Barataria-Terrebonne National Estuary Program

Management Conference Meeting #69 Minutes

Plantation Suite – NSU Student Union

9:30 a.m. – Thursday, November 6, 2014

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| **BTNEP Staff** | | | | | | | | | |
| X  X  X | Andrew Barron  Matt Benoit  Dean Blanchard  Joe Dantin | X  X  X  X | Richard DeMay  Delaina LeBlanc  Michael Massimi  Kristy Monier | | | | X  X  X | | Alma Robichaux  Jenny Schexnayder  Natalie Waters |
| **Management Conference Member** | | | | **Member** | | **Alternate** | | | |
| American Sugarcane League | | | |  | Flattery McCollum | X | | Herman Waguespack  John Constant | |
| Bayou Lafourche Freshwater District | | | |  | Hugh Caffery |  | | Benjamin Malbrough | |
| Coalition to Restore Coastal Louisiana | | | |  | Carey L. Perry |  | | Hilary Collis | |
| Coastal Conservation Association of LA | | | |  | John Walther |  | |  | |
| Coastal Protection Restoration Authority | | | |  | Jerome Zeringue | X  X | | Kyle Graham  Robert Routon  Karim Belhadjali  Darin Lee  Kenneth Bahlinger  Bren Haase  Carol Parsons Richard  Joseph “Wes’ LeBlanc | |
| Commercial Fisheries | | | | X | John Tesvich |  | | Peter Vujnovicch  Clint Guidry | |
| Greater Lafourche Parish Port Commission | | | |  | Chett Chaisson | X | | Davie Breaux  Joni Tuck | |
| Iberville Parish | | | |  | John Clark |  | |  | |
| Jefferson Parish | | | |  | Marnie Winter |  | | Jason Smith  Lily Zhou | |
| LA Association of Conservation District | | | |  | Brad Spicer |  | |  | |
| LA Association of Levee Boards | | | | X | Dwayne Bourgeois |  | |  | |
| LA Department of Ag & Forestry | | | | X | Joey Breaux |  | | Carrie Castille | |
| LA Dept. of Culture, Recreation and Tourism | | | |  | Debra Credeur |  | | Karen Leathem  Linda Smith | |
| LA Dept. of Economic Development | | | |  | Paul Sawyer |  | | Anne Perry | |
| LA Department of Education | | | |  | Ann Wilson |  | |  | |
| LA Department of Environmental Quality | | | |  | Christy Rogers |  | | Gregory Waldron | |
| LA Department of Health and Hospitals | | | |  | Chasity Cheramie |  | | Kathy LeBlanc | |
| LA Department of Natural Resources | | | | X | Charles Reulet | X | | Don Haydel  Sarah Krupa  Robert Williamson | |
| LA Department of Wildlife and Fisheries | | | | X | Marty Bourgeois | X | | Brady Carter | |
| LA Forestry Association | | | |  |  |  | |  | |
| LA Independent Oil & Gas Association | | | |  | Randy Robichaux |  | |  | |
| LA Landowners Association | | | | X | Tim Allen |  | |  | |
| LA Mid Continent Oil & Gas Association | | | |  | Mike Lyons |  | | Ed Landgraf | |
| LA Oil Spill Coordinators Office | | | |  | Brian Wynne | X | | David Gisclair  Karolien Debusschere | |
| LA Science Teachers Association | | | |  | Shannon Lafont | X | | Tera LaPrarie  Nathan Cotton  Jean May-Brett | |
| LA Wildlife Federation | | | |  | B.J. Barney Callahan |  | | Rebecca Triche | |
| Lafourche Parish | | | |  | Archie Chaisson, III | X | | Charlotte Randolph  Amanda Voisin | |
| LSU Ag Center & LA Sea Grant | | | |  | Rex Caffey |  | | Alan Matherne  Julie Falgout | |
| LUMCON | | | | X | Nancy Rabalais |  | | John Conover  Murt Conover | |
| National Marine Fisheries Service (NMFS) | | | |  | Rick Hartman | X | | Rachel Sweeney  Lisa Abernathy | |
| Nicholls State University | | | |  | Gary LaFleur | X | | Quenton Fontenot  Zack Darnell | |
| Plaquemines Parish | | | |  | P.J. Hahn |  | | Albertine Kimble  Krista Clark | |
| Point Coupee Parish | | | |  | J.A. Rummler |  | |  | |
| Sassafras LA | | | |  | Alex Naquin |  | |  | |
| South Central Planning and Development Commission | | | |  | Kevin Belanger  Jo-Anna Jones | X  X | | Martha Cazaubon  Cullen Curole  Simmone Caesar  Anna Choudhuri | |
| South Louisiana Economic Council | | | |  | Vic Lafont | X | | Simone Maloz  John Lombardi | |
| St. Charles Parish | | | |  | Earl Matherne |  | | Kim Marousek | |
| Terrebonne Parish Consolidated Government | | | | X | Al Levron | X | | Nic Matherne  James Miller | |
| The Nature Conservancy | | | | X | Jean Landry |  | | Nicole Love  Karen Gautreaux | |
| U.S. National Park Service | | | | X | Angela Rathle |  | | Allyn Rodriguez | |
| US Coast Guard | | | |  | Charles Reed |  | | Brian Black | |
| US Corps of Engineers | | | | X | Susan Hennington |  | | Barbara Kleiss  Mark Wingate  Cheri Price | |
| US Environmental Protection Agency | | | |  | Doug Jacobson |  | |  | |
| US Fish & Wildlife Service | | | |  | Ronnie Paille |  | | Bill Vermillion | |
| USDA/NRCS | | | |  | Quin Kinler | X | | John Boatman  Ryan Johnson  Alton James  Andrea Moore Harris  Russell Richard  Scott Edwards | |
| USGS | | | |  | Scott Wilson |  | | Phil Turnipseed  Kate Spear  Susan Testroet-Bergeron  Melissa Collin  Cole Ruckstuhl | |
| Guest Organization | | | |  | Guest |  | |  | |
| Barataria-Terrebonne Estuary Foundation | | | | X | Earl Melancon | X | | Michele Beary | |
| Daily Comet | | | | X | Lex Wilson |  | |  | |
| Royal Engineering | | | | X | Shelley Sparks |  | |  | |
| SWCA | | | | X | Jason Shackelford |  | |  | |
| UNO – CHART (Center for Hazards Assessment, Response & Technology) | | | |  | Kristina Peterson | X  X  X | | Melanie Sand  Katherine Norwood  Bennett Alldredge | |
|  | | | | X | Kerry St. Pé |  | |  | |
| Guest Speakers | | | | X | Martin O’Connel |  | |  | |
| Guest Speakers | | | | X | Chris McLindon |  | |  | |

