Symposium 2011 Proceedings

“Habitat CPR: Creating, Preserving, and Restoring Native Habitats in a Changing World”
featuring the Coastal Prairies and Marshes of Texas

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Houston, Texas
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Biographies

Field Trips

Sponsors

We gratefully acknowledge the efforts of our Symposium 2011 Education Committees. Speaker Committee: Lonnie Childs, Margaret Gnewuch, Lan Shen, and Jason Singhurst. Field Trip Committee: Lonnie Childs, Joe Liggio, Peter Loos, Warren Pruess, Jason Singhurst.
Management – The Vital Ingredient

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Abstract
To sustain progress toward achieving their mission, all organization’s need good management. Over the years, I have encountered Non-profit organizations with no plan, no budget, no history of minutes and in one public organization no bylaws. Non-Profit organizations are much harder to manage. For one thing, there is almost always a disconnect between the revenue stream and those receiving services.

Another issue is management of many non-profits came to management through the service organization itself. While they tend to be expert at delivering services they are in all likelihood are not professionally trained administrators. Many never had formal training.

This workshop deals with organization, planning and budgeting and how they meld together to help the organization achieve its mission. It is a highly interactive workshop designed to impart the maximum amount of knowledge into a short period of time. There will be a PowerPoint and handouts.
Cecil’s Current Board Service
- T F Chapter, Native Plant Society of Texas
- Lake Cities Municipal Utility Authority
- North Texas Regional Library System
- Lake Cities Library
- Oklahoma Museums Association
- Arbuckle-Simpson Nature Council
- Tri County Indian Nation Community Development Corporation

Boards
• Board Life Cycles
  - Formation
  - Performance
  - Maturity
  - Decline

Board Relationships
• Prospective Board Members should know:
  o being a board member is not a retirement perk, their responsibility is serious …
  o their usefulness to the chapter will come to an end …
  o they are not just there for the “cookies” …
  o board members have definite duties and they should act according to their fiduciary responsibility …
Governance - Boards

Management/Leadership activities:
- providing strategic support and expertise,
- raising funds,
- building community support that furthers the chapter’s goals is essential.

Management - Projects

Project Management
- A project has a finite life time
- Three Important aspects:
  - Definition of the Project
    - Time, Troops and Money
    - Good Planning – Time lines

Management - Outreach

Outreach & Education
External – Public Relations
- What is our message; how will it be communicated?
- The Communication Plan, Media Releases, & Business cards
Management - Outreach

Outreach & Education
External – Public Relations

- Demonstration Projects
- Plant Sales
- Quality speakers at monthly meetings

Management - Outreach

Outreach & Education
External – Public Relations

- Public Speaking
  Service Clubs, Gardening Groups…be the Native plant expert to the media
- Advocacy – for NPSOT

Management - Outreach

Outreach & Education
Internal – Public Relations

- Members are important – keep them informed
- Interesting Programs
- Field Trips
- Native Garden Tours
Management - Meetings

Meeting Management
Why hold a meeting?
- Decision Making
- Impart/Receive Information
- Ghost/Phantom Meetings
- Statutory reasons

Governance - Meetings

Participant responsibilities
- arrive on time and prepared
- hold no side conversations;
- ask and answer relevant questions; participate
- listen enthusiastically; LISTEN
- provide feedback; silence is consent

Management - Finance

Budgeting and Finance
- Budgets – Board policy in financial terms
- Profit and Loss Statement – Revenues and Expenses
- Balance Sheets – Assets, Liabilities and Owners Equity
Managements - Grants

**Budgeting and Finance**
- A grant is a proposal...We’ll do “this”, if you’ll give us the “money”.
- Defining a *project*…grants are not made for *program* financing
- Technical and Creative sides

Management - Grants

**Budgeting and Finance**
- Match your needs with the grant makers programs/criteria
- Drama, Trauma, Gloom & Doom
- It’s not about you, it’s always about people. Grant makers only fund causes.
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Membership Management – Principles For Success

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Abstract
Nurturing and growing our NPSOT membership is a desirable and even necessary goal for our organization which can only be accomplished by local chapter leadership. In this session, key principles and techniques for the both the recruitment and retention of members will be presented. The results from a chapter leader self-assessment previously sent out to chapter leaders will be shared to help understand where we are today with best practices in membership management. Time will be allowed after the presentation for an interactive sharing by the audience of ideas that have been successful in various chapters for growing their membership.
Moths, Why We Need Them And
How To Create Habitats For Them Using Native Plants

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Abstract
There are ten times as many moths as butterflies, but because so many moths are either nocturnal or lack bright coloring, they often go unnoticed and unappreciated. Some moths serve as important pollinators, most serve as important food for wildlife, and some are stunningly beautiful insects that bring us joy. Some of the more prominent groups, such as the Silk Moths, the Sphinx Moths, the Owlet Moths, and the Tiger Moths, will be featured. The presentation will include information about different moths’ habits, their caterpillars, and their host plants - native plants. The object is for the audience to learn more about moths and to point out another very important reason for growing natives, a reason that many attendees may not have known.

For the last few years gardeners have begun focusing on gardening for butterflies and for pollinators, which is a wonderful step forward in efforts to help wildlife. However, we need to broaden our ideas about gardening, as there are additional groups of insects that are worthy of their attention, and one of those groups is moths. They are often beautiful, are sometimes stunning flyers, and are an important part of a natural habitat.

Moths and butterflies are both in the order Lepidoptera – which is Greek for scaly-winged - and in the United States lepidopterans represent over 50 percent of all insect herbivores, an astounding number (Arnett 2000). In this country there are over 10,000 species of moths and less than 800 species of butterflies, and in Texas there are approximately 4700 moth species and less than 500 species of butterflies, so there are almost 10 times as many moths.

In order to tell the difference between moths and butterflies, there are a few basic differences to look for. To begin with butterflies are brightly colored and the majority of moths are more apt to brown or gray. Butterflies fly during the day and most moths are more active at night. Butterflies usually rest with their wings held vertically over their bodies and moths usually rest with their wings flat against their bodies. Butterflies usually have simple antennae with clubs at the tips, whereas moths generally have feathery antennae. Butterflies
generally have slender bodies and moths generally have bodies that are fatter and hairier. Lastly, butterflies pupate in a chrysalis and moths sometimes pupate in a cocoon.

Our lack of awareness of moths contributes to our lack of appreciation for them despite the fact that they are a very important part of our environment. Three of their most important functions are to serve as pollinators, to serve as natural controls for some plants, and to serve as food for everything from insects to small mammals.

As far as being a pollinator goes, moths are not quite as important as bees; however, they do have their niche. Since most moths are nocturnal, they do most of the pollinating for which they are specifically necessary at night, that is, pollinating flowers that open in the afternoon and evening and pollinating flowers that may have a deep tubular shape. Due to the darkness, these are often light colored flowers that reflect the moonlight or fragrant flowers that the moths can smell. Many diurnal moths do pollinate a variety of flowers as they get nectar, but since they are not as active as bees, their contribution is less significant.

The natural control of plants is done mainly by many of the moth caterpillars that we now consider pests, caterpillars that are merely doing their job of eating plants and “thinning the herd”, so to speak. As caterpillars eat their host plants they do kill some plants and thus keep diversity up and monocultures down. When they eat the leaves of trees, they may thin the canopy and allow more sunlight through and, therefore, allow new plants to grow. There are currently a few native moths causing problems in our forests, but any detrimental impact is largely due to the fact that humans have thrown the natural system out of balance, since humans have cleared forests and prairies and created millions of acres of chemical covered crops or of concrete-covered neighborhoods. In our yards there are very few pest caterpillars that cause severe damage, most just make our vegetation look bad for a short period of time, which is something we should learn to accept since those pest caterpillars and moths are often serving as food for other important creatures.

Which brings us to the last and probably most significant benefit of moths and their caterpillars and that is serving as food. Since almost all moths and caterpillars eat only plants, they are at the very bottom of the food chain, everything from insects, spiders, amphibians, reptiles, birds, and mammals eats them. For these reasons we should work at attracting them to our gardens and protecting them rather than destroying them and their caterpillars.
It is quite easy to garden for moths. Because there are so many species of moths and because many moth have more than one host plant, several in fact, if you plant native plants, you will be serving moths. Not every plant native to every garden is going to be a host plant, but there will be enough host plants in any group of natives that you plant that to get you off to a good start. Appendix A has a few places to locate information about host plants for moths. So to begin, plant natives.

Secondly, fuss with your yard as little as possible. Constant raking, blowing, pruning, digging, and working in the soil are going to damage the very things you worked hard to attract. There are caterpillars on the plants and there are pupae and cocoons on the plants, in the leaf litter, and in the ground, in addition to all the other creatures that are living in the habitat you are creating. If you must rake, try to create a wide ring around each tree, 3 feet wide or so, and rake the leaves into that ring so that cocoons in the leaf litter can survive. Another option is to plant trees and shrubs in a triangle and leave the center of the triangle as a place for the leaves since the pupae may have a chance of surviving there. Be imaginative about creating areas that are natural so that natural processes, like caterpillars becoming moths, can happen.

Lastly, in order to create a good habitat for moths, avoid using chemicals, both herbicides and pesticides. If you use herbicides, they are transferred from the caterpillars that eat the plants covered with herbicides to the predators that eat the caterpillars or moths so many creatures are affected badly. In much the same vein, chemical pesticides should be avoided due to the detrimental effects they have on so many animals beyond those that are targeted, since pesticides are rarely selective. Even organic pesticides are not really good because they, too, kill caterpillars indiscriminately. Bt, Bacillus thuringiensis, is a natural bacteria found in the soil and many recommend it to kill caterpillars that are pests in one’s garden. However, how does one keep the “good” caterpillars from getting killed as well? Those who grow fruits and vegetables may face more threats from “pest” caterpillars than other gardeners because the goal is to get produce, but it is important to try to figure out how to deal with the “problems” in a manner that won’t do harm to all the insects that are in the area of the vegetables and fruits. Growing a few extra plants on which one can place the unwanted caterpillars is a harmless and simple solution.
Gardening for moths is easy and it is the same as gardening for almost any other insects or animals one might pick. Plant native plants, allow the plants to be as natural as possible, and lose the chemicals in order to begin building an environment that will attract moths and ultimately all sorts of additional wildlife. This will bring balance and nature back to your yard, and there will be a wonderful show if you take the time to sit and watch.

There are somewhere between 65 and 70 families of moths in North America. The number varies due to recent taxonomic changes, all of which have yet to be accepted. Texas has the largest number of moth species and they are placed in at least 59 families. Some of the largest families and some of the most diverse families deserve special attention here, as well as some a few miscellaneous species.

**SATURNIDAE** - The family of the Silk Moths. Silk moths are some of the largest and most beautiful moths found in Texas. Most of the species use multiple trees and shrubs as host plants and usually there is only one brood per year, with the young tending to feed in groups.

The silk moth caterpillars spin a cocoon of silk in which they pupate. Sometimes the cocoon is attached to a twig in a tree, sometimes it is made inside a leaf that is on the tree and apt to fall off, and sometimes it is spun inside a leaf already on the ground. This is one of the reasons for not raking and bagging leaves. If the leaves must be raked, then rake them around the base of the tree and leave them be.

Examples and their host plants:

**LUNA MOTH**– Sweet Gums, Walnuts, Hickories, Sumacs, Persimmons, and White Birches.

**IO MOTH** – A list of over 100 host plants, including Hackberry, Blackberry, Redbud, Hibiscus, Clover, Willows, Mesquite, Beech, Elm, Linden, Oaks.

The caterpillars have stinging spines.

**PROMETHEA MOTH** - Tulip Tree (Liriodendron tulipifera), Ash, Cherry, Plum, Sassafras, Sweet Gum, Spice Bush, Maples, Linden

**CECROPIA MOTH** – Dogwoods, Box Elders, Cherries, Plums, Willows, Sugar Maple, Birch

Largest North American moth, wing span 5”-7”

**ROYAL WALNUT MOTH** – Hickories, Pecans, Sumacs, Black Walnut, Sweet Gum,
Persimmons

Caterpillar known as a Hickory Horned Devil

**SPHINGIDAE** – Sphinx Moths. The moths are also called Hawkwing Moths and Hummingbird Moths because when they are flying and hovering over a flower they resemble hummingbirds. The caterpillars are often known as Hornworms because most of them have a horn-like growth, at least up until their last instar, at their back ends.

Some of the Sphinx Moths can fly up to 30 mph and they have been studied due to their ability to fly side to side while hovering over a flower which may have evolved as a defensive maneuver in order to be able to avoid predators hiding in the flowers.

The sphinx moths have very stout, heavy bodies and sometimes after resting they shiver in order to warm up their flight muscles. Then later when they are flying, their body temperature can reach 104 degrees.

Sphinx moth caterpillars tend to have specific host plants or at least a limited number, as opposed to being the generalists that silk moths are.

When it is time for the caterpillar to pupate, the caterpillar crawls down to the ground and either makes its chrysalis above ground in the leaf litter or it burrows down and pupates in a burrow underground. Since the pupa may be above ground, once again, one should not rake and bag leaves, as one doesn’t want to damage the pupa.

Examples and their host plants:

**NESSUS SPHINX MOTH** – Members of the grape family, including Peppervine

**VIRGINIA CREEPER SPHINX MOTH** – Members of the grape family, including Virginia Creeper

**MOURNFUL SPHINX MOTH** – Members of the grape family, including the Cissus genus

**BANDED SPHINX MOTH** – Members of the Primrose family, including Evening Primrose and members of the Ludwigia genus

**JUANITA SPHINX MOTH** – Members of the Primrose family, including Evening Primrose, Gaura, and Willow Weed (Epilobium)

**WAVED SPHINX MOTH** – Green Ash, Hawthorn, Oak, Privet

**HUMMINGBIRD SPHINX MOTH** – Honeysuckle, Plums, Cherries, Hawthorns, Snowberry
**ARCTIIDAE** – Tiger, Lichen, and Wasp moths. This is a rather diverse group of moths that has several different looks.

The caterpillars of the Tiger Moth group are usually called Wooly Bears because they are very “bristley”, which is perhaps how the family got its name, since the Greek word “arctos” means bear.

When the tiger moth caterpillar is about to pupate, it uses its own bristles to build a cocoon as opposed to spinning a silk cocoon, which makes it very distinctive.

