



New Orleans: After The Storm?

The impact of weather events on native flora and
the built garden environment

By
Kathryn Braithwaite

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Bald Cypress Pneumatophore

Providing protection from wind throw during storm events, *Taxodium distichum* have evolved for the weather they are exposed to. Found in Bluebonnet Swamp, a site massively affected by both Hurricane Katrina, Irene and most recently Gustav.



Introduction

The Kew Diploma offers a student horticulturalist the biggest challenge of their life. As part of this challenge, the students are given the chance to gain a travel scholarship. The scholarship financially supports the students to study their chosen subject out in the field. Our task is to develop a project from the inception to the realisation, with botany in mind and no limit to what is achievable.

My project was designed to study the impact of hurricanes on native flora and the built garden environment. This journey of exploration took me throughout Louisiana, meeting experts and peers, visiting gardens and native habitats. I spent months engaging with colleagues in Louisiana and New Orleans, with their support we designed an expedition that saw me botanising in the swamp regions with Dr. Ken Krauss of the National Wetlands Research Centre, observing *Sarracenia* in their native habitat with a young Master Naturalist and in depth ecological assessments with Dr. Julie Whitbeck at the Jean Laffite National Park (coastal wetlands disturbed by hurricane activities). As well as the field work, I met with Dr. Lowell Urbach at Louisiana State University Herbarium, plus colleagues at New Orleans Botanical Gardens and Longue Vue Gardens who gave me clear insight into the damage caused by weather events.

I was lucky enough to secure funding from the RHS Coke Trust, plus Merlin Trust, Kew Guild and the Hardy Plant Society. This financial contribution allowed me to follow my dream of studying the impact of hurricanes on native flora and the built garden environment.

Observing *Azolla*

A genus of seven species of aquatic ferns in the family Salviniaceae. They are extremely reduced in form and specialized, looking nothing like conventional ferns but more resembling duckweed or some mosses.



Aims and objectives

The main **objectives** of the work were to:-

- engage with the practices and processes at New Orleans Botanic Gardens and begin to learn about their collections, history, current work and future plans.
- visit other local sites of horticultural value (including Longue View Gardens & the Garden District) and begin to understand how events have impacted on the work at these sites.
- work with local experts to understand the effect of climactic events on plants in their native environments and the subsequent restoration work in gardens and natural habitats.
- engage with the scientific community, through Louisiana State University and herbarium and observe their work.
- explore the landscape and flora in Louisiana and embark on various botanising trips, with a focus on coastal reserves and inland swamplands.
- to observe native flora in situ and assemble a comprehensive photographic record.

The overall **aims** of this study tour were to:-

- continue learning about the work of experts and horticulturalists around the world.
- continue learning about plant identification and native flora whilst developing my botanical field work skills.
- communicate with colleagues about cultivation techniques and methods of species diversification in botanical collections.
- improve my knowledge of the ever changing and intensifying impact of weather patterns on natural and built garden environments.
- continue my professional development and to have an learning experience that will allow me to keep progressing with in this industry.
- provide myself with a solid foundation for future projects (systematic, herbarium and dissertation).
- have an outstanding and rewarding experience.
- share the knowledge I have gained, through reports, presentations and discourse with colleagues.

