, aqueous slurries or aqueous muds shortly before being pumped into a well bore as part of the drilling fluid.

In fractured formations, the particles settle down, absorb water and swell in size while maintaining rigidity. The swelling property (especially from the cellulose fibers) helps lock the particles into the fractured substrate and seals the fractures against drilling fluid leakage. Using the composite material means the size distribution of the particles can be more easily controlled than mixtures of the individual components allow.

TigerBullets® currently is being manufactured by Wallace Molding and Millwork Inc. in Columbia, La., a traditional wood products company. The material is marketed by MI-Swaco Inc., of Houston, Texas (a Schlumberger company), and HolePluggers LLC in New Iberia, La.

So far, nearly 3 million pounds of material have been manufactured and sold. The material has been used by major oil companies including BP, Exxon, Chevron, XTO, Pioneer and OXY in more than 300 oil wells across the United States. International markets currently are being developed.

TigerBullets® uses recycled, green materials that biodegrade and, most importantly, are based on renewable natural resources that provide a significant value-added option for wood fiber resources in Louisiana.

This project is being sponsored by the Louisiana Board of Regents Industrial Ties Research Subprogram.

Continuous flow reactor advances treated wood industry

Todd Shupe, Professor

Dr. Todd Shupe recently visited the Chinese Academy of Forestry to work with colleagues in the Chinese Research Institute of Wood Industry in the development of a continous flow reactor.

The reactor will further advance Dr. Shupe's chromate copper arsenate treated wood research by allowing for the continous extraction of heavy metals from CCA-treated wood rather than the current batch operation method. Chromate copper arsenate-treated wood currently is disposed in landfills and presents an increasing economic and liability problem for the industry and a pressing environmental issue for society. Shupe has received two U.S. patents showing how heavy metals can be recovered from this material.

The new reactor will allow for the economic and technical feasibility of the recovery process to be better studied on a much larger scale that is more representative of an industrial setting.

The reactor will allow for two outputs – recovered CCA-treated wood and "clean" wood. One of the next key steps is to determine the ability of the recovered chromate copper arsenate to be recycled as a wood preservative. A key question is whether the recycled CCA retains its preservative properties. The clean wood can be used for numerous traditional wood products as well as emerging bioenergy and biochemicals.

Large volumes of treated wood are disposed for various reasons each year. Shupe's research takes this material, reduces it to a chip and seperates it into two main outputs – heavy metals and clean wood.

Used in the chemical and petrochemical markets for decades, continuous flow chemistry production methodology recently has been gaining interest in pharmaceutical research and development. The desire to develop new and improved chemical processes that optimize the use of resources has facilitated a large amount of work in the development of continuous flow reactor technologies. The use of modern continuous flow reactor technologies can deliver a number of distinct advantages over traditional batch processes. The continuous flow reactors allow for rapid analysis, optimization and scale-up of a chemical reaction. This ultimately leads to reduced cycle time, increased quality and increased yield.

School of Renewable Natural Resources
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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 website (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.

We are moving forward. How far we go depends on you!

D. Allen Rutherford,
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Yu-Hsin Hsueh on the Treasure Island site, Jean Lafitte National Historical Park and Preserve, June 25, 2011. Photo by Sanjeev Joshi.

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Forestry

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