**1.** Management Conference members and guests were asked to introduce themselves by stating their name and affiliation. Those who had not checked in with Jenny at the door were asked to do so.

**READING AND APPROVAL OF THE PREVIOUS DATE MEETING**

A motion was made by Jean May-Brett and second by Jean May-Brett to dispense with the reading of the August 7, 2014 minutes and to accept them as submitted. Motion carried.

**2. PROGRAM ACTIVITIES**

1. Personnel Changes – As chairman of the search committee, Al Levron informed the conference that progress was being made in the selection of the program director. He expected that an announcement would be made in the next few weeks.

Alan Matherne made a motion to deviate from the agenda and introduced Emily Maung-Douglass, Oil Spill Specialist with Louisiana Sea Grant. Emily stated that she is a member of a five person oil spill team working with the State of Louisiana and across the Gulf Coast Region. The goal is to understand oil spill needs and oil spill science questions, and how to better reach people with that information. She provided attendees with a flyer that included contact information.

1. Presentations/Exhibits/Field Trips/Volunteer Events

BTNEP staff highlighted a few program activities since the last meeting. Alma began by talking about the Bayou Lafourche Cleanup. The program/foundation was awarded $8,100.00 from Keep Louisiana Beautiful for the 2015 cleanup on March 14th. The program is seeking partners to assist with boats and volunteers. Once again, the program will be working closely with Bayou Lafourche Freshwater District. She was also happy to report that NSU also received a grant from Keep Louisiana Beautiful to start a recycling program on campus with BTNEP’s help.

Kristy Monier talked about the Estuary Artworks Event on September 27th from 1:00 p.m. to 5:00 p.m. in conjunction with National Estuaries Day. The program partnered with Purple Penguin Art Company to host an art competition. There were 46 kids ranging from 19 months to 18 years of age that were encouraged to draw their favorite estuary scene. There were four category winners and a grand prize winner. Participants were treated to pizza and drinks from Rotolo’s Pizzeria.

Andrew Barron talked about the program’s recent activity with RESTORE Act proposals. Andrew explained that one proposal was being channeled through NRCS. Jennifer Roberts has been coordinating the multi-agency efforts for the proposal with a meeting scheduled later in the day. They are in the final phases of that effort. BTNEP is also working in partnership with other NEPs across the gulf coast to submit a proposal through EPA in an attempt to receive funding through the next eight to ten years.