Examples and their host plants:
- **SALT MARSH MOTH** – Amaranthus sp., Dog Fennel, Hickory, Physalis sp., plus many other broad-leaf plants.
- **GIANT LEOPARD MOTH** – Commelina sp., Dandelions, Sunflowers, Violets, Willows, Maples, and more
- **ISABELLA TIGER MOTH** – Asters, Sunflowers, Birches, Elms, and many more
- **MILKWEED TUSSOCK MOTH, MILKWEED TIGER MOTH** – Milkweeds, Dogbane
- **SYCAMORE TUSSOCK MOTH, PALE TIGER MOTH** – Sycamores

Lichen Moths are in the subfamily Lithosiinae. The caterpillars feed on lichens and absorb some of the toxic chemicals found in the lichens. These chemical make the caterpillar taste bad and serves as a defense mechanism.

Examples and their host plants:
- **DARK GRAY LICHEN MOTH** – Lichens
- **SCARLET WINGED LICHEN MOTH** – Lichens
- **PAINTED LICHEN MOTH** – Lichens, algae, and moss on trees

Wasp Moths are in the subfamily Syntominae. As their name suggests, they resemble wasps, having long upper wings and small hindwings. This mimicry serves as a defensive measure, scaring their predators into thinking they are wasps.

- **SCARLET-BODIED WASP MOTH** – Climbing Hempvine
- **TEXAS WASP MOTH** – Host plant unknown

**NOCTUIDAE** – The Owlet Moths. This is the largest family, having been divided into 18 subfamilies, and there are over 2900 species in North America alone and for that reason, they are very important in a variety of ecosystems. There are many that nectar often so they assist in pollination, there are some whose caterpillars assist in decomposition due to eating wood,
leaf litter, and other organic matter, and there are many whose life cycles and caterpillars coincide with birds and their nesting so they serve as important food source for those birds.

There are very colorful moths in this group and there are some species that are considered to be agricultural pests. The most colorful of the noctuids are the Schinia moths, or the Flower Moths. They spend most of their time around the flowers that are their host plants so their colors are their camouflage.

Examples and their host plants:

GAILLARDIA FLOWER MOTH – Gaillardia pulchella
CLOUDED CRIMSON FLOWER MOTH – Gaura
GOLDENROD FLOWER MOTH – Goldenrod and Asters
RAGWEED MOTH – Ragweed
BLEEDING FLOWER MOTH – Liatris
LYNX FLOWER MOTHS – Heterotheca subaxillaris

The Catocala Moths are known as the Underwing Moths because the drab forewing covers the hidden, colorful – often orange or red with black lines - hindwing when the moth is at rest. The caterpillars generally feed on trees, with oaks being a favorite.

GEOMETRIDAE – The Looper Moths. The name of this family comes from the Greek “geo” meaning “earth” and “metron” meaning “measure”, which refers to the larvae known as loopers or inchworms. They seem to “measure the earth” by the way they inch along.
The caterpillars move that way because they have only two pairs of prolegs at the back instead of the five pairs that most caterpillars have. The caterpillars draw the back end up to the front end and a loop is formed before the front part of the body is moved forward. Most species use woody plants as host plants, though a few eat herbaceous plants.

The moths are distinctive because they hold their wings out to the sides, away from their bodies and with a little practice, you can use the outlines to identify a moth as belonging in this family.

WHITE-TIPPED BLACK – Euphorbiaceae, such as Phyllanthus
BENT-LINE CARPET MOTH - Smartweed
FALSE CROCUS GEOMETER MOTH (There are 4 species that look almost alike) – General feeders, including such things as goldenrods, elms, and dogwoods.
CHICKWEED GEOMETER – Chickweed, Smartweed, Clover, and other low plants.
WEBWORMS AND TENT CATERPILLARS—Tent caterpillars and webworms are two types of moths whose caterpillars form scary looking silk tents in trees, but they are usually beneficial, providing benefits such as providing food for all types of animals, fertilizing the forest floor with their frass which contains the nutrients of the digested leaves, and thinning the weak trees out of the forest since they don’t always survive the visit by the caterpillars.

Webworms and tent caterpillars are easy to tell apart. Tent caterpillars generally appear in the spring and form their tent in the crotches of branches. Webworms generally show up in the fall and form their tent at the end of branches amongst the twigs and leaves. Tent caterpillars are hairy and generally have some sort of pattern on their backs or sides, whereas webworm caterpillars are usually hairy and plain yellow. Accepting these caterpillars and their webs as part of a wildlife habitat can be a challenge for gardeners, but it is important to consider them as a vital part of nature since they feed bats, birds, snakes, turtles, wasps, and more.

As little as we see moths, it is amazing to realize how large a role they play in nature. Successfully nurturing them and their caterpillars can only be done by creating habitats with native plants and by protecting the moths, their caterpillars, and their pupae with thoughtful gardening practices. As gardeners it is imperative that we begin to focus more and more on the big picture, on the connectedness of all creatures and plants. By doing so, both wildlife and humans will benefit and we will find satisfaction, whether we ever see that fabulous, elusive moth or not.

APPENDIX A – Host Plant information
Bugguide.net
Bringing Nature Home, D.W. Tallamy – Great list of trees that serve as host plants for hundreds of moth species.
Butterfliesandmoths.org
Silkmoths.bizland.com

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“Tent Caterpillars=Bird Food”  Available at: Hybridbirder.blogspot.com/2010/04/tent-caterpillars-bird-food.html

Texas Entomology, compiled by Mike Quinn  Available at: Texasento.net

“What Eats Tent Caterpillars?”  Available at: Dailypuppy.com/articles/what-eats-tent-caterpillars/f3e1d01f-5ebe-4065-897c-a560e34ec735

World’s Largest Saturniidae Site!  Available at: Silkmoths.bizland.com
The Quiet Beauty of Our Coastal Prairie: Valuable, Vulnerable, and Vanishing

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Abstract
Between the new green of spring and the bright gold of autumn, our grasslands support a wonderful array of native plants and animals that make our coastal prairies rich. Wildflowers attract important insect pollinators. Insects attract birds and other animals. Many of these animals are small and not easily seen. Multiplied hundreds of species of colorful butterflies and dragonflies, bees and wasps, ants, grasshoppers, and beetles make their home on the prairie. Tallgrass prairie grasses thrive in the good prairie earth and reach heights of six to nine feet. Fibrous roots go down deep, twelve to twenty-one feet. When we think of grasses, we usually think of them in quantity - like a forest full of trees. But, once we know the forest consists of a variety of trees and we begin to see their individual characteristics, we no longer take them for granted. So it is with grasses, even though there are hundreds of species in Texas.

Along the Gulf Coast, tallgrass prairies are considered part of our wetlands. These are lush mesic prairies that are normally dry but can be flooded by storms for a week or more. In 1979 the city of Alvin set a record for the heaviest rainfall in U.S. history; 43 inches in 24
hours. The Houston Coastal Center prairie is only about 13 miles from the Gulf of Mexico and was under 3-1/2 feet of water during that storm. Thirty years later the prairie is still thriving.

Coastal vegetation thrives because of warm temperatures, high rainfall, and south winds coming off the Gulf. Coastal prairies have more mist and fog than areas farther inland. Morning mist is a unique characteristic of our coastal prairie. Grasses are designed to collect moisture from the mist so that, even in times of severe drought, water is provided.

Grasses are very leafy. Their cover conceals almost 100% of the soil in a high quality prairie. Prairie vegetation holds a considerable portion of rainfall upon its surface until it evaporates. In the early 1900’s, extensive scientific research was conducted by J. E. Weaver at the University of Nebraska. From that research published in North American Prairie, 1954:

- One acre of bluestem prairie may represent 5 - 8 acres of leaf surface.
- Big bluestem withholds about 66% of precipitation during a heavy rain and 97% during a very light shower.
- When an inch of water falls during an hour...prairie composed chiefly of big bluestem may intercept as much as 53 tons per acre. Clark (1937, 1940).
- Also, by interception, it prevents much water from reaching the soil; but once in the soil, loss by evaporation is decreased by shading. The total effect is to retard runoff and soil erosion.

A grass leaf has 3 parts; sheath, ligule and blade. The ligule is a membrane or ring of hairs on the inside of the leaf at the junction of sheath and blade. Only grasses have ligules; sedges and rushes do not have ligules. There is a collar on the outside of the leaf at the junction of the sheath and blade. In some grasses there is a little appendage called an auricle.

An important characteristic of grasses is a sheath that is split and overlaps the stem. Stems may be round, solid, hollow or flattened but never 3-sided (sedges have edges, i.e., 3 sides). Grass stems have enlarged (“swollen”) joints called nodes. During the growing season, taller grasses like big bluestem can grow a half inch per day.

A grass floret consists of a lemma and a palea with an enclosed flower. A grass flower consists of lodicules, stamens, and pistils. Typically, grasses have 3 stamens. Weak, delicate
filaments allow the tethered anthers (male) to be blown about by the wind so that pollen can reach the feathery stigmas (female). The tiny flowers are protected by multiple layers of covering; glumes, palea and lemma. Sedges and rushes do not have a palea and lemma. Flower spikes appear 7-21 days before the flowers begin blooming. On a spikelet with several florets the flowers will not bloom all at the same time but in sequence up the spikelet. Flowers actively pollinate 3-7 days at a time (Z. Wootan, pers. comm.)

What we cannot see beneath the prairie floor is an extensive fibrous root system that goes down 12 – 21 feet. Grasses don’t just hold the soil; they build the soil. Roots and rhizomes form a dense mat or sod. This is one reason why there were no trees on our American prairie until it was broken by the plow. Grasses are wind-pollinated and where there are no trees the wind blows free.

According to research by J. E. Weaver at the University of Nebraska:

- From an 8-inch thick mat of rhizomes in the underground framework of switchgrass, a square foot of soil reveals 50 feet of rhizomes.
- Rhizomes furnish abundant room for storage near the food factories above them and are close to the water and supplies of nutrients around and beneath them.
- In many grasses, new roots arise all along the path of the rhizome but they are thickest around the enlarged, vertical stem bases.
- Big bluestem produces great numbers of strong, branched rhizomes which are compacted into dense mats about 2 inches thick at depths between 1 – 3 inches.
- Their length per square foot of sod averaged 55 feet. This indicates that an acre of big bluestem sod might contain 400 miles of rhizomes.
- The general characteristics of the root system of a species are often as marked and distinctive as those of the plant parts above ground.

**BIG BLUESTEM** (*Andropogon gerardii*) is one of the “big four” tallgrass prairie grasses and can reach 9 feet. Known as “turkeyfoot” because of its turkeyfoot-like inflorescence, there is no mistaking this trademark grass. The tremendous stature of big bluestem makes a heavy demand on water. Stems have a waxy bloom, usually glaucous or bluish, and wax can be scraped off by a fingernail. Big bluestem was once a dominant because of its rapid growth, dense sod-forming habit, great stature, and tolerance of the plant’s seedlings to shade. These plants can live 15 years and more.

![Big bluestem flowering (September)](image1)

![Big bluestem ripe for harvest (November)](image2)
LITTLE BLUESTEM (*Schizachyrium scoparium*) is another one of the “big four” and reaches 6 feet. *Schiz* means split and *scoparium* means “resembling a broom or floorsweeper”. It is an important bunchgrass and a host plant for butterfly caterpillars, especially skippers. Little bluestem may not flower and produce seed every year, depending on weather conditions. Grassland birds and other animals depend on grass seed for food. This is an important reason why a healthy prairie has an amazing variety of grasses and forbs, maturing and bearing fruit at different times throughout the seasons.

Little bluestem changes colors throughout the season and turns a rich copper color in the fall. All the bluestems are colorful during the growing season, July to October. These are warm season grasses that usually flower after the longest day of the year. Cool season grasses renew their growth in early spring and usually flower before the longest day of the year. Generally, cool season grasses have hollow stems (e.g., *ROSETTEGRASS Dichanthelium*, *TEXAS WINTERGRASS Nassella Leucotricha*).

YELLOW INDIANGRASS (*Sorghastrum nutans*) is a true indicator species for high quality prairie and was once a climax grass. Yellow indiangrass is one of the “big four” and can reach 6 feet. Yellow spikelets give it a common name. Its botanical name is derived from *Sorghastrum* referring to the sweet juice in its stem and *nutans* meaning to nod or sway. This beautiful grass prances in the wind.

Hair-like structures are awns. These are nerve endings or extensions of the veins; actually, vascular bundles. Awns serve a purpose; they help disperse and plant the seed. Some grasses, (e.g., wintergrass *Nassella leucotricha* and blackseed needlegrass *Piptochaetium avenaceum*) have long twisted awns. Once the seed reaches the ground, the first moisture causes the awn to straighten and moves it straight down into the soil. Once it dries out again, the awn twists back up. This action screws the seed into the soil where it can germinate.
SWITCHGRASS (*Panicum virgatum*), another one of the “big four”, grows in large stands 6 to 8 feet tall and just as wide. The flowering head is an example of a panicle type inflorescence. This robust grass is a good seed producer and an important soil stabilizer along shorelines. It forms wind barriers, provides excellent nesting and cover for wildlife, and good winter cover for mammals. Switchgrass has horizontal underground stems called rhizomes. These underground stems produce new plants from shoots to reproduce vegetatively; they don’t always depend on seed to reproduce.

BUSHY BLUESTEM (*Andropogon glomeratus*) grows 4 to 5 feet. It is easy to recognize with its club-like inflorescence and villous (shaggy) hairs. It is one of the *Andropogon* tribe of grasses. *Andro* means man and *pogon* means beard – “bearded man”. *Glomeratus* means “gathered in bunches”. Even though it is big and bushy, the seeds are microscopic. Its stems are flattened and its branches are partially covered by sheaths. Bushy bluestem prefers poorly drained sites and provides nesting cover for mottled ducks. It offers protection for smaller animals and spiders and is good fawning cover for deer. In the fall and winter, bushy bluestem becomes bronze or copper colored.