Itinerary		
Date	Location	Time Allowances for Travel and at the Location
Saturday 19 th April 2014	Departure from London Heathrow Airport to New Orleans (via Atlanta). Collect hire car from airport and drive from airport to hotel in New Orleans.	10 hours total flight time including stop over without extra travel from home to airport etc. Allocation a full day.
Sunday 20 th April 2014	Explore the gardens of central New Orleans, including the NOLA Balcony Gardens and the Garden District. This initial activity will allow time to recover from jetlag.	Central thus limited travel Allocation – a full day.
Monday 21 st – Wednesday 23 rd April 2014	New Orleans Botanic Gardens - Time within the gardens to learn about the horticultural practices and processes used at New Orleans Botanic Gardens, this will include practical work with the garden staff and volunteers.	Central thus limited travel Allocation – three days.
Thursday 24 th April 2014	Longue Vue House and Gardens, New Orleans – Visiting Longue Vue Gardens to meet Amy Graham, head gardener, to learn about their recovery from Katrina, explore their native plant collection and meet their staff.	Central thus no limited travel Allocation – a full day.
Friday 25 th –April 2014	Jean Lafitte National Park - Barataria Unit, New Orleans - Julie Whitbeck, Ph.D., will take me on a botanising trip around the reserve.	A 30 minute journey from the centre of New Orleans Allocation – a full day.
Saturday 26 th April 2014	Lake Ponchartrain – Meeting with Dr. Hazel Turlington and John A. Lopez, Ph.D. from the Lake Ponchartrain Foundation. I will work with their PhD students and learn about their aims and observe the wetland flora of the lake.	Meeting with the team did not happen – time used for additional trip to Avery Island
Sunday 27 th April 2014	Journey to Baton Rouge and recuperation time.	One hour travel time Allocation –half a day for travel and half for relaxation.

Monday 28 th April 2014	Bluebonnet Swamp Nature Centre and Reserve - Meeting with Matt Herron, from University of Louisiana Monroe and co-president of the Capital Area Native Plant Society, who will escort me on a field trip to botanise in the swampland.	Short drive from hotel to meet with Matt Allocation – a full day
Tuesday 29 th April 2014	LSU Herbarium - Dr. Lowell Urbatsch at Louisiana State University Herbarium and laboratories who will give me a tour of the herbarium and relevant department of the University.	After departing the site I will travel to Lafayette, Louisiana. Allocation – a full day
Wednesday 30 th April – Friday 2 nd May 2014	USGS-National Wetlands Research Centre, Lafayette – Meeting with Dr. Ken Krauss I will observe his work and will be taken out to botanise in the field.	Travel from Baton Rouge to Lafayette is around one hour. Allocation – two days
Saturday 3 rd May	Return journey to London	



Quercus virginiana

This plant is also known as the southern live oak, is a normally evergreen oak tree native to the southeastern United States. A perfect tree to withstand the onslaught of hurricanes. It can tolerate some shade and drought and is very tolerant of salty conditions (storm surges).

I observed it around the Lake Ponchartrain and Avery Island, dripping with *Tillandsia usnioides* and resurrection fern *Pleopeltis polypodioides* - an iconic image of the south!

The Locations Visited

National Wetlands Research Centre



The centre addresses emerging issues that are of concern to natural resource partners and the scientific community in thematic, geographic, and scientific areas where decision critical information is needed by the nation's environmental and water managers. Hosting around 150 staff, with a mix of scientific and technical skills, ranging from plant, wetland, and animal ecology to mapping, remote sensing, geographic information systems, computer and electronic technologies, information technologies, and water quality analysis.

My first day at the USGS: National wetland Research Centre

New Orleans Botanical Garden

The seeds for the New Orleans Botanical Garden were planted in 1936, when the City Park Rose Garden opened. The New Orleans Botanical Garden was funded by the Works Progress Administration (WPA), created New Orleans' first public classical garden. Today, it is one of the few remaining examples of public garden design from the WPA and showcases the Art Deco influences of three renowned talents of the era: architect Richard Koch, landscape architect William Wiedorn, and sculptor Enrique Alf rez. The public garden was rechristened the New Orleans Botanical Garden in the early 1980s.

Outside New Orleans Botanical Gardens





The long driveway to Longue Vue House

Longue Vue Gardens And House

The home and gardens were born of the dreams of Edgar and Edith Stern, pillars of the New Orleans community. It was the combination of the Sterns working with landscape architect Ellen Biddle Shipman (1866-1950) and architects William (1897-1984) and Geoffrey (1909-1985) Platt that resulted this wonderful oasis of beauty and elegance set in charming New Orleans. By the 1960s, Edith Stern had conceived of the idea of opening Longue Vue to the public; many of the garden developments during this time reflect both this foresight and Edith Stern's generous desire to share her legacy with generations to come.

Longue Vue opened its gardens to the public in 1968 and was in continuous operation until Hurricane Katrina and the subsequent levee failures flooded the property for two weeks.