Andrew also talked about the status of the 2015 Tidal Graph Calendar. Final edits are being made and the calendar should be available by mid-December. The theme this year is BTNEP Projects to help to educate the public about BTNEP. Dean announced that the 2015 Bird Calendar had already gone to print. Richard confirmed that statement and announced that they had partnered with the Atchafalaya National Heritage Area. The bird calendar was designed to educate birders across the nation about our coastal problems and to connect the birds that utilize the natural habitat, and to promote tourism here in the state of Louisiana. Twenty-five thousand will be printed with approximately half going out-of-state. This year’s theme is ducks.

Michele Beary of the Barataria-Terrebonne Estuary Foundation talked about the 4th Annual Spahr’s Gulf Tournament.

1. Media Interviews

All media events were listed in the agenda.

1. Meetings

All program meetings were listed in the agenda.

1. Projects Status

All projects initiated and completed were listed on the agenda.

**3. SCHEDULE OF NEXT MEETING DATE**

Reminders – February 5, 2015 – Plantation Suite @ NSU Student Union

− May 7, 2015 – Plantation Suite @ NSU Student Union

− August 6, 2015 – Plantation Suite @ NSU Student Union

− November 5, 2015 – Plantation Suite @ NSU Student Union

**4. DISCUSSION ITEMS**

1. “Rio Grande Cichlid Project Update” – Martin O’Connell of UNO Nekton Research Lab

Martin O’Connell gave a presentation on Rio Grande cichlids research. His presentation covered response to different temperatures, potential overlap in diet as some native fishes, and response to different salinity levels. Martin credited 90% of the research to O. Thomas Lorenz. Tom received a tenure track position in Georgia before the project completed so Martin was presenting.

Martin went over the historical work done over the last decade, talked about the three sub-projects funded by BTNEP, and gave some of the implications of the findings about this invasive species. Previously, they knew that cichlids have been around since the 90s but were probably released around the mid-80s. The initial plan was to see the extent of their dispersion but that was changed due to Katrina. Cichlids continued to spread after Hurricane Katrina. He talked about the range and expansion starting around 1996 and believed that they started in Metairie and in canals in New Orleans. They are now expanding into Barataria. They also looked at aggression in these animals that was clearly evident in field and lab observations. Although these are freshwater fish, he has observed them in the estuary at salinity levels of 5 and 7ppt acting aggressively towards blue crabs and mullet. In these experiments, cichlids showed an interesting level of aggression. If a native fish like a blue gill is on nest or in a hole, they will defend that hole and cichlids do the same thing. However, if you introduce another bluegill or a cichlid and there is a blue gill in the hole, the bluegill will not attack, but the cichlid will attack. So, in both situations, the cichlid is aggressive where the bluegill is not. The bluegill is only aggressive when defending its hole.

Martin explained what was done for the BTNEP sub-projects. They looked at the response of cichlids to low temperatures and possible use of thermal refugia, diet and possible overlap with native fishes, and cichlid growth and behavior under different salinities. They now know that these animals move through estuarine corridors to expand their range. Consistent populations have been found in urban canals where there are disturbed habitats, lower native fishes, and concrete structures in Orleans and Jefferson Parishes. Occasionally there are spotty occurrences in more natural wetlands surrounding the Greater New Orleans Metro Area (GNOMA) but not like what was seen in urban canals. It is believed that these animals are using culverts as thermal refugia. In Texas, they have been known to shoal up and find natural thermal refugia in deeper water to survive cold weather. The artificial structures may be contributing to the success of this invasive species in urban habitats.

Martin shared results of the annual Rio Removal Rodeo held in New Orleans City Park. They worked with LDWF to team up with a bass rodeo where people are given free range to take as many cichlids as possible. Data collection results showed cichlid numbers for years 2008-1,500, 2009-3,000, 2010-0, and 2011-42. The decline in 2010 and 2011 were after two cold winters indicating that they respond to the cold. From this, they constructed an imitation culvert, used an outdoor passive integrated transponder (PIT) tag arena, where they could track movement as temperatures changed. There were 11 cichlids and 11 bluegill that were monitored from November 2012 through January 2013 and measured responses as temperatures fluctuated. Temperatures were taken in the arena itself, air temperatures outside the arena, as well as temperatures at City Park to get a natural control to see if the temperatures in the arena were similar to what was seen in City Park. He displayed a line graph showing their findings. While both species used the culvert as a thermal refuge, all of the fishes survived through a 48 hour period of below 10 degrees Celsius. Some cichlids survived to seven degrees Celsius and were more active than bluegill above 13 degrees Celsius. The implications indicate that if cichlids are able to tolerate temperatures as low as seven degrees Celsius then typical winter temperatures will not diminish their expansion; especially in light of increasing global temperatures and the confirmation of culvert use may help in possible future eradication or at least culling efforts. Bluegill were also in culverts but remain somewhat active even at seven degrees Celsius. This information may be used to help differentiate and pinpoint cichlids during eradication.