BROOMSEDGE BLUESTEM (*Andropogon virginicus*) is one of the “bearded men”. Straight awns distinguish it from splitbeard bluestem (*Andropogon tenarius*). Sheaths protect the flowering parts until the floret opens. A close-up of broomsedge will show the yellow anthers releasing pollen and the feathery stigmas. The upper lemmas are hyaline (thin and translucent or transparent). Light may be a factor in the timing of the floret opening.
SILVER BLUESTEM (*Bothriochloa laguroides*) has silky spikelets that are glaucous or whitish. This grass provides nesting cover for birds and escape cover for rabbits and rodents, making good habitat for foragers like raptors and coyotes; it is important fawning cover for deer. Silver bluestem blooms early in summer and throughout the fall.

FLORIDA PASPALUM (*Paspalum floridanum*) is our biggest paspalum reaching 5 to 6 feet and is a good seed producer. Its name *floridanum* does not refer to the state of Florida but means “covered with flowers”. Florida paspalum has interesting spikelets that are glabrous (bald) and plano-convex (flat on one side and convex on the other).

At the base of the grass flower there are, commonly, two membranous parts called lodicules. At pollination time when conditions are right, these lodicules swell and push against the palea and lemma to open the flower.

BROWNSEED PASPALUM (*Paspalum plicatum*) has a brown patch on its seeds that will become very dark brown at maturity making it easy to identify in the field. Once stripped of its seed, the characteristic rachis can be seen. There are many paspalum species in Texas.

EASTERN GAMAGRASS (*Tripsacum dactyloides*) forms large circular bunches or clumps 7 feet in diameter and 8 to 9 feet tall. Eastern gamagrass renews growth in the spring from extremely large and compact rhizomes. The massive foliage consists of bright green leaves and in a time of drought, can resemble oasis in a withered landscape. These highly specialized plants are monoecious meaning they have unisexual spikelets; both sexes occur on the same plant. Each branch of the inflorescence bears staminate (male) spikelets above and pistillate (female) spikelets below. At maturity the staminate spikelets break off at the nodes leaving hard, bony pistillate units at the base of the inflorescence. These units contain the caryopsis or grain (seed).
GULF CORDGRASS (*Spartina spartinae*) forms dense clumps 4-1/2 feet high. Often, this tough grass will be the dominate one, sometimes to the exclusion of other species. *Spartina* gets its name from spikelets that are pectinately arranged (i.e., as the teeth of a comb). It provides important nesting material and cover for quail and for endangered Attwater’s Prairie-chickens. These grassland birds travel on the ground between clumps while foraging for insects in the spring.

Spartina species build up the soil. There is a record of *Spartina townsendii* that was planted in Holland outside the dikes and in rows at right angles to them. Within a few years a solid meadow had formed and by 1938, the deposit of soil was up to 6 feet in 10 years. Smooth cordgrass (*Spartina alterniflora*) is abundant in tidal flats and bays throughout the Gulf Coast.

GULF MUHLY or HAIRYAWN MUHLY (*Muhlenbergia capillaris*) is one of our pink grasses growing 3 to 3-1/2 feet tall. Densely tufted with awns by September, pink mounds of muhly resemble cotton candy. Leaves are straight and tough in contrast to LOVEGRASS (*Eragrostis*), another pink grass that typically has leaves that are more grass-like and has no awns.
KNOTROOT BRISTLEGRASS (*Setaria parviflora*) is one of our shorter grasses reaching only 2 to 3 feet. *Parviflora* refers to its “puny” flowers. These tiny flowers produce seed almost year around making it very important to wildlife, especially to grassland birds.

LONGSPIKE TRIDENS (*Tridens strictus*) is a bunchgrass growing 5 feet with a stout stem and contracted spike-type panicle. The leaves are long and involute (edges rolled inward lengthwise with the upper surface to the inside) which helps reduce transpiration during hot, dry conditions. During times of drought, a tallgrass coastal prairie can be 1-1/2 feet shorter overall. Tridens provides good forage and seeds for birds and small mammals.

The importance of native plants to wildlife cannot be overemphasized; native grasses are as important as air and water. Grasses also provide nutrients, minerals, and organisms in the soil that benefit wildflowers. Some wildflowers (e.g., Indian paintbrush *Castilleja indivisa*, American bluehearts *Buchnera americana*), are hemi-parasitic and derive water and nutrients from grasses. Wildflowers attract insect pollinators. Insects attract birds and other animals.

Gayfeather or BLAZINGSTAR (*Liatris pycnostachya*) grows 4 to 5 feet and blooms from the top down. One of our most beautiful and important wildflowers, these native plants are utilized in every season; blooms provide nectar and pollen for butterflies and bees; spiders use the tall spires to anchor webs; seeds provide food for birds; dried stalks become perches
for birds and dragonflies. Roots go down 16 feet or more allowing them to thrive during fire or drought. There are several liatris species in our area. Bracted gayfeather (*Liatris bracteata*) is a very rare plant of Texas and grows nowhere else in the world except on our coastal prairie.

Historically, there were no trees in the Houston area except along creeks and riparian areas. The Gulf Coast Prairies and Marshes region has always been fairly flat and wet with an amazing complex of prairie potholes and mysterious pimple mounds. **Prairie potholes** are natural depressions that hold water but can also dry out seasonly.

**MAIDENCANE GRASS** (*Panicum hemitomon*) is becoming rare as these natural areas disappear. Maidencane is a robust perennial that grows from creeping rhizomes (below ground) and stoloniferous (aboveground horizontal stems that root at the nodes) bases. Used for shoreline stabilization; provides good forage for wildlife.
**Pimple mounds**, as the name implies, are slightly raised areas on the prairie. These are smaller specialized habitats within the prairie ecosystem. Plant species found on the mounds may be shorter, more abundant, or sparser than in the surrounding area. These special places are home to harvester ants and gophers. A pimple mound becomes a stage for meadowlarks to use when singing their melodious songs. The once abundant, but now rare, Attwater’s Prairie chickens use the mounds for “booming” (i.e., displaying, dancing, and fighting) to win mates before disappearing into the nearby grasses.

Some rare and endemic species occur on pimple mounds and on naturally barren or sparsely vegetated saline slick spots, usually on sandy to sandy loam soils. These areas are home to Houston camphor daisy (*Rayjacksonia aurea*), Texas prairie dawn (*Hymenoxys texana*), Texas windmill grass (*Chloris texensis*), threeflower broomweed (*Thurovia triflora*), and bracted gayfeather or blazingstar (*Liatris bracteata*).
Plant associations for these rare plants include grasses; Gulf cordgrass (*Spartina spartinae*), little bluestem (*Schizachyrium scoparium*), whorled dropseed (*Sporobolus pyramidatus*), Texas Willkommia (*Willkommia texana*), brownseed paspalum (*Paspalum plicatum*), and silkyscale (*Anthaenantia*).
Below is a partial list of photographed native plant species, arranged alphabetically by families, Houston Coastal Center Prairie (Area 2) Galveston Co:

**MONOCOTS**

**AGAVACEAE**  
*Manfreda virginica*  
American aloe

**AMARYLLIDACEAE**  
*Cooperia traubii*  
Rain lily

**CYPERACEAE**  
*Carex meadii*  
Mead’s sedge  
*Rhynchospora caduca*  
Anglestem or falling beakrush  
*Rhynchospora colorata*  
White topped sedge

**HYPOXIDACEAE**  
*Hypoxis hirsuta*  
Yellow star grass

**IRIDACEAE**  
*Sisyrinchium angustifolium*  
Blue-eyed grass

**ORCHIDIDACEAE**  
*Spiranthes vernalis*  
Spring ladies tresses orchid

**POACEAE**  
*Andropogon gerardii*  
Big bluestem  
*Andropogon glomeratus*  
Bushy bluestem  
*Andropogon tenarius*  
Splitbeard bluestem  
*Andropogon virginicus*  
Broomsedge bluestem  
*Bothriochloa laguroides*  
Silver bluestem  

**POACEAE (continued)**  
*Eragrostis capillaris*  
Lovegrass  
*Muhlenbergia capillaris*  
Gulf muhly, hairyawn muhly  
*Nassella leucotricha*  
Texas wintergrass  
*Panicum virgatum*  
Switchgrass, upland switchgrass  
*Paspalum flavum*  
Florida paspalum  
*Paspalum plicatum*  
Brownseed paspalum  
*Schizachyrium scoparium*  
Little bluestem  
*Setaria parviflora*  
Knotroot bristlegrass  
*Sorghastrum nutans*  
Yellow indiangrass  
*Spartina spartinae*  
Gulf cordgrass  
*Tridens strictus*  
Longspike tridens  
*Tripsacum dactyloides*  
Eastern gamagrass

**EUDICOTS**

**ACANTHACEAE**  
*Ruellia humilis*  
Wild petunia, prairie petunia

**APIACEAE**  
*Eryngium yuccifolium*  
Rattlesnake master  
*Polystaenia nuttalii*  
Prairie parsley
EUDICOTS (continued)

APOCYNACEAE
- *Amsonia illustris*  
  Showy bluestar
- *Asclepias verticillata*  
  Whorled milkweed
- *Asclepias viridiflora*  
  Green milkweed

ASTERACEAE
- *Arnoglossum ovatum*  
  Indian plantain
- *Coreopsis tinctoria*  
  Plains coreopsis
- *Helenium flexuosum*  
  Purplehead sneezeweed
- *Helianthus angustifolia*  
  Swamp sunflower
- *Helianthus maximiliani*  
  Maximilian sunflower
- *Liatris acidota*  
  Slender gayfeather, blazingstar
- *Liatris bracteata*  
  Bracted gayfeather, blazingstar
- *Liatris pycnostachya*  
  Gayfeather, blazingstar
- *Rudbeckia hirta*  
  Black-eyed susan
- *Rudbeckia texana*  
  Texas coneflower
- *Silphium gracile*  
  Rosinweed
- *Solidago sempervirens*  
  Seaside goldenrod

CONVOLVULACEAE
- *Ipomoea sagittata*  
  Saltmarsh morning glory

EUPHORBIACEAE
- *Euphorbia bicolor*  
  Snow-on-the-prairie

FABACEAE
- *Baptisia sphaerocarpa*  
  Yellow wild indigo
- *Chamaecrista fasciculata*  
  Partridge pea
- *Dalea candida*  
  White prairie clover
- *Dalea purpurea*  
  Purple prairie clover

GENTIANACEAE
- *Eustoma exaltatum*  
  Bluebell gentians
- *Sabatia campestris*  
  Prairie rose gentian

LAMIACEAE
- *Salvia azurea*  
  Blue sage

ONAGRACEAE
- *Gaillardia aestivalis*  
  Yellow indian blanket
- *Gaura lindheimeri*  
  Large flowered beeblomson

PASSIFLORACEAE
- *Passiflora incarnata*  
  Passionflower vine

RANUNCULACEAE
- *Clematis crispa*  
  Blue jasmine, curly clematis

RUBIACEAE
- *Hedyotis nigricans*  
  Prairie bluets

SCROPHULARIACEAE
- *Agalinis heterophylla*  
  Prairie gerardia
Below is a partial list of photographed native plant species, arranged alphabetically by common names, Nash Prairie in Brazoria Co:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
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<tbody>
<tr>
<td>American bluehearts</td>
<td>Buchnera americana</td>
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<tr>
<td>Black-eyed susan</td>
<td>Rudbeckia hirta</td>
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<tr>
<td>Blue-eyed grass</td>
<td>Sixyrinchium angustifolium</td>
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<td>Buttercup, weak</td>
<td>Ranunculus pusillus</td>
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<td>Buttonbush flatsedge</td>
<td>Cyperus Cephalanthus</td>
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<td>Carolina larkspur</td>
<td>Delphinium carolinianum</td>
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<td>Coreopsis, plains tickseed</td>
<td>Coreopsis tinctoria</td>
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<td>Cutleaf evening primrose</td>
<td>Oenothera laciniata</td>
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<td>Heartwing sorrel</td>
<td>Rumex hastatus</td>
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<td>Hoaryypea</td>
<td>Tephrosia onobrychoides</td>
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<td>Indian paintbrush</td>
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<td>Ladies tresses orchid</td>
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<td>Swamp sunflower</td>
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<td>Yellowpuff</td>
<td>Neptunia lutea</td>
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<tr>
<td>Zigzag iris</td>
<td>Iris brevicaulis</td>
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</table>
Acknowledgements

More than 40 years ago, Glenn B. Aumann, Director Emeritus of the UH Houston Coastal Center, had the wisdom and foresight to protect and preserve the tallgrass prairie within its borders. I am grateful to Dr. Aumann for introducing me to our Coastal Prairie and for giving me the privilege of photographing this rare gem.

Special thanks to Peter and Susan Conaty who realized the worth of the Nash Prairie and Mowotony Prairie. Their tireless efforts and enthusiasm led to the preservation of two priceless prairies.

Special thanks to Jaime Gonzalez with the Katy Prairie Conservancy for giving me the opportunity to share in his work of educating the public, especially the next generation, on the importance and enjoyment of service in conservation.
References:


National Climatic Data Center
National Oceanic and Atmospheric Administration
http://www.ncdc.noaa.gov


Wildscapes: Habitats Attract A Diversity Of Wildlife, But Insects Are the Key To Success!

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Abstract
You’ve heard the saying “Plant it and they will come!” That’s the motto for any Wildscape garden. By carefully selecting the appropriate plants to provide the nectar, seeds, fruit, and larval foods for wildlife, we can create a working habitat. However, the true measures of success for any habitat are the insects in residence! From dragonflies to tiny pollinators, insects serve important roles in the habitat.
Sources, Shallows And Serendipities Of Water In A Sustainable Landscape

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Abstract
A question I want each of you to consider for the next ten minutes is -
If you don’t currently have a sustainable landscape, why not convert your yard to one?
and
If you have a sustainable landscape, join us in reviewing one of its fundamental features - water.

Sustainability seems to be one of the buzz words used in the current dialogue between those involved in what has developed into traditional landscapes over the last 70-75 years and those interested in a more connected holistic approach to the earth. Buzz words can lead to confusions, and in today’s dialogue this is readily apparent when sustainability and conservation are lumped together. These two ideas, value systems, perhaps cultures are not one and the same. Rather, in many instances, they involve similar processes but have distinguishable goals.
Defining sustainability and conservation is a start but doesn’t result in understanding or a playfulness that makes both ideas come to life. Words associated with conservation such as protecting, supervising, preserving lend themselves to a reactive maybe even defensive stance. In contrast sustainability is inclusive, strengthening, nourishing and potentially more ambitious than conservation. Taken together these two elements in a landscape are the best of all worlds.
A sustainable landscape, which we will investigate for the next half hour, is possible only with conservation of one of life’s most critical ingredients - water. Join me in what I hope will be an enlightening presentation.