Abita Creek Flatwoods Preserve

Abita Creek Flatwoods Preserve supports a significant tract of intact pine flatwood wetlands in southeast Louisiana. It supports high quality examples of longleaf pine flatwood savannah, slash pine – pond cypress woodlands and bayhead swamps. Numerous rare plant and animal species have been detected thus far. Nearly 30 rare plants have been identified on the area, including four species that are protected only here in Louisiana: Georgia tickseed (*Coreopsis nudata*), Louisiana quillwort (*Isoetes louisianensis*, federally listed: Endangered), Spring Hill flax (*Linum macrocarpum*), and little-leaf milkwort (*Polygala brevifolia*). Two of these, Spring Hill flax and little-leaf milkwort, are known in Louisiana only from this area.



Visiting the preserve to observe *Sarracenia*

Lake Pontchartrain

The Lake Pontchartrain Basin is a 10,000 square mile watershed encompassing 16 Louisiana parishes. Owing to past exploitation, the ecosystems of the lake are under stress. Marshes, for example, are turning to open water, and cypress swamps are being killed by salt water intrusion from hurricane storm surges.

Lake Pontchartrain Basin Foundation- conservation goals:

- Protect Critical and Sensitive Areas
- Mitigate Floods and Manage Storm water
- Establish a Network of Parks
- Maintain Rural Character
- Protect and Restore Wetlands

Entering Lake Pontchartrain to observe the health of the Cypress



The Garden District

The Garden District is a neighbourhood in the city of New Orleans, noted for the architecture and impressive gardens. Although experiencing wind damage from Hurricane Katrina in 2005, this area on old high ground escaped the extensive flooding of much of the rest of the city. Wind damage from Katrina was the most noticeable effect.

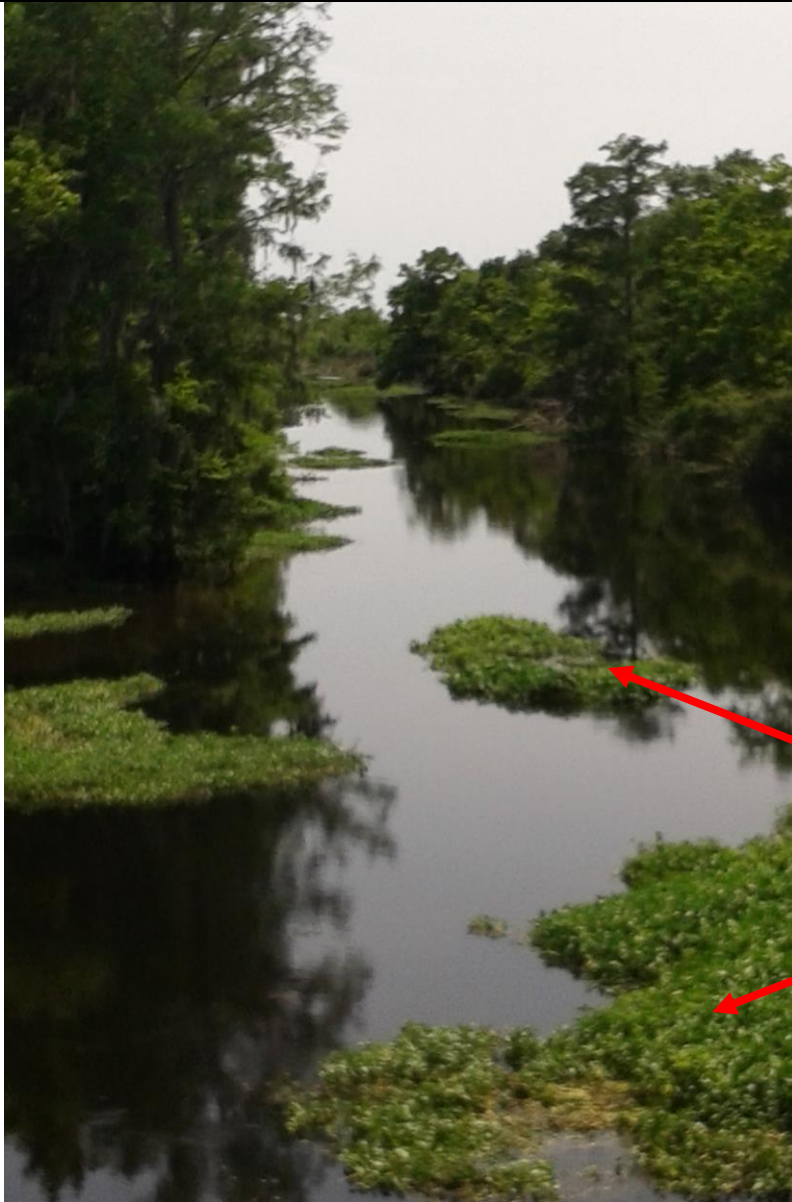
Louisiana State University and Herbarium