Based on the New Orleans cichlids study, it was assumed that diet was mostly vegetation as algae seemed to be their main source of food. This assumption changed while studying tilapia in Port Sulphur. Cichlid found there showed a diet of crawfish, insects and other fishes. The cichlid diet changed based on habitat and what the associated species were. He stated that tilapia eat everything and have larger cichlids vacuuming up whatever is left. They sampled cichlids from concrete and earthen-based canals. They deployed Hester-Dendy samplers to assess available prey and fish guts were dissected and organisms were identified to the lowest possible classification. They gathered from the study that with better habitat, cichlids will eat more diverse stuff like bivalves, gastropods, snails, and crustaceans. They also looked at which species were most impacted by Rio Grande cichlids in Bayou St. John and found that it was the smaller fish species that were the most impacted. Those findings had not yet been published. When they compared the guts of the bluegill versus the cichlids, they noted a lot of overlap in the diet. They were eating crustaceans, gastropods, insect, and bivalves so if you put these animals together, there could be a situation of concern. Crustaceans including crawfish, were the most abundant prey item for both species. If the resources are limited, there is a possibility of competition between these two species. Cichlids are adapting to new habitats and new prey items.

Early dispersion models run in 2002-2003 suggested that cichlids were using estuarine corridors. They had a starting point in Metairie and Kenner and were occurring in freshwater habitats in New Orleans East and Orleans Parish with models indicating that they were getting there through Lake Pontchartrain with salinity levels up to 5-7 ppt. They later confirmed this by putting traps out in the lake with hopes of containing cichlids diminishing. With this confirmed, they needed to see how they responded in the lab to different salinities. They measured and assessed behavior (aggression) at three different salinities. They looked at fresh water, brackish (15ppt), and full marine salinity (35ppt). The animals were exposed to progressively increasing salinities (2.5ppt increase every 2-3 days) until they reached the target salinity. Growth was measured after one month, six months, and one year. Results showed that they did the best in one year in the freshwater and seemed to be growing lesser in the brackish water but survived for a year. In fact, there was still some growth in full sea water but none survived acclimation to full seawater past one month. One positive note was that if they are surrounded by high salinities, then they will not survive very long. In the estuary 15ppt is far south in the system. Lake Pontchartrain is around 5-7 ppt so these animals are going to able to move and survive for a year in fairly salty water.

The assessment of aggressiveness was measured by the number of bites at a mirrored image. He noted at that time that aggression is the key to cichlid success as an invader. Results showed a significant difference and were significantly more aggressive when held in brackish water. The implications are that seawater kills cichlids eventually but they seem to be able to survive in brackish water, they become more aggressive in brackish water, are a threat to natives, and estuary salinities will not prevent their spread. He stated that river diversions will be an issue. This would not only be an issue with Rio Grande cichlids but also with other invasive species. We will see more Asian carp in the estuary. We are likely to see many animals coming from up north ending up in places that we do not want them.

In Summary, he stated that Rio Grande cichlids are adept at surviving winters in Louisiana, consume multiple prey items that are also consumed by native fishes such as bluegill, and can tolerate the salinity levels of most estuarine habitats in Louisiana. While results are not encouraging regarding future expansion of the aggressive invader, finding how they use thermal refugia may be the basis for management attempts. If potential refugia can be targeted for culling or eradication efforts when water temps are between seven degrees Celsius and 10 degrees Celsius, it may be possible to keep local densities at a minimum. He stated that we may never be rid of them but there are simple ways to keep the numbers down in our estuary.

Al Levron called for questions. Marty Bourgeois asked if any information was available on them as a prey item. Martin responded that alligator gar eat them. Earl Melancon asked if they spawn in brackish water and Martin replied that they were spawning in low salinity water. Al Levron asked if there was opportunity to be a commercial species. Martin said that that had been brought up in the past. They don’t taste bad but didn’t want to encourage a commercial market where people would start spreading them around. He would rather see them used as a fertilizer fish and encouraged the rodeo where there is a significant impact because of the closed environment in Bayou St. John and to tell fisherman that they are interfering with bass and bluegill. Michael Massimi asked his opinion on how they got to the West Bank and if Katrina was responsible for their spread, or a coincidence. Martin explained that there were small amounts on the West Bank just before Katrina. He felt that it was back-yard management and humans for some reason like to move fishes around. Andrew Barron questioned the current regulations for collecting. Martin responded that you cannot move them around alive and Marty Bourgeois confirmed no limit or season on dead. Marty asked about population structure. They have seen some up to five to seven years old. Michael Massimi said that they now have one report of cichlids in a canal draining to Lake Verret.