I. ATTAINING WATER SUSTAINABILITY IN A LANDSCAPE*
SUSTAINABILITY is an idea; an idea that is developing and evolving -
SUSTAINABILITY is a process; a process that is exponential -
SUSTAINABILITY is a goal; a goal that if realized will change our world -
SUSTAINABILITY is an elixir -
SUSTAINABILITY is

“ACTING in a manner that improves our quality of life by balancing
economic vitality, a healthy vibrant community, and mindful stewardship of natural resources and the environment for current and future generations”

excerpted from the Pikes Peak Regional Sustainability Plan.

This statement is about as good as it gets as there is no universally accepted definition for the term SUSTAINABILITY. The Latin root of sustain “tenere” meaning to hold is pretty manageable and seems to fit the contexts in which SUSTAINABILITY is currently being used, but beyond that, discussion after discussion extends or limits the application of the ideas. Rather than investigate the range and depth of how or why SUSTAINABILITY is so difficult to get ones arms around, a brief review of the history of the idea is adequate for the context of this discussion.

Since its modern-day introduction as an approach to world-wide issues in the early 70s, the term SUSTAINABILITY has addressed at a minimum the three dimensions included in the Pikes Peak Plan - environmental, economic, and sociopolitical - with an additional mandate that present patterns must be evaluated for their impact on the future. The use of this trifurcated approach requires an understanding that these elements are not parallel. Environmental and sociopolitical dimensions are usually circular, overlapping and inclusive of each other while classic economics, possibly the most important of the three as an idea or man-made structure, has historically ignored both contrary to Adam Smith’s WEALTH OF NATIONS, Matthew Simmon’s LIMITS OF GROWTH, and Paul Hawken’s NATURAL CAPITALISM. Natural resources such as clean water, breathable air (as contrasted to air polluted from mineral extraction), and human health (as contrasted to human diseases) have not historically been line items in governmental or corporate budgets, profit and loss
statements, or other fiscal reporting forms. SUSTAINABILITY’S extraordinary potential to impact the present and the future must, therefore, include dollar values for society’s requisite intangibles - healthy people, clean air, and drinkable water. It is this collectivism this connectedness (the total is greater than the sum of its parts) of all three dimensions that makes SUSTAINABILITY a key idea now with significant reaches into the future.

This paper is a discussion about SUSTAINABILITY’S inclusiveness and connectedness. It is a story of how one resource - water - in one identifiable application - suburban and urban landscapes - connects with soil, air, manufactured items, human health, biological and botanical life, culture, and, and, and

II. WATER AND ITS CYCLE - ARE WE PART OF IT?

The water cycle is sometimes portrayed as a diagram of identified stages of water with raindrops moving from a gas to a liquid and back. The cycle, as an abstract idea, a model, requires specific atmospheric conditions to work. Liquid water with an appropriate temperature, the right wind currents, etc. on the surface of the earth evaporates as a gas. Evaporation rises, cools, collects into rain drops and falls back to the surface where it may percolate into the earth, settle into a lake, join the world’s oceans or end up elsewhere.

When botanical life is added to the water cycle transpiration occurs; when biological life is added to the water cycle evaporation and elimination both contribute. Neither of these forms of life can exist without water but both take water out of the cycle for periods of time. Looking at life forms that ingest and hold water it is possible to relate them to physical earth science forms of aquifers, lakes, and rivers as water is always on the move and only temporarily stored.
Is it significant that biological and botanical life are or are not including in the traditional water cycle? Is it significant that when botanical life is removed from the surface of the earth, evaporation rates change? Is it significant that as biological life increases more and more water is removed from the cycle? Does the water cycle model without botanical and biological life address SUSTAINABILITY? Is the cycle broken in a drought?

III. THE SUSTAINABILITY OF TREATED WATER USES IN OUR LANDSCAPES?

Since the end of WWII and the proliferation of urban life and suburban communities in the United States that require treatment of water and delivery infrastructures, water for the landscape has usually come from public water providers - districts and utilities. In some locations sources of water are wells (ground water); in others water comes from lakes, rivers, reservoirs (stored surface water) often fed from a combination of sources.

About this same time period, the middle to late 40s, a house in the suburbs with a green lawn covering the front yard became the standard for much of America from the deserts of the southwest to the villages of New Hampshire. The end of the conflicts in the European and Asian theaters, the development of plastic from petrochemicals, and the conversion of natural resources into electricity made it possible among other changes to maintain a landscape of green in the suburbs that featured turf, the green lawn part of this idealized picture. Rain water just wasn’t dependable enough if one wanted green most of the year and irrigation systems built from plastic pipes, valves, etc. became the norm. The costs of extracting the petroleum from the earth, the distillation of the petroleum, the manufacturing of the plastics requiring water and energy and creating pollution of the air and water, the delivery of the products requiring roads and automobiles/trains, and the disposal of
these products as they break down and are taken to landfills where they do not degrade are not reflected in the price of the products. As society subsidized more and more of the steps required to establish and maintain a green lawn, the tradeoffs have been ignored. Today, turf, these green lawns that many homeowner associations require individuals to maintain, is the one plant in America that covers the most acreage - more acreage than food crops, or cotton or hay. In addition these green lawns/turfs receives 50 - 65% of the treated water delivered to a residence.

There were a number of factors that contributed to this end result of lawn-mania. Hydrology, the science of water, was poorly understood so except for an occasional extreme event, water was available almost magically when the faucet was turned on. The costs of water have been kept artificially low by accounting systems that ignores many of the components that make potable water available. Because the resource seemed endless and pollution was possibly not understood, it was merely a matter of treating and moving from one place to another. Ownership of water via water law, developed long before WWII, just wasn’t an issue; in the west where water was scarce the law was adjusted so that even though it was significantly different from the water law in the east where water was abundant it all seemed to work out without too much conflict. And as companies moved employees from the east coast to western areas such as Phoenix, Los Angeles, San Antonio the establishment of green lawns in arid areas was possible, probable, and a reality. Water wasn’t an issue; water wasn’t a concern; it was good, it was safe, it was artificially cheap.

In some areas before the turn of the century and more broadly by the turn of the century awareness about water and its uses began to change. Research into how stages of the water cycle are impacted by human activities and the possibility that water is a finite resource
became accepted. Increases in population in urban and suburban areas began to be felt by the water industry as infrastructure demands expanded and more and more water was needed to satisfy a families’ indoor needs let alone outdoor/grass needs. Summertime peak demands became part of the vocabulary in many urban settings resulting in increased water providers’ expenditures necessitated largely by the desire to water landscapes during hot weather. Pollution from industry, from agricultural activities, and from urban areas due, among other things, to treatments used on lawns have become a concern.

Currently in Texas and many other areas throughout the United States, water districts provide water treated for human consumption to residents. Referencing an often quoted number to get the idea across the average resident in Texas uses 150 gallons/day of treated water. What the average Texas uses this water for is of course each Texans’ choice. However, another commonly referenced statistic is that 50 to 65% of the treated water delivered to a residence is applied to the landscape which is predominately irrigated turf.

The costs and treatments of water are increasing. We are pumping our aquifers dry. Subsidence is occurring in numerous areas. Water is increasingly being polluted. We are in a drought. The Texas Water Development Board projects that the population will increase, the supply of water will decrease, and that we will experience an inadequate water supply to maintain the current quality of life during our lifetimes.

Do the projections just referenced fit SUSTAINABILITY ideas, processes or goals? Treated water requires energy to move from its source to a treatment facility; it requires energy to treat as well as the energy expended to obtain the chemicals and equipment required for treatment; it requires energy to distribute and then our irrigation systems
distribute 50% or more of this water down the storm drain as our landscapes cannot absorb what we apply.

SUSTAINABLY the question has to be asked. Does using treated water in the landscape constitute “acting in a manner that improves our quality of life by balancing economic vitality, a healthy vibrant community, and mindful stewardship of natural resources and the environment for current and future generations?”

IV. DOES COLLECTING ALTERNATIVES TO TREATED WATER FOR USE IN A LANDSCAPE CONSTITUTE SUSTAINABILITY?

Sources of untreated water for use in the landscape include rain water, condensate from air conditioners, gray-water and dew. All of these alternative sources of untreated water except dew require containerization before distribution. What and how the containers are manufactured and delivered to a site becomes a component when SUSTAINABILITY is the goal. Recycled products are a great start down the right path. When a local source is the origin of the recycled item a couple of significant steps toward SUSTAINABILITY are realized.

Currently there are dozens if not more rain barrel styles and appliances available. THE TEXAS MANUAL ON RAINWATER HARVESTING published by the Texas Water Development Board is a great resource if basic information is needed. In addition to this manual most Master Gardener programs have information and individuals available to help get the collection started. Rain water can be collected and distributed SUSTAINABLY through a process of investigation, learning from others, and sincere intent, or it can be the
latest fad. Be sure before getting too involved to check with the homeowner’s rules under which you live.

Collecting air conditioners condensate is addressed by a variety of plumber codes in cities and counties throughout Texas. Distribution of the condensate into landscapes is sometimes spelled out but at the outside usually okay unless specifically prohibited. Thanks to the availability of plastic hoses, piping, etc. distribution isn’t usually an economic issue but manufacturing of the materials themselves, the chemicals used to condense the moisture, the energy required to run the unit - all are part of the equation to determine SUSTAINABILITY of the practice. Relevant information may be found in Chapter II of the International Building Code as amended to reference the Texas Accessibility Standards (TAS).

Gray-water is another source of water for landscapes although is usually arrives at a residence as treated water and flows through a meter before becoming gray-water. Santa Barbara CA was the first city in the United States to codify the collection and treatment of gray-water. The moniker, gray, indicates a liquid less contaminated than black water which contains human excrement but not as “pure” as potable water that is considered clear or white. Texas has addressed the collection and use of gray water in Section 26.0311 of the Texas Water Code. SUSTAINABILITY issues with equipment to process this resource are relevant as there are health concerns addressed by Section 341.039 of the Texas Health and Safety Code.

Morning dew on the grass and weeds is apparent if one is out and about before the sun evaporates this moisture. Is it serendipity or are these plants just very clever in their abilities to obtain moisture and if so why are they ignored, dug out, herbicided, and often
identified as invasive without studying their survival techniques? What are their secrets? Could it be their root structures? Could it be the number of their stomata? Could it be the texture of their stems? Could it be the shapes of their leaves? If these plants are so successful (they are green and some even flower - as long as they aren’t invasive) do they have a role in a SUSTAINABLE landscape?

The sources of all the above water except gray-water certainly can conserve or eliminate the use of treated water in the landscape when the landscape is designed or maintained for efficient water use. Gray-water meets a different criteria that has value in its own right when considering the overall picture. Ultimately the conservation of capturing and distributing untreated water in recycled locally obtained containers is a step in the right direction and contributes to SUSTAINABILITY. But beyond this step?

V. SUSTAINABILITY REQUIRES A REEVALUATION OF LANDSCAPES THEMSELVES - A HOLISTICALLY APPROACH OF HOW AND WHAT WE DO

Actual experiences working with SUSTAINABILITY ideas, processes, and goals are happening across America and around the world. These experiences are happening in a garden in Spring, Texas as a result of the involvement of a water district’s board of directors stepping up to the plate and providing leadership. Harris County’s Water Control and Improvement District 132’s Board of Directors is responsible, among other mandates, for providing potable water to its constituents but hasn’t limited itself to this dimension. The Directors’ scope of involvement includes an awareness of the water world’s challenges; sponsoring conservation programs similar to those being tried by other Districts across
America, and educating itself about projections and options for Texas’ current drought and future demands.

This water district has approximately two acres of land that the Board began developing into a demonstration and research garden for visitors almost two years ago. The original goal was to create a place for visitors and constituents of the water district to experience various water conservation techniques ranging from collecting water to growing native plant life that once established thrives with only rainwater and mulch resulting in an overall healthy habitat.

In the process of thinking about this garden the Board became aware of The Sustainable Sites Initiative and applied to be a pilot program site. The Sustainable Sites Initiative, SITES, information is available online at www.sustainablesites.org. The water district site was selected and in keeping with the broader objective of SUSTAINABILITY the water district’s goals for the garden changed. Over the months as work has progressed on creating/changing a traditional garden and healthy stand of invasive plants into what is becoming a SUSTAINABLE site, more has been learned than was ever imagined before working with SUSTAINABILITY.

Practices focusing on water at the Garden have migrated from conserving treated water in the landscape to an awareness of the uses of water in manufacturing, agriculture, energy; collecting untreated water to maintain trees and plants after augmenting the soil to efficiently utilize the water; and developing ways to hold the water collected in the landscape so it not only benefits plants but alleviates storm drain overflows. Basically the practice of holding untreated water on the landscape has resulted in (1) digging holes (rain gardens), creating berms, making indentations in the earth (after evaluating soil structure),
(2) changing the slope of the landscape. Current builders and landscapers shape landscapes so that the land around buildings slopes into the street creating lost irrigation water and rainwater that flow into the street and down the storm drain instead of percolating through the earth, and (3) improving the quality of water entering bayous and the Gulf by eliminating the use of pesticides and herbicide on the site. The garden landscape now holds water in flower or vegetable beds furrows and shallow trenches. Rain gardens, bogs, detention ponds - all these shapes found at the Garden - do the same thing. They collect and hold water; they contribute to SUSTAINABILITY.

These few items are only a beginning, possibly a baby step toward SUSTAINABILITY. The Board knows that changing landscape ideas isn’t any easier than any other of life’s changes. With the help provided by the Sustainable Sites Initiative Guidelines the changes that have been made are basic changes - simple, slow, and steady efforts. The Board of Director’s collective passion for doing the best it can for its constituents has come from each of the individual members, but it is the unified effort, the contributions of each to the whole that has created the strength and scope of this unfolding SUSTAINABLE garden. Creating this SUSTAINABLE site has released creativity, utilized experiences from Board member’s pasts, forced realistic goals, and resulted in change. The old often quoted saying by Lao Tzu fits very well “a journey of a thousand miles begins with a single step”.