Founded in 1869, the Louisiana State University (LSU) Herbarium is the oldest collection of preserved plant specimens in the Gulf South and is the second largest collection of Louisiana plants. Originally composed entirely of specimens of vascular plants, it now also includes fine collections of lichens and fungi.

Jean Lafitte National Historical Park and Preserve

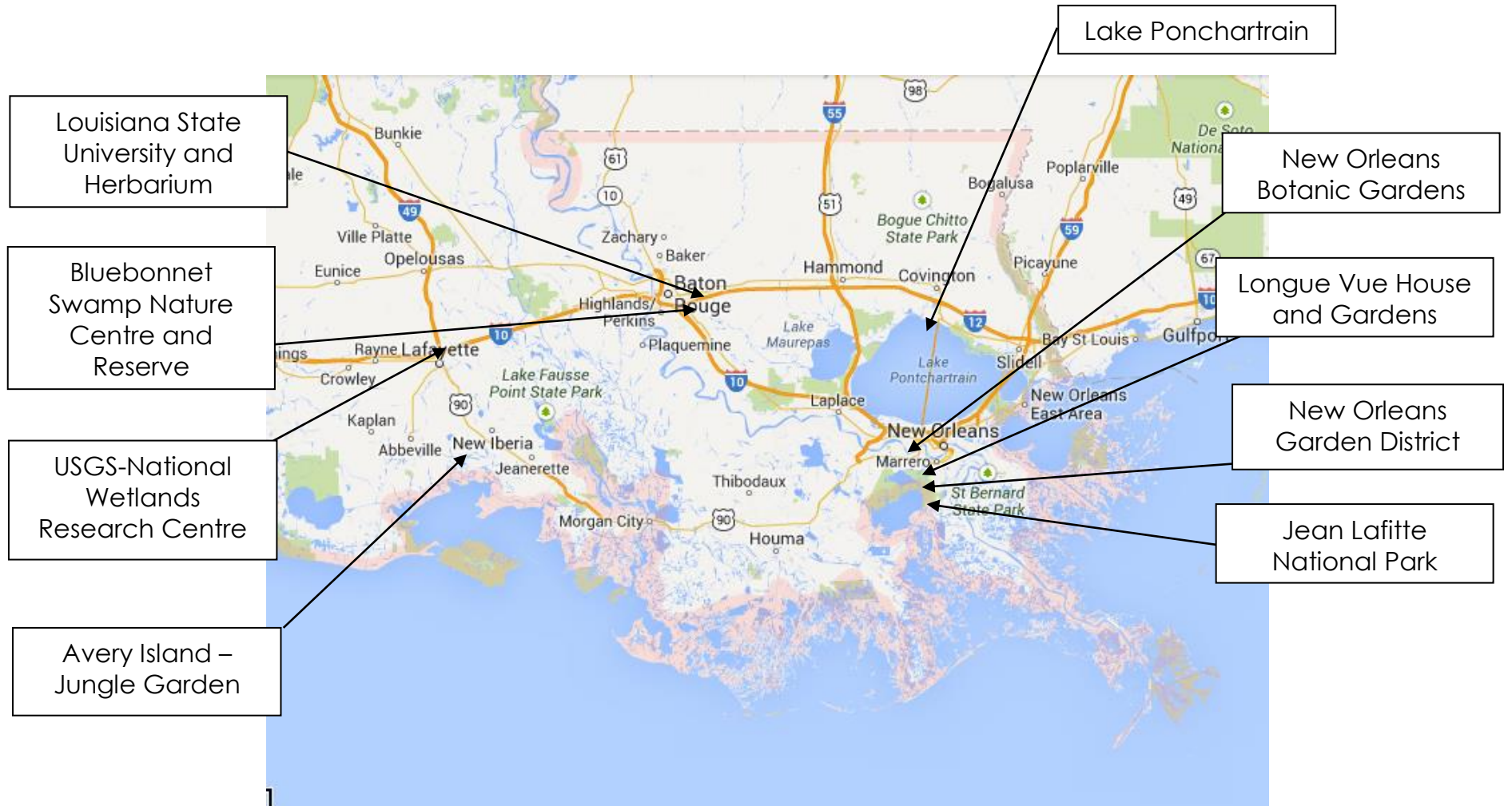
The site protects six significant examples of the rich natural and cultural resources of Louisiana's Mississippi River Delta region. I visited the Barataria preserve, which encompasses 23,000 acres include bayous, swamps, marshes, forests, alligators, nutrias, and over 200 species of birds. Boardwalk and dirt trails wind through the preserve, it can also be explored using kayak and canoe.