1. “Implications of Controlling the Mississippi River for Restoring the Louisiana Coastal Wetlands” – Chris McLindon

Chris McLindon began his presentation by noting a change in the title of his presentation to “Geology of the Coastal Wetlands of South Louisiana. This presentation had originally been done for Louisiana Sea Grant back in July with the title of “Implications of Controlling the Mississippi River for Restoring the Louisiana Coastal Wetlands” but after giving the presentation numerous times, it had evolved into what the conference was seeing. It was previously geared more toward what humans did wrong in managing the Mississippi. Most of what is discussed about the wetlands of south Louisiana is what is at the surface. Most of his interest lay in what was below the surface. The layers below the surface record a history of what has happened in the past. By comparison, it can also tell us a lot about what is going on today. For example, New Orleans is underlain by a barrier island. The surface of the barrier island runs below the city and Lake Pontchartrain. When the Causeway was built, each individual piling was designed and built to rest on that remnant barrier island surface. More about that would be covered later.

Understanding the wetlands means understanding the Mississippi River and how it deposits sediment. The Mississippi River system has been continuously depositing sediment for about 50 million years, which records the natural history from which we can gain a lot of information. It is a naturally evolving ecosystem. Patterns of change in the past offer insight to changes being experienced today and changes that are likely to happen in the future. Most changes are due to interplay between sediment supply, subsidence and sea level change. He stated that if there was going to be a theme to his talk, it would be the interplay between those three factors. While there are measurable anthropogenic, human caused effects; a significant majority of changes taking place today are natural. An increase in sediment supply results in an increase in land building while subsidence has the opposite effect. Sea level change results in a pendulum effect and swings back and forth. We have seen this over the last few million years. Sea level rise tends to force the effect of subsidence while seal level falling tends to increase sediment supply. These are the dynamics of what is going on in land building of wetlands in south Louisiana.

To put that into context, Chris showed an image reflecting global sediment thickness. The Gulf of Mexico is the largest sedimentary basin in the world - approximately 13 miles thick. He talked about the geological history of the Gulf of Mexico Basin. The Mississippi River has been contributing sediment into the Gulf of Mexico basin for about 50 million years. He showed the geological epochs with sea level change that had varied through time while noting that that interplay was critical for understanding processes in the northern Gulf of Mexico. The original thickness of deposits of the Eocene 45 million years ago were over in Texas and Southwest Louisiana continued through the Oligocene and the Miocene up to 10 to 20 million years ago became what is coastal Louisiana today. What is going on below the surface today is what happened during the Miocene. This is one of the most well-studied basins in the world. He showed maps of the delta systems from the Miocene epoch 10 to 15 million years ago. He explained that the pattern today is similar to what happened during the Miocene epoch. The reason the modern deposits are so well understood is that the sand bodies, the tributary mouth bars, crevasse splays, over bank levee deposits from these deltas are sand layers which ended up becoming reservoirs for the oil and gas fields that are below the surface today. He noted a cross section, the accumulation of sediment as the river continuously delivered sediment, it delivered enough to pile up a mile of sediment at any given time but the elevation of the surface never changed more than a few feet because the accommodation capacity of the basin allowed for that accumulation by subsidence. Subsidence is probably the single most important aspect of the Gulf of Mexico Basin. He displayed a series of slides to show how the basin developed starting at 150 million years ago when the basin was just opening up, to 65 million years, then 20 million years. The maps showed the movement of the continents and the development of the sedimentary basin which is called the Gulf of Mexico Basin. He noted that coming off the Mid-Atlantic ridge there were a series of transform faults along which that movement occurred, the sediment shed from the North American continent through that entire period built out layers of sediment and accumulated into the basin that we know today. This feature is known as the Terrebonne trough and is the most significant geological feature of the Gulf of Mexico Basin and directly underlies the coast of Louisiana. Under our feet is the most significant geological feature in the largest sedimentary basin in the world and its mechanism is primarily subsidence. He stressed that when we hear the figure quoted that we are experiencing the highest subsidence rates in the world today, the answer is: Where else would you expect it? He showed a three dimensional model from Brian Stephens extrapolating the transform faults coming off the mid-Atlantic ridge under South Louisiana. It depicted the deep crustal blocks that were seen on the cross section and showed the outline of the Terrebonne Trough. He showed layers of granite 15 miles below the surface. He explained that the basin is subsiding in to the center of the trough. For any point below the surface of the earth today, you could follow its history backwards in time until you got to the point where it was deposited originally 80 million years ago. So for any point that you would follow in time, you can track its subsidence velocity through time until it ends up where it is today. Another way to say this is, that a point in Northern Lafourche Parish has been continuously subsiding for 100 million years. Next he covered what the Gulf of Mexico Basin is made of. The Miocene Deltas 10 to 15 million years ago were deposited at the surface, they were deposits of the Mississippi River and have followed a course through time today at a depth of about 8,000 feet and those sand layers from the Mississippi River deposit make up the reservoirs which contain oil and gas in that area.