My challenge to each of you as you leave here today is take the next step. If you are involved in SUSTAINABILITY through recycling, capturing untreated water, or whatever, there are additional steps you can take. If you aren’t practicing SUSTAINABILITY start today with whatever small step will work for you. With or without the current drought each
of us has the obligation to commit to SUSTAINABILITY in our landscapes. Remember SUSTAINABILITY is an idea, its a process, its a goal and it will only be an elixir if we join hands and make it happen. Brian Fagan wrote in his important book Floods, Famines and Emperors that

...... For thousands of years we have been predators on earth, taking and exploiting rather than giving back, using up finite resources on the mistaken assumption that we were the appointed masters of the world. We have destroyed forests; eroded topsoil; polluted and altered the atmosphere; poisoned oceans, rivers, and lakes...

AND

the uncertainties that confront us are daunting, but with the crisis not yet upon us, there is still hope.

SUSTAINABILITY’S ideas, processes, goals give us a way to realize this hope in YOUR landscape AND MINE

* landscape throughout this document mean suburban or urban landscapes
**gray-water is interchangeably spelled grey-water
*** see legislative changes from the 2011 legislature for homeowner associations, section 202.007
Prairie Restoration as Barn Building
Lessons Learned in Community-based Conservation

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Abstract
Traditional communities have long built (raised) barns as a way of strengthening community bonds while at the same time meeting a very real need – creating new barns. Involving local communities in restoring habitats, including prairies, can have similar benefits. Conducting a systematic, community-based restoration can increase awareness and ownership of habitats, help create educational spinoffs, and help restorationists find non-traditional funding and volunteer resources. This lecture will focus on the successes and challenges of one community-based prairie restoration project (Project Blazing Star) and will engage participants in a discussion on how such projects can be scaled up to meet ever-more-ambitious conservation goals.

Presentation may be found at:
The TXNDD: A Tool For The Conservation of Rare Populations of Plants

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Abstract  
TPWD’s Texas Natural Diversity Database (TXNDD) is a clearinghouse for information on populations of rare species. Currently we track over 200 species of plants in Texas, and we make this information available to conservation decision makers across the state. In this talk I will review how we collect, map, organize, and disseminate data according to the natural heritage methodology. This methodology is followed by programs across the NatureServe network in all 50 states. In many states there is a powerful relationship between heritage programs and native plant societies. Texas Native Plant Society members already contribute to the TXNDD, and we look forward to collaborating on plant conservation into the future.

Will this development project impact any important plant populations? How many populations are left? Is this species endangered? These are some of the critical questions that arise when it comes to plant conservation, and Texas Parks & Wildlife Dept. (TPWD) has a database designed to help answer them. The Texas Natural Diversity Database (TXNDD) tracks important populations of plants so that we can provide the data needed when it is needed. It is a powerful tool for making sure rare plants and plant communities are taken into account when important conservation decisions are made. NPSOT and the TXNDD are natural allies when it comes to supporting research and conservation of native rare plants, and NPSOT members are important contributors to the database. Our current challenge is to make sure known populations are represented in the database, and NPSOT is recognized for their valuable contributions to rare plant conservation.
Background

The TXNDD, established in 1983, is TPWD’s most comprehensive source of information on rare, threatened, and endangered plants, animals, invertebrates, exemplary natural communities, and other significant features. The TXNDD is part of a nation-wide network of natural heritage programs known as the NatureServe network. Programs across the network use a consistent methodology for compiling data on features with significant conservation value, which allows us to aggregate data at a national scale and compare information across state borders.

The TXNDD collects data from a diverse set of sources including: museum and herbarium collections, peer-reviewed publications, experts in the scientific community, conservation organizations, qualified individuals, and on-site field surveys conducted by TPWD staff. However, the TXNDD does not accept data that was collected while trespassing or without consent of the landowner. Once data is submitted, it is mapped and entered into the database using the natural heritage methodology. Data is then publicly available and is disseminated upon request by species or by geographic area.

What does the TXNDD track?

**Element**: Unit of natural biological diversity, representing species (or infra-species taxa), ecological communities, ecological systems, or other non-taxonomic biological entities, such as migratory species aggregation areas.
**Element Occurrence (EO):** *Area of land and/or water where a species or natural community is or was present and has practical conservation value.*

The EO is the fundamental unit of the natural heritage methodology and the basis for the TXNDD. At a minimum, every EO record has a defined Element and Location. An Element can be a species, ecological community, or animal aggregation. Currently, we track 735 different elements in Texas.

Number of elements and EOs tracked by the TXNDD:

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Elements Tracked</th>
<th>Number of EOs in the TXNDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants</td>
<td>231</td>
<td>3767</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>158</td>
<td>169</td>
</tr>
<tr>
<td>Vertebrates</td>
<td>242</td>
<td>2897</td>
</tr>
<tr>
<td>Animal Aggregations</td>
<td>6</td>
<td>1025</td>
</tr>
<tr>
<td>Plant Communities</td>
<td>98</td>
<td>852</td>
</tr>
<tr>
<td>Total</td>
<td>735</td>
<td>8710</td>
</tr>
</tbody>
</table>

Each record has a spatial representation which is mapped according to natural heritage methodology mapping standards. In addition to providing consistency, this methodology enables us to consolidate nearby observations taken from multiple years into a discrete record, or EO. Thus, each EO provides a comprehensive summary of what is known about that population over time. It may consist of a single observation from a single day, or it could include hundreds of nearby observations from multiple observers taken over the course of several decades.

The bare minimum for an EO is the Element identification and location, but each EO record is a compilation of observations and related information for that location. Rare plant EOs are a repository of information on population size, reproductive condition, habitat descriptions, associated species lists, land tenure, threats, and other management issues.
With sufficient information EOs can be ranked based on their probability of persistence; which is critical to evaluating their value to conservation.

Whenever someone contributes to the TXNDD, their raw data, photographs and other supporting documentation is referenced and archived. Each EO lists the references they are based on so if someone needs more detailed information, they can go back to the original data. These references are an invaluable resource that will provide a historical context to future research and conservation efforts where EOs are documented.

**Who uses the TXNDD?**

The TXNDD produces around 100 reports a month to environmental consultants, government agencies, conservation organizations, scientists, and others. For example, an element request is made when a government agency is evaluating the status of a species, or a researcher is studying the population genetics of a species.

TXNDD plays a vital role in the environmental review process in Texas. Consultants often request data from the TXNDD early in the development stage of projects such as roads, pipelines, cell towers, etc. Therefore, it is very important to represent rare plant populations in the TXNDD. Populations not represented in the TXNDD may not be considered in the project review process. Even when a population is on protected property, its presence draws attention to nearby populations because consultants become aware that it could be in the area. When TPWD’s Habitat Assessment Program evaluates a potential project, they use the TXNDD to evaluate the potential impact on known populations and the availability of habitat in the vicinity of the project.
TXNDD and NPSOT: Natural Allies

NPSOT and the TXNDD are natural allies in rare plant conservation. NPSOT has chapters and members across the state. NPSOT members have expertise on local populations, access to undocumented populations, and the manpower to go out and explore new areas as well as revisit known sites. The TXNDD is a tool that can maximize the conservation value of NPSOT knowledge by making it available to researchers and conservationists when they need it and in a format that they can use.

NPSOT chapters can add to the database either by documenting new populations or checking on populations already in the database. The TXNDD can provide a reporting form and a list of EOs in your chapter area. In addition, chapters may already be involved in projects involving populations of tracked species. If so, any project reports would be an ideal source for the TXNDD.

Finally, NPSOT members are already submitting data on rare plants and will continue to be a valuable source of information for the TXNDD. It might be in the interest of NPSOT to start tracking these contributions with the goal of supporting members who contribute to our understanding of rare plants and to highlight the importance of NPSOT to rare plant conservation.
Plant species tracked by the TXNDD:

<table>
<thead>
<tr>
<th>Abronia ameliae</th>
<th>Centaurium blumbergianum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abronia macrocarpa</td>
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<td>Croton pottsii var. thermophilus</td>
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### Plant species tracked by the TXNDD (continued):

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Functional Assessment of Coastal Marsh Plant Communities at Four Restored Sites in the Galveston Bay System

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Abstract
Coastal marsh ecosystems anchored by smooth cordgrass (*Spartina alterniflora*) are extremely productive and provide a number of ecologically critical functions and services. In response to the substantial loss of marsh communities in Galveston Bay over the past 50 years, active restoration of numerous coastal wetland systems have been undertaken. The restoration of Pierce Marsh, in the lower Galveston Bay system (1999-2006), employed four different design techniques: filled levees and grid, sinusoidal and zigzag terraces; each restored area was planted with *S. alterniflora* on approximate 3-ft centers. In 2007-2008, we evaluated the functional success of each restoration design, compared to a natural marsh reference site, focusing on *S. alterniflora* density, biomass and productivity, sediment macronutrients, and diversity of naturally established marsh plants. The reference site functional measures exceeded those of all four restoration designs, particularly in sediment macronutrients and corresponding shoot densities and plant productivity.

Introduction
Coastal marsh ecosystems in Galveston Bay and along the upper Texas Gulf coast are critical to the ecological function of many species among many trophic positions. These marshes are typically anchored by smooth cordgrass (*Spartina alterniflora*), a hearty species that grows naturally wherever the sediment type and salinity regime are conducive. *Spartina*
marshes are some of the most highly productive communities in the world: they export nutrients into the estuary, function as wave buffers in times of tropical storm activity, provide shelter and nourishment for the juvenile stages of many marine invertebrates and fish, and serve as habitat for resident and migratory waterfowl. For example, shrimp and blue crab production has been correlated with the availability of wetland habitat in estuaries, and habitat use modeling suggests that tidal fringe and submerged aquatic vegetation are more valuable than non-vegetated shallow bottom when examining habitat use by brown shrimp (Minello, 2004 and references therein). Additionally, benthic infauna that are nutritionally important for penaeid shrimp are most abundant in vegetated habitats within lower Galveston Bay and shrimp growth is positively correlated with the abundance of marsh epiphytes and phytoplankton (Minello, 2004 and references therein).

White et al. (1993) estimated that wetland loss in the Galveston Bay system has exceeded 45,000 acres since the 1950’s. Much of the loss can be attributed to subsidence, conversion to upland uses, isolation of wetlands, and dredge and fill activities (White et al., 1993; Ward and Armstrong, 1992). The Galveston Bay Plan (Galveston Bay National Estuary Program, 1995) identifies lost or degraded habitat as a top problem in the bay system. The plan’s first priority is to protect and restore coastal wetland habitats. In support of this mission, several million dollars have been spent creating and/or restoring numerous estuarine marshes in the Galveston Bay system over the past 15 years. As these projects have been implemented, the methodology has evolved concurrently based on “lessons learned” during the construction and implementation. Projects have evolved from simply planting along a shoreline that appears suitable, to construction of terraces, mounds, and islands of various sizes and shapes to create variations in elevation and marsh edge, which
provide habitat for a number of different species. Dredge material is commonly used for marsh restoration activities, and can involve the use of wave breaks and containment levees.

In general, the success of individual projects has been measured by either the amount created of vegetated area (acre/acre) or fringe (low) marsh (linear foot/acre). Although some of these created/restored marshes have been monitored for plant density (primarily *S. alterniflora*), marsh expansion, and use by nekton, some studies indicate that there may be a need to evaluate created and restored marshes to determine success at the functional level and tailor restoration strategies accordingly. Minello and Webb (1997) found that some created marshes in their study exhibited significantly lower densities of decapod crustaceans than natural marshes up to 15 years after construction. This suggests that the productivity of a created marsh may not be a simple matter of planting the appropriate vegetation, but may be related to other factors important in natural marshes, such as sediment composition, infauna, and total low marsh edge (Minello, 2004; Rozas and Minello, 2001; Whaley and Minello, 2002).

Our study examined whether functional differences are achieved through different marsh restoration techniques. The study area, Pierce Marsh, is comprised of 2,346 acres of mixed high, mid, and low marsh surrounding an open water embayment. Nestled between Highland Bayou to the north and Basford Bayou to the south, and located along the Central Migratory Flyway, Pierce Marsh supports wintering ducks as well as a variety of shore and wading birds, and supports invertebrate and vertebrate fishery species, which rely on the protected waters of the marsh for breeding and foraging (Galveston Bay Foundation, 2003 and 2008). Inflows from Highland Bayou and limited sheet flow from adjoining uplands provide freshwater into the marsh. These freshwater inflows are balanced against tidal inputs
of brackish and saline water from west Galveston Bay to the south. Hydrologic changes to the site were caused by a combination of ground subsidence and development, which diverted overland sheetflow and reduced the supply of nutrients and sediment to the marsh. Large areas of emergent marsh within the Pierce Marsh Complex have become open water as a result of land surface subsidence. However, since subsidence rates in the Galveston Bay system have been declining, it has been possible over the past decade to restore wetlands that had become shallow open-water.

Restoration of the Pierce low marsh began in 1999 and proceeded as funds were available through 2006. A primary reason for choosing Pierce Marsh as a study location for this research was that several different projects were conducted within this single marsh complex, allowing for a more direct comparison among different restoration techniques. Restoration within Pierce centered around variations of terracing techniques where shape and relative position of the terraces differ. Terracing involves “borrowing” sediments from the bottom and stacking them to form linear berms which are then planted with S. alterniflora at an elevation generally between the low and high tide lines (Fig. 1). An alternate method also represented in Pierce includes a beneficial uses marsh composed of a leveed area arranged to trap fluid sediments that are pumped in using a hydraulic dredge until elevations of the ultimately consolidated material within the levees are sufficient to support S. alterniflora. The fill within the levees often takes on an irregular elevation across the cell, resulting in a mosaic of elevations and flooding characteristics throughout each cell.
Four areas of the marsh have been the focus of low marsh restoration efforts since 1999 (Fig. 2 and Fig. 3):

- Grid terraces (GRD/PRC2): constructed in 1999; 153 terraces in a 63-acre area
- Sinusoidal terraces (SIN/PRC3): constructed in 2001; 41 terraces within a 49-acre area, and including oyster shell on the crown of each terrace for colonial bird nesting use
- Zigzag terraces (ZIG/PRC4): constructed in 2004; 49 terraces within a 25-acre area
- Beneficial uses marsh (BUM/PRC5): constructed in 2005; approximately 200 acres total within the levees
Figure 2. Aerial view of Pierce Marsh complex showing the locations of the reference site (PRC1), four restoration sites (PRC2-5), and open water site (PRC6).