Opposite – The vast bayous of Barataria preserve



***Eichhornia crassipes* – highly problematic invasive species outside its native range – full of aerenchyma.**

Visualisation of locations visited



Map of New Orleans and Louisiana coastline showing main trip locations.

Work Programme

New Orleans Botanic Gardens

I spent the bulk of my time working with Susan who showed me the inner workings of the gardens, which was an incredible insight into the commercial capacity of a garden (weddings, events, older people etc.). We discussed the process of recovery from hurricanes, the influx of volunteers from across the USA to assist with the clean-up operation (mainly from corporate companies) and what would be done differently in the future. I was shocked to learn that none of the plants on site are accessioned and the gardens have no scientific/education affiliations. Which allowed me to ponder the importance of the plants in this context, why protect a collection if there is no massive value placed upon them.....just buy some more?! I was also invited to join the Master Naturalists quarterly meeting, which allowed me to meet most of the top ranked industry professionals in the south east.

A highlight for me was observing the flower spike from an *Agave americana*. This collection of plants were put in after the restoration from Hurricane *Katrina* and *Irene*. I was informed New Orleans had one of the coldest winter in decades last year and as such it is suspected the *Agave* have gone into flower in response to these temperature conditions. I missed the flowering but it as an epic sight!

Two of the *Agave americana* ready to bloom



Jean Lafitte National Park - Barataria Unit, New Orleans – I spent the day with Julie who took me into the swamps to observe the site and discuss the ecological processes involved during the impact of a hurricane. The ultimate conclusions to our discussions is that the impact of man (anthropomorphic) are causing far more damage than weather events with ever do in this region. For example, the Mississippi river is being diverted in various incorrect locations (run by the US Army), which means, the river velocity is reduced and the divergent sediment that is usually flushed down stream to deposit in the delta and is being retained. This sediment is vital to create new the land mass on coastal edges. There are two sites with chronic reduction in mass and encroachment in land. The natural levies are being reinstated through mechanical means, involving unsustainable dredging of sediment and transportation to coastal regions.

As part of this day, I worked with a young entomologist who is working towards a thesis on canopy cockroaches - I helped set up forest canopy traps. A complete tangent but one that saw me learn more about the science of entomology.



Setting up roach traps – those from the canopy and those that fall into the ‘cups’ below



The Levee at Barataria Unit – new reinforced concrete walls to protect New Orleans from storm surges and flooding

Abita Creek Flatwoods Preserve - This trip was a pure botanising process, with Matthew Herron as our guide.



The Hurricane Lily – this is one of the many plants I wanted to observe whilst on my trip. Found at various sites along my journey, *Lycoris albiflora* is an upright perennial from a bulb. Widely used in cultivation, they were imported into North Carolina from the Far East and now grow wild. As such they have become emblematic of the hurricane regions of the US.