He went on to talk about the mechanisms of subsidence. The three main causes of subsidence for south Louisiana being crustal downwarp, lateral salt movement, and lystric faulting. He explained that as the Gulf of Mexico basin opened, he likened the crustal downwarp to taking taffy and stretching under its own weight, it would just sink. And that original downwarp from the extension of the continental crust creates the focus of the basin and the Terrebonne Trough is immediately under that. Within the context of the basin there are the original salt deposits from when it was a closed basin. Sediment was deposited on top and caused it to contort as salt is less dense than the sediment on top of it, causing it to move upward as dome. The important thing to see is the thickening sedimentary layers into the center of the basin that is created by the movement of the fault. The thickening is indicative of subsidence. If it is getting thicker in one area, it means that the bottom is dropping out. Also located in the basin are faults which are offsets of the earth and have three characteristics. One being they are lystric meaning they follow a curved path into a horizontal so they are able to translate vertical movement into horizontal movement. They cause subsidence on their down slope side with a down drop block and sedimentary layers are thicker than they are on the up slope block due to the subsidence of the movement of the fault. In many cases, they cut to the surface as a surface expression of faults.

His next slides covered sea levels and ice ages and he referenced the work of James Hanson, advocate for the concept of climate change. He graphed carbon dioxide, sea level change and methane measured from bubbles trapped in ice layers from the past. Each ice layer represented one year counting back to 400,000 years ago and trapped in bubbles within those ice layers is the original atmosphere from that time. Sea Level is measured from many different phenomena of how it is expressed on the surface. To get a really good fit between the variations of these three factors indicating a cycle of nature. He depicted this as a pendulum on his slides to provide context. Every time there is an ice age, sea level drops. When the ice melts, sea level comes back up. Twenty thousand years ago was the peak of the last ice age. There was about a mile of ice across Canada and the northern U.S. that extended all the way down through Iowa. There was enough icebound on the continent to lower sea level about 400 feet. The onset of melting took place and the rates of seal level rise were dramatic, at a foot or more per day. He moved on to about six thousand years ago when sea level was stable or leveled off. We hear the number six thousand years ago relative to the coast a lot. This is the period when the wetlands and estuaries were formed and this has everything to do with the stability of the sea level. During this period, sea level was rising so fast that the delta deposited sediment was churned up and washed over. There was no retention of delta. The sediment supply of the river never stopped. During the time that this ice was melting, there was probably a massive amount of sediment being washed down into the Gulf of Mexico but the river was unable to sustain a delta. This is also the period that coincides with recorded human history. In order for civilizations as we know them today to really develop, there had to be both coastal communities and river basin communities and they were just not able to sustain a community long enough to develop a civilization until this period. During the last one hundred years, there is a measurable break in sea level rise. Data from Pensacola was an indicator of this and it showed no subsidence. Twenty thousand years ago, sea level was 400 feet lower in South Louisiana than today and the shoreline was out to what is now the continental shelf edge. He referenced the Pleistocene surface in a block diagram that is the surface across south Louisiana; it is fairly well preserved because of its significant differences in lithology. He explained that this whole area of cultural Louisiana looked like Southern Mississippi with hills more than 200 feet in elevation. There was an incised channel of the Mississippi River that carried massive amounts of sediment and probably built the majority of the Mississippi Fan which is out there today. As sea levels rose, it was rising so fast that the sediment was washed over and turned into reworked sediment that you cannot identify the delta. There certainly were deltas of some kind that were there but they were not preserved. The point at about six thousand years ago, where sea levels stabilized, gave us a static system in which the entire canyon system or basin filled system filled in with sediment, resulting in nice flat deltaic deposits across them. The development of the Holocene Delta during this period of flat sea level rise is what allowed us to build up coastal wetlands we know today.