Figure 3. Photographs of the four designs used to restore marsh habitat in the Pierce Marsh complex, with dates the sites were constructed and planted with S. alterniflora.
Each restoration area was designed by a professional engineering company and executed in the field by professional contractors. Planting at each site was conducted by volunteers, often over the course of several weeks or months, depending on the availability of plants, transportation, and volunteers (Galveston Bay Foundation, 2003 and 2008).

The choice of different designs among the four sites was related to needs-based criteria, such as the need to maximize low marsh edge and minimize erosive wave fetch, to incorporate specific habitat types (i.e., nesting habitat for colonial waterbirds), the area (acreage) and bathymetry in which the restoration was to occur, the texture and consistency of the sediments in the restoration area, and the availability of sediment (i.e., beneficial use of off-site dredge material or use of on-site borrow material). Design changes from one restoration project to the next were often selected to address perceived problems in previous restoration efforts, based on observations after the restoration sites were completed. Post-construction reports often indicated success, based on anecdotal observation with little “hard” data beyond simple plant coverage.

Previous research in Galveston Bay and other locations has indicated that there are nearly always significant functional differences between created/restored marshes and natural reference marshes, particularly in infaunal and nekton densities (Rozas et al., 2005; Rozas and Minello, 2001; Minello and Webb, 1997). Studies have also emphasized the importance of increased marsh edge when examining natural reference marsh production relative to created marsh production (Rozas and Minello, 2001; Whaley and Minello, 2002). The organic content of reference marshes relative to created marshes has also been noted as significant, as has the “mosaic” or patchy nature of the marsh edge and vegetation in natural reference marshes relative to terraced marshes (Edwards and Proffitt, 2003; Feagin and Wu,
Our research assessed the function of four restored sites within the Pierce Marsh complex on West Galveston Bay, relative to a natural, unrestored reference site in the same complex. Pierce Marsh offers a unique opportunity to study several different marsh community parameters within different restoration techniques, all within one general area or complex, which allows a comparison among sites that are similar in water quality and other environmental conditions.

The specific objectives of this study were to (1) compare four restoration designs and a natural reference site within the Pierce Marsh complex using plant species richness, diversity and coverage, S. alterniflora productivity (chlorophyll, root/shoot biomass and leaf metrics), and (2) compare the abiotic components important to function in the same four restoration sites, reference and an open water site (shallow, subsided, unvegetated, open water and targeted for future restoration) within Pierce Marsh using sediment texture and macronutrients and heavy metal content. Results from only the first objective will be covered in this paper.

**Methods**

An aerial map of the Pierce Marsh complex was overlain with a numbered grid pattern. The locations of three transects (A, B and C) for each restoration type were selected using a random number generator (Fig. 2). All sites were sampled in August/September 2007 and July/August 2008. Access to the sampling areas was provided by airboat or outboard.

Transects were established at the reference (REF) site by setting the origin close to the marsh edge and recording the GPS coordinates, then extending a line 20 meters into the
marsh, perpendicular to the edge. Three stations were established along each transect: one at the origin (Station 1), one at the 10-m mark (Station 2) and one at the 20-m mark (Station 3). Transects were established at the restored sites (GRD-grid, SIN-sinusoidal, ZIG-zigzag and BUM-beneficial uses material) by setting the origin at the edge of one side of the berm and recording the GPS coordinates, then extending a line 20 meters diagonally across the berm to the edge on the other side. Three stations were established along each transect: one at the origin (Station 1), one at the 10-m mark in the center of the berm (Station 2) and one at the 20-m mark on the opposite side (Station 3).

At each station, a 1/16m² plot was set to the right of the transect and a 1/4m² plot was set to the left. All shoots of *S. alterniflora* in the 1/16m² plot were counted and recorded (shoot density), then all *S. alterniflora* shoots and roots were dug out of the plot and placed in large plastic trash bags. At the laboratory, the samples were washed to remove sediment and all of the shoots were carefully separated from the roots. Shoot and root material from each station was weighed (wet weight), then dried at 105°C for 24 hours and reweighed (dry weight). Biomass was recorded in grams dry weight.

All plants in the 1/4m² plot were identified and their relative coverage within the plot were recorded, as well as the percentage of the plot that was unvegetated. Five additional shoots of *S. alterniflora* were collected randomly from within three meters of the station and the following metrics were recorded for each plant: shoot length; number of leaves; length, width, thickness and chlorophyll comparison index (Minolta SPAD 1500) of the newest leaf; length, width, thickness and chlorophyll comparison index of the oldest living leaf.

Data from all field and laboratory analyses were entered into Excel spreadsheets. Analysis of variance and regression analyses (Minitab v.15) were used to determine
significant differences ($p \leq 0.05$) among the reference and restored sites on the basis of $S. alterniflora$ metrics, biomass, productivity, and site species richness and diversity.

**Results and Discussion**

Within the Pierce Marsh complex, an undisturbed reference site (REF), four restoration sites (GRD, SIN, ZIG and BUM) and an open water site (OPN) that may someday become a restored marsh site were all studied in this project. At each site, plant material and sediment from three stations along each of three transects were collected in 2007 and 2008 (a total of nine stations per site per year). This study was designed as a pilot for future monitoring and analysis of the different restoration designs in Pierce Marsh.

The sediment used to create the grid terraces (GRD/PRC3), the sinusoidal terraces (SIN/PRC4) and the zigzag terraces (ZIG/PRC2) came from adjacent bay bottom. The sediment in the beneficial uses material (BUM/PRC5) leveed site was donated from within the canal system of a nearby, incomplete development that was started in the 1970’s. Variables important to consider in analyzing which, if any, of the designs is the most ecologically successful include the age of the restoration site at the time of this study (which ranged from two to eight years) and the actual design strategy.

Total plant coverage was significantly higher ($p \leq 0.05$) in the REF marsh (mean of 70% coverage) than in the restored sites (35-50%), with coverage in the ZIG site just half of that found in the REF site (Fig. 4). Total coverage at GRD, SIN and ZIG was negatively affected by the absence of $S. alterniflora$ at the berm midpoints (Station 2) at each of these sites. Coverage by $S. alterniflora$ ranged from 10% (ZIG) to 50% (BUM) and was more dependent on restoration design than by site age.
Biomass of *S. alterniflora* shoots was significantly higher (*p* ≤ 0.05) in the REF and BUM marshes than in the other restored sites, with lowest shoot biomass occurring in ZIG (Fig. 5). Shoot length of *S. alterniflora* at BUM was significantly higher than at REF or any of the other sites (data not shown); the larger plants and higher biomass could be the result of the fast growth of young *Spartina* and/or possibly a different ecotype. We currently are investigating ecotypic variation in *S. alterniflora* from sites throughout Galveston Bay in a parallel project and will be able to address this factor soon.

![Figure 4. Comparison of total plant cover and *S. alterniflora* cover among reference and restoration designs in the Pierce Marsh complex (REF = reference, GRD = grid terrace, SIN = sinusoidal terrace, ZIG = zigzag terrace, BUM = beneficial uses material).](image-url)
One of the most striking results of this study was the difference in *S. alterniflora* root biomass. Root biomass in *Spartina* from the REF marsh was three (ZIG) to fifteen (GRD) times higher than that from the restored sites (Fig. 5). The age and undisturbed nature of the REF marsh surely factored into the tremendous root biomass; however, there was no relationship between site age and root biomass at the restored sites. High root biomass is essential to the overall productivity and ecological services provided by salt marshes, e.g., stabilizing sediments and exporting nutrients.

One of the most important measures of success of a plant community is its level of primary productivity. For the Pierce Marsh project, chlorophyll $a$ was calculated from the SPAD measurements taken on individual *S. alterniflora* leaves in the field ($\text{Chl } a (\mu g/cm^2) = 3.429 + 0.208[\text{SPAD}])$ (Biber, 2007) and primary production was calculated as $3.7 \text{mg C / hour}$.
Using this approach, the average productivity for individual *S. alterniflora* plants was highest at the ZIG site and lowest at the BUM site (Fig. 6). However, combining this data with the shoot density data for each station, the most productive areas were the REF marsh and the ZIG and BUM restored sites. Although individual plant productivity was comparable to the other sites for *S. alterniflora* from GRD and SIN, the station productivity values were depressed due to low *Spartina* coverage (<15%). It is also notable that the high productivity of *S. alterniflora* at the ZIG site occurred in spite of this site exhibiting the lowest biomass values among the restored sites.

![Figure 6. Comparison of individual *S. alterniflora* plant productivity and total station productivity among reference and restoration designs in the Pierce Marsh complex (REF = reference, GRD = grid terrace, SIN = sinusoidal terrace, ZIG = zigzag terrace, BUM = beneficial uses material).](image-url)

Although the lowest station *Spartina* productivity among the Pierce Marsh sites occurred at GRD, this site supported the highest number of plant species at 11, compared to
the next highest richness of six at SIN (Figs. 7 and 8). The diversity of species inhabiting GRD included sea oxeye daisy (*Borrichia frutescens*), big-leaf sumpweed (*Iva frutescens*) and several others that were not found at any of the other sites. Only one species, *S. alterniflora*, was recorded at BUM, although other species were noted off the transect. Five species were recorded from the REF marsh.

![Bar chart showing plant species richness among reference and restoration designs in the Pierce Marsh complex.](chart.png)

**Figure 7.** Comparison of plant species richness among reference and restoration designs in the Pierce Marsh complex (REF = reference, GRD = grid terrace, SIN = sinusoidal terrace, ZIG = zigzag terrace, BUM = beneficial uses material).
Conclusions

Recent studies examining restored estuarine marshes indicate that significant differences are typically found between the restored sites and comparable reference sites (Edwards and Proffitt, 2003; Feagin and Wu, 2006; Minello and Webb, 1997; Rozas et al., 2005; Rozas and Minello, 2001; Whaley and Minello, 2002). Possible reasons for these differences have been attributed to an outright lack of low marsh edge and/or erosion at the marsh edge of terraces (Rozas and Minello, 2001), to differences in sediment content (Edwards and Proffitt, 2003), to irregular patterns of plant growth, and the corresponding low marsh edges and subsequent flooding characteristics found in natural marsh versus terraced marshes (Feagin and Wu, 2006; Minello and Webb, 1997).
Pierce Marsh offers a unique opportunity to examine these restored marshes at a functional level over a number of years as they transition from newly created marsh systems to a state of peak function and services. Here, different restoration methods can be directly compared, as these systems are subject to very similar environmental factors (i.e., sediment regimes, salinity regimes, etc.). This study examined whether functional differences are achieved through different marsh restoration techniques. While this is made somewhat difficult due to the relative age of each restored site, real differences were noted among the restored sites, and between the restored sites and the reference site, particularly when examining macronutrient values in the sediments and corresponding shoot densities, and when examining plant productivity among the sites.

This study should be viewed as a pilot study for ongoing data accumulation for these factors over a several year period. Based on this study, not one of the four restored sites is functioning at the same level as the reference site. This would agree with other research conducted in Pierce (Feagin and Wu, 2006; Rozas et al., 2005). These studies also recommend that restoration projects should maximize the area of marsh vegetation and create a high degree of water to marsh interspersion in order to function at a level most representative of low marsh reference systems (Feagin and Wu, 2006; Rozas et al., 2005). This study examined one restoration site (BUM) that is substantially different in restoration methodology than the other three. This site appears to include, by virtue of the irregular pattern of elevation created by the fill in the levees, an interspersed edge similar in outright appearance to the reference marsh. As this site has been only very recently restored (2005), it is obviously still in transition. However, already it appears to be more similar to the reference sites relative to the other restoration sites by its $S.\ alterniflora$ shoot biomass and
productivity. It will be interesting to track the development of the plant and infaunal communities, as well as changes to the sediments that may occur as these communities mature, to see which, if any, of these sites achieve a functional equivalence to the reference site and how long that may take among these sites.

**Literature Cited**


An Overview of the Ecology of the Texas Coastal Wetlands

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Abstract
The Upper Gulf Coast of Texas presents a world-class diversity and quality of wetland habitats that is little appreciated by most that live here. In this presentation, I review the geologic origin and biophysical evolution of this unique landscape. I will also address prospects for the conservation of ecologically intact remnants of this once-vast landscape. Finally, I will review regulatory issues associated with our Gulf Coast pothole wetlands and some recent research that might have some impact in this arena.
Restoring Estuarine Marsh Habitat with Beneficial Use of Dredged Material at Goose Island State Park

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Abstract
Goose Island is exposed to wind-driven waves crossing Aransas Bay on the central Texas coast. GIS analyses of historical aerial photographs indicated that approximately 25 acres of emergent marsh habitat were lost due to erosion between 1969 and 2001. Texas Parks and Wildlife Department with assistance from federal, state and local partners implemented a habitat restoration project to stabilize the shoreline, protect near-shore seagrass beds and restore estuarine emergent marsh. An offshore rock breakwater was constructed to stabilize the island and earthen levees were constructed on the north side of Goose Island to form containment levees surrounding two marsh restoration cells in 2005. Since then dredged material from nearby boat channels has been placed into the cells to raise the elevation of the bay bottom in the 25-acre restoration site to support emergent marsh. Volunteers planted Spartina alterniflora from nearby marshes to facilitate natural colonization of the site.

Goose Island is an integral part of the Goose Island State Park located on the southern tip of Lamar Peninsula, 12 miles northeast of Rockport in Aransas County, Texas. It is located in Aransas Bay on the central Texas coast near the Aransas National Wildlife Refuge. The park is comprised of 321.4 acres and provides public access to Aransas and St. Charles bays. Goose Island is located within the Coastal Bend Bays & Estuaries Program area and the Mission-Aransas National Estuarine Research Reserve study site. The island itself is part of the Permanent School Fund lands and has been leased to Texas Parks and Wildlife Department to operate as a state park since 1933.
Goose Island’s undeveloped southern shoreline consists of a shell ridge with smooth cordgrass (*Spartina alterniflora*) marsh occurring in front of portions of it. Dominant plant species occurring on the shell ridge include sea purslane (*Sesuvium portulacastrum*), wolfberry (*Lycium carolinianum*), camphor daisy (*Haplopappus phyllocephalus*), and seashore dropseed (*Sporobolus virginicus*). Behind the shell ridge, high marsh grades into intertidal smooth cordgrass marsh and tidal flats. The high marsh vegetation consists of glasswort (*Salicornia virginica*), maritime saltwort (*Batis maritima*), marshhay cordgrass (*Spartina patens*), sea-ox-eye daisy (*Borrichia frutescens*), and saltgrass (*Distichlis spicata*). Smooth cordgrass is the dominant intertidal species. Tidal channels occur within the high marsh and intertidal marsh habitats. Breaches in the island support patchy ephemeral seagrasses comprised mostly of widgeon grass (*Ruppia maritima*).