Population of *Saraccenia alata* found at Abita - I also observed *S. psittacina*, *Drosera* sp. and *Urticaria*

Bluebonnet Swamp Nature Centre and Reserve

Meeting with Matthew (Master Naturalist), Clare (Director of the Centre) and John (Volunteer who has photographed hurricane damage in the swamps for thirty years) we explored the mile of gravel paths and boardwalks linking varied habitats such as the cypress-tupelo swamp, beech-magnolia and hardwood forests. The swamp is dry at this time (Summer), but it is the tree canopy that gave more clues to the damage caused by hurricanes. The most recent that has passed through is Gustave in 2008. Ripping and tearing the canopy away, allowing light to reach the forest/swamp floor, thus, germination and thriving of those species usually unable to flourish.

Hurricane Katrina and Irene – this image was taken by one of my tour guides at Bluebonnet Swamp (John Hartgerink) a few weeks after these events took place. As you can observe this tree has been twisted apart, suggesting spiralling winds. Other trees have been horizontally sliced in two (a clean cut), indicating massive gusts. It is thought that Irene actually became a tornado inland. For a swamp the damage is to flood, immersing the plants with salt water and removing the vital forest canopy.





Before and After - Some of the damage caused by Gustav at Bluebonnet in 2008 - still in recovery.

Lake Ponchartrain

A site only observed briefly. The meeting with the Save Our Lake team did not occur and thus, I was chaperoned by Matthew Herron during our visit to Abita Reserve and Bluebonnet Swamp.

Exploring the lake margins - we can see evidence of flooding/drought, salt intrusion and species decline.



USGS-National Wetlands Research Centre, Lafayette

I met with Dr. Ken Krauss over to days, which included :-

- A tour of the vast \$3billion research centre – one of the major project they are involved in is the mapping of coastal regions in the USA, for military, industry and conservation (dubious)
- Discussion of hurricane impacts – pulses of salinity into fresh water habitats, cypress tree losses equal the production of marsh land, the search and rescue process performed by the wetland research team in the aftermath of hurricanes (access to boats and expertise) etc.



Research units - studies into aquatic plants



Very dangerous activity – air board boats for field work

- **Bayou Teche National Wildlife Refuge** - located in the coastal towns of Franklin, the 9,028-acre (36.54 km²) refuge is forested with bottomland hardwoods and cypress-gum forests. The refuge was established in St. Mary Parish in 2001, which is the site we visited. A swamp marsh highlighting the conservation efforts of the team.
- **Savannah and prairie lands** – a pure botanising expedition with a team from the research centre and Dr. Chris Reid.

Longue Vue House and Gardens, New Orleans

I spent a day with Amy Graham and her team, learning about the history of the gardens, how they came to be and the impact of the hurricanes upon the site. As with New Orleans Botanic Gardens, they had an influx of 'corporate helpers', but are still in recover mode after ten years.



Staff involved in precision hedge cutting

Everything in this image is newly restored since Katrina. From the herringbone paving (historically correct) to the planting to the rear of this image. Is the financial and emotional cost worth retaining this architectural and botanical heritage? And what if this level of disaster happens again?

Conclusions and Outcomes

The first and most important lesson I have learned throughout this trip, is that the subject matter I chose to study is so multifaceted it would require me to achieve a plethora of Phd's in ecology, climatic sciences and botany to fully articulate what I have witnessed. Not taking into account the human and emotional impact of weather events on gardens and landscapes.

But alas, my main concerns for the work was to see how the flora of Louisiana is affected by storm damage. This is twofold and I can offer an insight into the destruction caused in the built garden environment and the more complex situation of 'damage' cause to ecological systems. It is this second part of my study that has given me the biggest education and raised many more questions than answered.