Chris’ next slide covered the interplay between sediment supply and subsidence and how they control the development of wetlands. This has been pretty well studied. The Corps of Engineers as well as many other parties have taken hundreds of cores deep enough to penetrate the entire Holocene across the coastal plain. He referenced David Frazier’s work from 1967 where he used hundreds of cores taken across the coastal plain to interpret data from sixteen deltas that went into the construction of the wetlands. He assigned an age and geographic location for each of the deltas. The graph showed that each component delta had a distinct life span with a creation, abandonment and eventual subsidence below the surface. That is the natural expectation of a system as they each have a life span that comes to an end. We can take a snapshot of points in time every thousand years and will be able to see what the coast may have looked like at these points in time through the past. He joked that for folks from Metairie Ridge or Gentilly that always wanted to live on a barrier island, they do. This can be tracked through time and tied to points in human history.

In 1932, a critical point in time, a period from which all land area change is measured with the first aerial images. The general conception is that in six thousand years, the delta system built out the wetlands in a steady state growth period then in 80 years destroyed. He explained that Frazier compiled a lot of data from cores and was able to map deltas both on the surface and in the subsurface. As an example, he showed a sequence of slides of the barrier islands from New Orleans East to Grand Isle showing what was not immediately obvious - that the historical deltas of the coast tend to overlap each other over time. Frazier also used the cores and borings to construct cross sections that show the third dimension of the Holocene delta sequence. This reveals the critical element of subsidence that drives the delta cycle and allows for the continual construction of the coastal wetlands. Subsidence has been unrelenting, and the open bodies of water that are being formed in the marshes of one delta are due to the same mechanism of subsidence that pulled others below the surface. He pointed out a spot on the map where a cypress stump was located 33 feet below the surface that was carbon dated to be 2,100 hundred years old. With that, it can be determined that subsidence rate is 33 feet in 2,100 years is 9 mm a year. In fact, the evolution of deltas through time is absolutely dependent on subsidence and is an integral part of how deltas evolve and how wetlands were built. Harry Roberts, James Coleman and Shea Penland collaborated to develop this concept of the delta cycle. The active delta is the channel which is being fed by the Mississippi River is where the most land growth is taking place; a river changes course and you go through this succession of post abandonment evolution. The ship shoal chain mouth bars that are lying out in the front of the delta developed into barrier islands and headland beaches, the marshes of the original barrier island behind these barrier islands begin to subside below the surface and you are left with only the natural levee deposits along the original river channel. These evolve into open water and as that progresses, the entire original delta subsides below the surface ending with an open bay with a barrier island out in front of it. Eventually the barrier island subsides and you end up with a submerged shoal which is the original tributary for the mouth bar of the deposits of the river in open water.

He ran through the cycle again, with focus on building and where it is in the delta cycle. He showed the progression through time using the same sequence of time increments previously examined, but this time paying attention to progression of the delta cycle, and where new marsh was being created, and where abandoned deltas were subsiding below the surface. He had numbers in the lower right corner of each slide to show an estimate for the number of square miles of new land created and number of square miles of land loss during each time interval. There was a total submergence of close to 30,000 square miles of wetlands over the past six thousand years. There is usually a rapid building phase followed with a slow decline.

Methods for measuring subsidence from GPS, tidal gauge data and historical data were reviewed. GPS can be used to measure horizontal and vertical movement but is limited to dry land. The other principle way to measure subsidence is to use historical data by measuring high and low tide daily for a period of decades. He pointed out that the data has a definite slope due to global sea level rise. Due to subsidence, sea level rise is happening at a higher rate at Grand Isle when compared to Pensacola which is the bench mark and is not subject to subsidence. Shea Penland used tidal gauges across the coast to look at the subsidence rates in millimeters per year since 1932.

He went back to mechanisms and the likely epicenters of subsidence. There is a pretty well established system of faults. He referenced John Lopez’s Ph.D. dissertation work and showed an image of the fault running across the Highway 11 Bridge in Lake Pontchartrain where there is a visual offset. If you follow that fault, offsetting sedimentary layers below the surface at a depth of about 50 to 60 feet, the vertical offset is almost 20 feet. Down to 80, it is almost 30 feet of vertical movement along this fault. This phenomenon of the down slope side being thicker than the up slope side meaning it is an actively subsiding a block. This fault is actively down moving on one side causing subsidence. Ft. Proctor, built in 1865, was used as a visual representation as historical records indicate that it was built 150 feet inshore from Lake Borne and probably four to five feet above sea level. It has now been measured at four feet below. It has subsided eight feet in 150 years and is consistent with measurements of subsidence today. In regards to finding mechanisms for tidal gauge subsidence values, he talked about Harry Robert’s work where he used oil industry seismic data to projects faults to the surface. Faults are offsetting sub surface layers. He showed maps of surface faulting. You get these linear expressions of the fault and then on the down slope side you get the development of these open bodies of water known as deep lakes. They have one sharp linear edge and a rounded body with the down drop block subsiding below the surface. He followed this with a photo of a cypress swamp in Montegut as an example. He went on to explain that faults are a sliding surface. Down drop blocks and rotation of the marsh surface and gravity feeding allows for salt water to move in to low areas. This is the mechanism of salt water intrusion. It is the change in elevation of the marsh surface.