The shallow waters of Aransas Bay north of Goose Island support scattered living oysters, active oyster reefs and smooth cordgrass marsh. The shallow bay waters south of the island support expansive beds of shoal grass (*Halodule wrightii*) as well as scattered eastern oysters. The seagrasses, salt marshes, and oyster reefs associated with Goose Island provide important feeding habitat for waterfowl, shorebirds, and wading birds, and provide important nursery areas for commercially and recreationally important finfish and shellfish.

Coastal wetland loss in Texas is significant and is a continuing concern because of the essential roles that wetlands perform in providing fish and wildlife habitat, stabilizing shorelines and sediments, and improving water quality. Texas Parks and Wildlife Department (TPWD) staff compared aerial photography from 1969 and 1995 and determined that 17.1 acres of Goose Island eroded from the southern shoreline, while 1.5 acres accreted on the island during that time period. Results of shoreline mapping efforts by TPWD staff
and contractors using GPS receivers indicated that an additional 8.5 acres of Goose Island’s shoreline eroded between 1995 and 2002. Most of the 25 acres of Goose Island that has become submerged since 1969 was originally high marsh and intertidal emergent marsh habitats. Continued erosion and submergence of Goose Island threatened the remaining seven acres of smooth cordgrass marsh and ten acres of associated high marsh on the island and degradation of valuable oyster reef habitat and marsh habitats along the Lamar Peninsula shoreline located on the leeward side of Goose Island.

A feasibility study and analysis of potential shoreline protection and marsh restoration alternatives for Goose Island was conducted by a professional services provider in 2002. The study was funded by state and local partners. Several parameters at the site were assessed to evaluate the feasibility of implementing a shoreline protection and marsh restoration project. A bathymetric survey, side scan sonar survey, magnetometer survey and a geotechnical survey were conducted along with preliminary oyster and seagrass surveys. The prevailing winds and waves were also analyzed.

Several constraints had to be addressed by the project team and professional services provider when evaluating the feasibility of and selecting an alternative for stabilizing the shoreline and restoring marsh habitat at Goose Island State Park. The selected alternative needed to address the shoreline erosion problem while preserving and/or increasing the quantity, quality and diversity of habitats and living resources in Aransas Bay. The team wanted to create the marsh restoration site using dredged materials from nearby boat channels. The project had to be environmentally acceptable since a Section 10/404 permit would be required to implement the project. Finally, the selected alternative needed to be acceptable to neighboring landowners and park visitors.
Potential solutions that were evaluated to address shoreline erosion included onshore and offshore revetment, an offshore sediment filled tube and an offshore rock breakwater. The project team selected the offshore rock breakwater alternative to stabilize the eroding southern shoreline of Goose Island. This alternative placed the rock breakwater approximately 500 feet offshore (south of) Goose Island to avoid impacting seagrass beds located near Goose Island. The offshore breakwater alternative facilitated construction of the breakwater by barge, if needed, and created a protected lagoon environment between the breakwater and island that the project team thought might enhance seagrass establishment. Limestone rocks were chosen to construct the offshore breakwater instead of using a sediment filled tube or articulating concrete revetment mats covering a berm because rocks are more resistant to human and environmental impacts and because they provide hard substrate habitat for aquatic plants and animals to use for attachment and protection. Constructing the offshore breakwater from rocks was also comparable in cost to the other alternatives at the time.

Suitable locations for creating a 25-acre marsh restoration site were also evaluated during the feasibility study and alternatives analysis. A site was chosen north of Goose Island to avoid seagrass beds located south of the island. Only scattered oyster clumps were found in the selected site during the feasibility study so it was an environmentally acceptable location. Being leeward of both the offshore breakwater and Goose Island made the location ideal for long term sustainability of restored marsh since it would be protected from erosion caused by wind-driven waves.

Texas Parks and Wildlife Department (TPWD) sought and received funding from several federal, state and local partners for the project. Applications for a Section 10/404
permit from the U.S. Army Corps of Engineers, an amendment to the coastal lease between the Texas Parks and Wildlife Department and the Texas General Land Office and concurrences from the U.S. Fish and Wildlife Service and the Texas Historical Commission for compliance with required regulations associated with using federal funds were submitted. All necessary authorizations for the implementation of the Goose Island Shoreline Stabilization and Marsh Restoration Project were received and TPWD started Phase I of the project in 2005 beginning with construction of a 4,400-foot-long offshore rock breakwater using land-based construction equipment. The contractor built a temporary road from the park’s bulkhead out into the bay using dump trucks and a backhoe. The road was built with the breakwater materials placed along the approved breakwater alignment. Once the contractor reached the designed endpoint of the breakwater, the backhoe was worked back towards the bulkhead, reshaping the road into the final breakwater as it went. The breakwater was constructed with a crest elevation of +2.2 ft NAVD ’88, minimum crest width of 5 ft. and 2:1 side slopes. Ten gaps were constructed in the breakwater to facilitate ingress and egress of animals and to maintain water quality in the lagoon between the breakwater and the island.

The second component of Phase I was the construction of 6,560 linear feet of levees using in situ material to outline two marsh restoration cells within a 25-acre marsh creation site. The levees were constructed to contain dredged material that would be used to raise the elevation of the bay bottom within the marsh restoration site to a suitable elevation to support smooth cordgrass marsh. The levees were constructed with a crest elevation of +3.0 ft. NAVD ’88 and 4:1 slopes. Two water control structures were also installed in the levees to help regulate water quality during dredging operations. The levees were stabilized by
transplanting plugs of marsh species harvested from adjacent natural marshes on the levees. Phase I of the Goose Island Shoreline Stabilization and Marsh Restoration project was completed in December 2005.

Phase II of the Goose Island Shoreline Stabilization and Marsh Restoration project included three components: preparation of final engineering plans for the marsh restoration site and the two dredge material borrow areas, placement of dredged material into the marsh restoration site and planting smooth cordgrass in the site. In September 2007, TPWD contracted with a professional services provider to complete the construction documents. A new aerial photograph and results of new bathymetric surveys of the marsh restoration site and an adjacent reference marsh were used to complete the final engineering design. Final engineering plans and bid packages were submitted to TPWD in January 2008.

Two nearby boat channels were identified as sources for dredged material to raise the bay bottom within the marsh restoration site. By using these channels as sources of material to place in the marsh restoration site, TPWD was able to improve public boat access to Aransas and St. Charles bays while using the dredged material beneficially to restore marsh habitat lost in the area to erosion and conversion to open water habitat. In May 2008, TPWD awarded a contract and issued a notice to proceed with dredging operations. Approximately 26,295 cubic yards of dredged material from the Neptune Harbor borrow area were used to create 15 marsh mounds within the eastern cell of the marsh restoration site. An additional 26,402 cubic yards of dredged material from the Goose Island State Park boat ramp channel were used to create three large mounds within the western cell of the marsh restoration site in 2008 and 2010. Dredging operations occurred in different years due to availability of funding and to allow the dredged material to settle in between dredging operations.
Over 11,000 *Spartina alterniflora* plants were transplanted by TPWD staff, school groups, scouts, community volunteers and non-profit organizations during 2007 and 2008 to stabilize the marsh restoration site containment levees. The Aransas Bay chapter of the Coastal Conservation Association hosted a volunteer planting day on October 17, 2009 and twenty-two volunteers planted 1800 plugs of *Spartina alterniflora* on the marsh mounds in the eastern cell. Despite the current drought conditions, the transplanted plugs have survived and multiplied facilitating the natural colonization of smooth cordgrass in the marsh restoration site. Additional volunteer planting days are scheduled this fall to plant the mounds in the western cell of the marsh restoration site.
Objective
The aim of this study is to evaluate the response of little bluestem to agriculture lime and CFB ash.

Abstract
Little bluestem is one of the most widely distributed native grasses in North America. However, no data was found to indicate the response of little bluestem in southwest Louisiana to soil amendments. As a byproduct resulting from burning petroleum coke, the chemical composition of CFB ash includes calcium oxide (CaO). The CFB ash should have similar effects as agriculture lime on increasing soil pH. So the aim of this study is to evaluate the response of little bluestem to agriculture lime and CFB ash. The experiment compared three rates (2, 4 and 6 tons per acre) and a control (no soil amendment) using a randomized complete block design. Basal area (length and width) and plant height data were measured from 4 plants in each plot in mid-May, mid-September, and mid-November. Reproductive tillers were counted from each plant in mid-November. The height of ten samples and soil samples per plot were collected around those same times. Data were analyzed using CropStat v.7.2 in appropriate error terms. Plant height was affected by date and block, but not by treatment. Basal area and plant volume were affected by a date*treatment interaction. Later in the season, the 4 ton rate of both materials increased basal area and plant volume. It also increased the number of reproductive tillers. No significant difference of the seed harvest in each treatment was observed. There was an increase in basal area, plant volume and tiller number with the use of CFB compared to Ag Lime (in the 2 and 4 ton rate) and no treatment. In the 6 ton rate, no increase was found.

Introduction
Little bluestem is one of the most widely distributed native grasses in North America. The plant has excellent drought and fair shade tolerance and fair to poor flood tolerance. It grows preferentially on sites with pH 7.0 and slightly higher. No data was found to indicate the response of little bluestem in southwest Louisiana to soil amendments. With different rates of liming source, the little bluestem may have a different response in growth and production. Agriculture lime modifies soil pH from low to high. The chemical composition of CFB ash, a
byproduct resulting from electricity production, mainly includes calcium sulfate (CaSO$_4$) and calcium oxide (CaO). The CFB ash should have similar effects as agriculture lime on free hydrogen ion removal.

**Materials and methods**

Treatments and material rates in tons per acre and grams per plot are listed in Table 1. The study utilized a complete randomized block design with four (4) block or replicates. Individual plots were 5’x20’, with blocks being 35’X20’. A five foot ally between blocks was used to reduce material contamination between plots and allow for traffic movement without unneeded movements in plot area.

Data from the soil web survey indicates the soil would be classified as a Crowley-Vidrine silt loam, a fine, smectitic, thermic typic albaqualf. An initial soil sample indicated the initial pH was approximately 5.0, available phosphorus, potassium and sulfur levels were low. A single application of a 42-16-34 (N-P$_2$O$_5$-K$_2$O) lbs per acre was made on 8 August 2010 to all plots.

Plant data was collected in May, September and November. Four plants were selected from each plot to determine plant volume (Basal area (length and width) and plant height). These same individual plants were measured during each data collection periods. In addition, 10 random plants were measured for height. This data was collected, and subsequently reported, in millimeters or centimeters. Data analysis was conducted with CropStat v. 7.2 using appropriate error terms, analyzed as a split plot in time study.
Results and Discussion

Basal area and plant volume were affected by a date*treatment interaction (Table 2). Later in the season, the 4 ton rate of both materials increased basal area and plant volume. The seed harvest in each treatment showed no significant response to treatment. There was an increase in basal area, plant volume and tiller number with the use of CFB compared to Ag Lime (in the 2 and 4 ton rate) and no treatment (Table 3). In the 6 ton rate, no increase was found. Plant height was affected by date and block, but not by treatment (Table 4). Instead of disposing CFB Ash into landfills, the use of it as soil amendment will reduce the disposal costs and the purchase of Ag Lime in agriculture.

Literature Cited


Acknowledgments
Special thanks to the following for their assistance with this project:
Janet Woolman, Louisiana Environmental Research Center (LERC)
Alan Davis, LA-Ash
Ms. Cecilia Richmond, Louisiana Native Plant Initiative
**Tables**

Table 1. Liming materials and rates utilized.

<table>
<thead>
<tr>
<th>Liming Material</th>
<th>Rate</th>
<th>Tons/acre</th>
<th>Grams/plot</th>
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<td>0</td>
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<tr>
<td>Ag Lime 2</td>
<td>4591</td>
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<td>9182</td>
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<tr>
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Table 2. Little Bluestem plant height response to soil amendment, Agricultural Lime or Circulating Fluidized (CFB) ash, amendment rate and date of sampling.

<table>
<thead>
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<th>Rate</th>
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<td>CFB Ash</td>
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<td>16.83</td>
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**Fisher’s Protected lsd**

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NSD= No Significant Difference
Table 3. Little bluestem basal area and plant volume response to soil amendment, Agricultural Lime or Circulating Fluidized Bed (CFB) ash and amendment rate.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate</th>
<th>Basal Area($cm^2$)</th>
<th>Height (cm)</th>
<th>Volume ($cm^3$)</th>
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NSD=No Significant Difference

Table 4. Little Bluestem response of the basal area and plant volume to each date of sampling.

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<th>Date</th>
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<th>Height (cm)</th>
<th>Volume ($cm^3$)</th>
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Rattlesnake Master (*Eryngium yuccifolium*) Individual Seed Size And Total Seed Yield Response To Date Of Harvest.

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Abstract

*Eryngium yuccifolium*, more commonly known as rattlesnake master, is a plant that is native to a large portion of Louisiana. Further, with substantial habitat loss, the availability of high quality seeds for re-establishment is vital. Using transplants, a foundation block of rattlesnake master was established in the spring of 2008. Seed production, peak harvest, total seed yield, and individual seed size data were collected for three years. Seed heads were harvested manually as they ripened, stored in labeled paper bags, dried, and then threshed in date lots. In 2008, seeds were harvested when ripe from September through December. The greatest individual seed sizes were recorded in mid-September and mid-October. The optimal harvest period was October, with the greater than 75% of the total annual seed harvest accumulated during this month. In 2009, ripened seeds were harvested August through November with individual seed size greatest in mid-September. The optimal harvest period was determined to be the last half of September, during which the accumulated seed harvest accounted for 61% of the total annual harvest. In 2010, the seeds were harvested from early September through early November. With the limited information available about the reproductive characteristics of rattlesnake master, the data gathered from this study will aid in making this native species commercially-available for restoration projects.