The flooding potential in New Orleans has been noted since at least the 1820s. The largest and most dynamic impact caused by recent hurricanes was that of Hurricane Katrina, followed by Hurricane Irene. Irene came only a few months after the devastation caused by Katrina. The two events brought different problems, whilst Katrina created water surges and thus flooding, Irene followed up with battering winds. The natural ecology of the plant environments of Louisiana mean they are adept to these extreme weather patterns (e.g *Taxodium distichum* 'knees'). However, this combination of salt water flooding (lasting 3 weeks) and hurricane winds meant the understory and forest floor flora suffocated, whilst the tree canopy was ripped apart and trees toppled. As the canopy was opened, pockets of sunlight were able to emit through to the once shaded forest floor, leaving new and invasive species to become emergent and dominant. The swamp forests I visited have still not fully recovered after 10 years.



Sarracenia alata



Botanising with the guys from the National wetland Centre

As well as working out in the field with a range of experts, I also liaised with staff at three major gardens in Louisiana. The first being the Jungle Garden at Avery Island. Avery Island is surrounded on all sides by bayous (slow-moving, muddy rivers), salt marsh, and swampland and sits about 140 miles (225 km) west of New Orleans. Avery Island is actually a huge dome of rock salt and was created by the upwelling of ancient evaporite (salt) deposits that exist beneath the Mississippi River Delta region. Holding vast swathes of live oaks, plus a national collection of *Camellia*. This site retained its integrity during the two major weather events, due to the reduced force of the hurricanes as they moved inland.

I spent a large amount of time at Longue Vue Gardens and House, plus New Orleans Botanic Gardens, whose director was my main host. Both of these gardens lie in the centre of New Orleans and were irreversibly damaged in the storms. Amy

Graham, the head gardener at Longue Vue explained the complex process from impact to recovery. Katrina brought with it massive flooding, where by the salt water surges were held in the garden compound for up to three weeks. As staff were evacuated, Amy was the only employee to stay behind. The energy and water infrastructures within New Orleans were rendered unusable for weeks after the event, thus water could not be pumped out of the gardens. Then came the drought conditions, leaving Amy unable to irrigate any of the collections which may have been salvageable had this been available. It took almost 3 years to reinstate the gardens infrastructure back to a usable standard, as tradesmen within the city were focused on more important ventures. I witnessed post-event photographs highlighting the devastation to the collections and the site as a whole.



Peggy Martin – a found rose. This is the only plant that survived at New Orleans Botanical Gardens, after Katrina struck. Nobody can explain why, but it seems to have withstood the massive influx of salt (standing in seawater for three weeks) and actually thrived after the event.

- What can we learn from this type of anomaly?
- How can we use plant sciences and our horticultural knowledge to utilise the unknown strengths of plants?

With losses of 80% of the plant collections at both gardens, it raises the questions....

- How does a garden protect its plant collection in the face of potential devastation from a weather event and how do you rebuild a garden and move forwards from such events?
- As the UK becomes more prone to flooding and extreme weather events, how would RBG Kew respond to such a disaster?

Having heard the stories of so many people who have been at the forefront of regenerating the gardens of New Orleans, I can see the answer will never be a simple one. RBG Kew are in a privileged position to have the resources provided by the Millennium Seed Bank, holding eons of genetic information and one that all gardens could tap into. But, this only provides us with seeds, which could take decades to grow on, to fill the acres we have at Kew!

The starting point would be to open up a dialogue both at RBG Kew and throughout the botanical garden network. Being proactive and pre-emptive, to secure and share live plant material should be built into botanical garden policies, especially for those working with endangered and rare species. As with the impact of Hurricanes Katrina and Irene at New Orleans Botanical Gardens and Long Vue Gardens, it is often the aftermath of loss the inspires people to make the big changes that have too long been overlooked.



***Xylocopa virginica* - Eastern Carpenter Bee**

Future Plans

This journey has offered me a life changing experience. It is one that has helped to redefining my current practice, stimulated me to ask new questions about the horticultural industry and inspired me to identify with clarity, what my post-Kew career ambitions are. Without this study experience, horticultural students can become blinkered to the potential of the world and what we can really achieve with our newly developing skills. To build knowledge, to build a foundation, to build networks, we must take opportunities and strive to accomplish our aspiration. The Kew Diploma is harnessing my capacity to attain my potential with in horticulture.