The 2012 USGS Map was used to show interplay between the three factors and land area change. He noted that the pattern is pretty clear that there are definite hotspots of land area change. We know that the sediment supply of the Mississippi has change substantially. In the late 1800s there was an abnormal increase in the sediment supply before the locks and dams. Eugene Turner at LSU went back to the European occupation of North America and made estimates of suspended sediment supply in the river. Early agriculture within the Mississippi River Basins was very inefficient with tremendous amounts of erosion so there was an actual increase in sediment supply in the river as land use increased. The anthropogenic, human, effect was an abnormal increase in sediments being delivered. As construction of locks and dams came into place, it cut that supply off and you get a dramatic rate of land loss which is generally described at this point in time. Part of what we are seeing is a response to an artificial inflation. It just so happens that the baseline from what we measure change was right at this peak which may have been artificial as a little bit more land was created than what would have been normal. In 1973 without the existence of the old river control structure, the river would have changed course and under a natural system would have gone down the Atchafalaya. So the net effect of the levees on the wetlands is probably not as great as it is played up to be. There are clear patterns of subsidence in land area changes and hot spots across the northern part of the estuary. Land area change seems to be expressed predominantly on the down gradient side of the faulting.

Where do we go from here and what are the expectations? What if humans were not here? What if we went back to 1932 and tried to project 500 years forward? What we know now based on the patterns we saw in the past, knowing that the river could have changed course in 1973? This subsidence is natural. It is not a crisis but a natural evolution. He felt that we are hurting ourselves by continuing to say that we are in a state of ecological crisis. We are in a state of natural evolution. What is not happening is the building of the next delta. We should think in terms of land building and not restoration. We should build land in terms of buffering storm surge. He pointed out the fault boundary across south Louisiana stating that it was the center of the Terrebonne Trough and that if we are going to do restoration, it should be done on the northern side of this border to be meaningful restoration.

Chris called for questions. Kerry asked about data regarding the rates of subsidence. He replied that the LSU Center for GeoInformatics has been tasked and is ongoing. They just went through three to four years of equilibrating mechanisms. Discussion followed. Al Levron asked if he was independent. Chris replied that he works for Stone Energy but has been independent. Assuming that he has made this presentation to various groups, how has it been received? Within the industry there is an obvious recognition. The industry has billions of dollars in infrastructure along the coast that is in jeopardy and has sole possession of the data and technology. The New Orleans Geological Society has started an initiative to publish an atlas of faults in south Louisiana with the intent to get some extraction of data from the 3D surveys to get it into the hands of academia. They just want to get the science into the right hands. Al stated that if we were to except everything said as fact, the bottom line is we should concentrate our interest elsewhere as a lot of the initiatives in the Master Plan are folly? He responded that he was trying to refrain from making any editorial comments and trying to be about putting the science out there. If anyone had questions, he encouraged them to contact him at [chris\_mclindon@att.net](mailto:chris_mclindon@att.net) or 504-756-2003. Al thanked him for his presentation.

1. NSU Farm Facilities Improvements – Matt Benoit

Matt Benoit gave a presentation on the farm facilities improvements being completed at the Nicholls State University Farm. He gave a brief background and objective for the improvements needed. Matt goes around coastal Louisiana in the maritime environment collecting seeds and acorns to grow out at the farm. He showed images of the old shade house that has been outgrown. He talked about the MOU with NSU. The current shade house is 3,600 square feet and they added another 1,200 square feet to the existing structure in addition to better drainage. A green house was added, the potting area was reroofed, and a storage facility of 100 X 50 feet with enclosed storage of 25 X 50 feet. This allowed the program to have all of its equipment and printed materials all in one place while cutting the cost of paid storage. Matt took everyone through the process. The green house was made possible by a grant from Mosaic.

**5. NEW BUSINESS**

There was no new business.

**6.** **ADJOURN**

The meeting adjourned at 11:30 a.m.