Since returning from New Orleans in May, I have been driven to maintain this momentum and to embark on two more projects. I have managed to secure funding to support a trip to New York in September, where I will be hosted by New York Botanic Gardens, Brooklyn Botanic Gardens and the team behind the Highline. The purpose of this journey will be to consolidate the lessons I have learned about the inner workings of American Botanical Gardens and to provide research opportunities for my forth coming dissertation.



Acknowledgements



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Collaborators and colleagues:

- Dr. Susan Capley – Education Director, New Orleans Botanical Gardens.
- Amy Graham - Head Gardener, Longue Vue Gardens and House.
- Dr. Lowell Urbatsch - Director and Professor of Biological Science at Louisiana State University and Herbarium.
- Dr. Ken Krauss – Research Ecologist, USGS National Wetlands Research Centre.
- Dr. Chris Reid - Wetland Botanist, USGS.
- Dr. Larry Allain - USGS National Wetlands Research Centre
- Dr. Julie Whitbeck –senior ecologist with the National Park Service.
- All associate of the Master Naturalist Program, Louisiana.

All the staff and students at RBG Kew who have supported my endeavours, with special thanks to Richard Wilford and Carlos Magdalena and Joanne Everson whose guidance has been immeasurable.

APPENDICIES

Flora Observed During the Trip





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6



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15



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Plant Names

1	<i>Aristolochia serpentaria</i>
2	<i>Baptisia nuttalliana</i>
3	<i>Calopogon oklahomensis</i>
4	<i>Hypoxis hirsuta</i>
5	<i>Carex complanata</i>
6	<i>Cnidocolus texanus</i>
7	<i>Helenium vernale</i>
8	<i>Helianthemum carolinianum</i>
9	<i>Polygala crenata</i>
10	<i>Tradescantia reverchonii</i>
11	<i>Sagittaria papillosa</i>
12	<i>Schoenolirion croceum</i>
13	<i>Vaccinium stamineum</i>
14	<i>Viola lanceolata</i>
15	<i>Viola lanceolata</i>
16	<i>Woodwardia virginica</i>

Biographies of supporting staff

Susan Capley - Education Director, New Orleans Botanic Gardens

Dr. Susan Capley has a PhD in Plant and Soil Science with the emphasis in Horticulture Enterprise Management from the University of Kentucky. She has more than twenty years' experience working in landscape maintenance, organic vegetable production, greenhouse production, and a floral designer for outdoor display gardens. Currently Susan is the Education Director at the New Orleans Botanical Garden.

Dr. Ken Krauss - Research Ecologist, USGS National Wetlands Research Center

Dr. Krauss completed an M.S. in Forestry at Louisiana State University in 1997, and a Ph.D. in Environmental and Evolutionary Biology from the University of Louisiana at Lafayette in 2004. He has been a scientist with the federal government since 1997, first with the USDA Forest Service in Stoneville, Mississippi and, then, in Honolulu, Hawaii, where he studied sedimentation, systematics, regeneration, growth, invasion biology, and ecophysiology of Pacific island forested wetlands in the Federated States of Micronesia and Hawaii. Dr. Krauss began working at the USGS National Wetlands Research Center (NWRC) in 2001, where he maintains an expertise in forest ecology and ecophysiology, and serves as one of NWRC's climate change scientists focusing on mangroves and tidal freshwater forested wetlands.

Dr. Lowell Urbatsch - Director and Professor of Biological Science at Louisiana State University and Herbarium.

Prof. Dr. Lowell Edward Urbatsch is a botanical professor and an important illustrator. He earned his PhD at the university of Georgia, Athens, in 1970. He is one of the top five researchers involved in "CyberFlora Louisiana" which hold 1.1 million electronic herbarium specimens. Dr. Urbatsch has taught plant taxonomy and wetland ecology at LSU for three decades.

Amy Graham – Head Gardener, Longue Vue Gardens and House

Graham was one of five Longue Vue gardeners prior to the storm, but is the only one who returned to make her home in New Orleans and tackle the clean-up effort.