Introduction

At one time, the majority of land mass in southwest Louisiana was comprised of coastal prairie (2.5 million acres). Today there is approximately 1000 acres in Louisiana. Most of the area has been converted from multispecies prairie primarily into monoculture urban, suburban, ranch and farm land (Allain et al. 1999). Most prairie remnants are found in the right of way areas around roads, highways and railroads. In order to restore the coastal prairie, it is important to understand the plants that need to be reintroduced. Because it attracts a very diverse population of pollinators such as bees, wasps, beetles, skippers, and moths, one plant specifically, Rattlesnake master, plays an important role in the re-establishment of the prairie. Rabbit and deer also like to forage on the young leaves (Allain 2007). Yet there is very little know about this plant.
In order to have a plant commercially available for habitat restoration, efficient production techniques must be developed. Yield is a function of plants per unit area, seed number per plant and individual seed weight. Consequently, an increase in the number of seeding or flowering heads per unit area results in an increase in the number of potential seeds that will be produced. The point of this ongoing study is to identify the effect of harvest period on seed yield, seed numbers, and average seed weight.

Material and Methods

On March 29, 2007, approximately 40 plants from one location where subdivided into 600 propagules. These propagules were planted into a 16 x21 m plot. In order to increase genetic diversity, plants were transferred from other locations and placed systematically throughout the planting area. When the plot was first created the plants were watered manually, but late in the year a drip irrigation system was installed.

The seed head harvest period began on September 4, 2008, and lasted until the middle of December. In 2009, harvesting began on August 25 and continued till November 12, 2009. The 2010 harvesting season was from September 9, 2010 until November 11, 2010.

When seeds became loose in the seed head and the head turned to a brown color, they were harvested. After harvest, they were placed into brown paper bags and a fresh weight was recorded. These bags were then put into a forced-air dryer for 2 to 4 weeks (100°F). The bags were removed and re-weighed, and the loose seed was separated from the seed heads. A sub-sample of each bag was collected, weighed, and each seed head was counted, which allowed for the determination of the average weight of each seed head, and the data recorded. The estimation of seed heads per harvest was derived by dividing total seed head weight per
sample by average seed head weight. Using a Kincaid Bundle Thresher, we threshed the seed heads from each harvest date separately. The thresher was set at maximum throttle and the ventilation spread of about one inch (2.5 cm). As the seedheads were threshed, seeds were divided into two categories; “threshed” and “blowout”. Each of these categories was sieved, weighed, and the data recorded. A sub-sample of the sieved seeds was weighed, chaff was separated manually, seeds were counted, and only seeds were re-weighed. Sample purity, average seed size, and seed number per sample were calculated. All of the data collected was then entered into an Excel spreadsheet for analysis.

**Results and Discussion**

Rainfall varied greatly from one year to the next (Figure 1). Drought was evident in the fall of 2008 and the early spring of 2009, followed by an extensive period of excess rain, and then another drought again in most of 2010. In 2008, the optimal harvest period was October (Figure 2), during which the accumulated seed harvest comprised more than 75% of the total annual harvest. The total seed yield was greatest from mid-September to mid-October in 2009 and 2010 (Figures 3 and 4). In 2009, seeds were harvested from August through November, with individual seed size greatest in mid-September. Optimal harvest period occurred during the last half of September, with accumulated seed harvest accounting for 61% of the total annual harvest. During 2010, the harvest period was from September through November, with peak harvest in mid-October, and the combined harvest from two dates (10/18 and 11/19) yielded 30% of the year’s harvest. Investigations into the climatic factors that may have influenced the changes in yield on different dates are warranted. Information gathered from this study will aid in the development of rattlesnake master as a commercially-available species.
Literature Cited


Figures

Figure 1. Monthly cumulative rainfall at the Louisiana Environmental Research Center location in 2008, 2009, 2010 and the long term average (1962-1995) of the site.

Figure 2. Threshed and blowout seed production as affected by harvest date in 2008.
Figure 3. Threshed and blowout
Figure 4. Threshed and blowout seed response to harvest date in 2010
Southwest Louisiana Native Herbaceous Broadleaf Plant Response to Date of Planting

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Abstract
The Natural Resource Conservation Service has recommended planting native herbaceous broadleaf species in the fall. However, little research data has been available to support this recommendation for southwest Louisiana. A study, conducted at the McNeese University farm, compared the response of 15 native species to four planting dates (October, November, March or April). The study used a split plot randomized complete block design with three blocks. The main plots were based on the date on which the seeds were sown, and subplots were established according to plant species. Weeds were controlled using multiple applications of glyphosate (0.5 lb a.i./ac/application) during the summer of 2009. An application of 200 lbs/ac of 0-23-30 was applied to the site then disked for seedbed preparation in September 2009. Fifteen 8-foot rows were seeded with the appropriate plant species on each planting date in each block. Two hundred seeds of each species were planted in each row. The site was monitored monthly. Weeds were controlled by hand, mowing, or herbicides. Data collected (8 April, 2010) was analyzed using Crop Stat™ v.7.2. A significant plant species by planting date indicated fall was not the optimum planting date for all species.

Introduction
Prairies have long been associated with the image of tall grasses, forbs, and dainty flowers swaying in the breeze. Native Louisiana prairie forbs have become increasingly rare due to local economic development, farmland conversion, railroad right-of-way expansion, and other factors. With fewer prairies, many native animals have been eliminated from Louisiana including the prairie chicken, bison, red wolf and the prairie vole (Allain et al., 1999). Since seeds of local ecotypes are not available, seeds from other prairie ecotypes have been used for restoration. Many non-native plants do not have a high success rate in this part of the
nation. These plants have been vital for Louisiana prairie restoration. The mission of the Louisiana Native Plant Initiative at the Louisiana Environmental Research Center (LERC) has been to procure native plants, establish foundation seed stock and help restorationists bring these native plants back into the Gulf Prairies.

These species have a wide variety of potential uses such as prairie restoration, medicinal applications, grazing habitat re-establishment, and landscape beautification. Native species may also be planted on fallow land to provide a variety of benefits including those listed above. With the restoration of the native plant species, the re-colonization of native insect and animal species may be plausible. Little or no published scientific research has been available to provide information regarding the best planting dates for Louisiana ecotypes of herbaceous dicotyledon prairie plants. This project addresses the issue of defining best planting dates by examining the most appropriate season to seed various species.

**Materials and Methods**

Experimental treatments were defined according to planting date (October, November, March, April.) and native plant species utilized (Table 1.) The study used a split-plot design with three replications per treatment group. Each main plot was defined by the planting date, with the split plots containing different plant species. Each block contained 15 rows of seeds, and each row contained a different species. Rows were completely randomized in each block. Each row was 8 foot long with 18 inch row width (distance separating them). An application of glyphosate [0-23-30 (N-P₂O₅-K₂O), 0.5 lb active ingredient per acre per application]) was applied to the tilled seedbed prior to seedbed preparation to control perennial grass weeds during the 2009 summer months.
The rate of seeding (number of seeds per 8 foot row) varied somewhat with seed size. The most lightly seeded rows were planted with 200 seeds. Species with larger seeds (i.e. Rosinweed and Indian plantain), were planted with only 100 seeds per row due to seeds occupying more planting space. As per standard agronomic practices, seeding depth also varied with seed size. Seeds were sewn by hand at depths of ¼ to 1 inch. Smaller seeds were planted closer to the surface than larger seeds. An attempt was made to distribute seeds uniformly throughout the row. Furrows were prepared on the day of planting to protect against moisture loss. A garden rotary edger, along with a shovel, was used to create furrows. Rows were filled immediately after seeds were sown to enhance seed-soil contact and reduce soil moisture loss.

Weed removal was conducted monthly in the spring and weekly during the summer. Little or no weeding was necessary during the winter of 2010-2011. Total numbers of germinated plants were counted approximately every four weeks. Results from the final analyses (8 April 2011) were analyzed using Crop Stat™ v.7.2.

Results and Discussion

A significant plant species vs. date-of-planting interaction was observed for native plant counts (P<0.001). Planting date seemed to have a significant impact on the germination of specific plants (Table 1). Germination was low or non-existent in six plant species over the entire observation period. Three plants species had extremely low survival rates (<5%). Six of the persistent plant species showed March as the best planting month. Yellow wild indigo had the highest survival rate of those planted in November. Rosinweed exhibited abundant
germination in both October and March. The least successful germination rate for all species occurred when seeds were sown in April.

Weather conditions probably influenced germination, seedling emergence and plant survival. In 2009, precipitation was extremely high. The cumulative rainfall in October was 14 inches which was much higher than the average of 3.9 inches. In contrast, the rainfall for November was 4.0 inches. Except for February 2010, the native plants faced an ongoing drought. Fall is not necessarily the best time to plant all species.

Conclusion

It is obvious that the conventional practice of planting native forbs in the fall did not provide the best results during this study. Plants, like people, cannot be successfully utilized in a “one-size fits all” philosophy. While results are interesting, the data collected from the current study represent only one year, and firm conclusions should not be drawn. Due to the extreme climatic factors during the time of this study (2009 above average rainfall, 2010 less than average rainfall), additional research should be conducted to expand the data base.

Literature Cited

Tables

Table 1. Number of live plants per row as affected by native plant species and date of planting.

<table>
<thead>
<tr>
<th>Native Plant Name</th>
<th>Planting Date</th>
<th>10/21/09</th>
<th>11/18/09</th>
<th>3/19/10</th>
<th>4/21/10</th>
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<tbody>
<tr>
<td>Rosinweed</td>
<td>Silphium gracile</td>
<td>33.0</td>
<td>14.0</td>
<td>19.7</td>
<td>0.0</td>
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<td>Wooly rose-mallow</td>
<td>Hibiscus lasiocarpus</td>
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<td>2.3</td>
<td>15.3</td>
<td>4.3</td>
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<tr>
<td>Ashy sunflower</td>
<td>Helianthus mollis</td>
<td>6.7</td>
<td>1.3</td>
<td>17.3</td>
<td>0.3</td>
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<tr>
<td>Yellow wild indigo</td>
<td>Baptisia sphaerocarpa</td>
<td>4.7</td>
<td>33.3</td>
<td>3.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Giant coneflower</td>
<td>Rudbeckia grandiflora</td>
<td>4.0</td>
<td>7.0</td>
<td>19.0</td>
<td>0.0</td>
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<tr>
<td>Lanceleaf coreopsis</td>
<td>Coreopsis lanceolata</td>
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<td>0.0</td>
<td>3.7</td>
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<td>Bee balm</td>
<td>Monarda fistulosa</td>
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<td>0.0</td>
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<td>Texas coneflower</td>
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<td>Indian plantain</td>
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<td>Cluster bushmint</td>
<td>Hyptis alata</td>
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<tr>
<td>Obedient plant</td>
<td>Physostegia digitalis</td>
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<td>Slender Mountain Mint</td>
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<tr>
<td>Flatsedge</td>
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<td>Falling beakrush</td>
<td>Rhynsora caduca</td>
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Fisher’s Protected LSD<sub>0.05</sub> 13.2
Figure 1. Monthly cumulative rainfall at the Louisiana Environmental Research Center location in 2009, 2010 and the previous long term average (1962-1995).
Abstract
The Armand Bayou Nature Center (ABNC) is a 2500 acre urban wilderness preserve located in southeast Harris County. ABNC actively manages 700 acres of coastal tallgrass prairie through an integrated strategy of prescribed burning, mowing, herbicide treatment and monitoring. Additionally, locally rare prairie plants are cultivated in the ABNC native plant nursery and re-introduced into prairie landscapes. These large-scale plantings are accomplished through the collaborative efforts of service learning projects, which are attended by local school groups and community based restoration events. This is one of the few publicly accessible prairie remnants in Harris County allowing it to serve as a living classroom for students and a place where local residents may enjoy one of the rarest views remaining in Texas, coastal tall-grass prairie.
Abstract: The Pollinator Game is a PowerPoint based game similar to Jeopardy. Workshop participants are divided into groups for a little friendly competition. Groups are asked questions in order to discuss and learn about pollinators rather than use a standard lecture style. Afterwards handouts are given out discussing pollinator habitat, building nest boxes, and pollinator friendly plants. Examples of a wood bee box and cane tube bundles for cavity nesting bees will be on display.

Paper:

The Pollinator Game is designed to give participants an introduction to the activities and importance of pollinators. Participants are divided into groups to discuss answers and test their knowledge. Twenty-five questions are asked during a PowerPoint based game similar to Jeopardy. Five questions each are included in the categories of pollinator basics, bees, pollinator habitat, name that pollinator, and flowers.

The categories are designed to get participants thinking. Why do we need pollinators? What economic value do they have to humans? What habitat requirements do pollinators have? How can you encourage pollinators to visit and live on your property? Which pollinators are needed to produce the foods you enjoy? What are the relationships between pollinators and flowers?

After the game is completed, handouts will be available with more detail on pollinator habitat, building nest boxes, and pollinator friendly plants. Examples of a wood bee box and
cane tube bundles for cavity nesting bees will be on display. Participants are also encouraged

to visit the following websites for more information on pollinators:

- North American Pollinator Protection Campaign/Pollinator Partnership (NAPPC) [http://www.pollinator.org/](http://www.pollinator.org/)
- NAPPC Eco-Regional Guides to Pollinator-Friendly Plantings [http://www.pollinator.org/guides.htm](http://www.pollinator.org/guides.htm)
Partners and Protocols for Plant Conservation –

Becoming a Citizen Scientist

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Abstract
Lady Bird Johnson Wildflower Center promotes the sustainable use and conservation of native plants and landscapes. By providing regional workshops and online resources, the Wildflower Center encourages residents in each natural region to collaborate with landscapers, plant nursery managers, educators, academics, and land stewards to create, preserve, and restore the native habitats that define the region. Use of established protocols for monitoring invasive species and reporting endemic species allows native plant enthusiasts to track changes in native habitats over time. Furthermore, participation in established information networks encourages native plant enthusiasts to focus limited resources in the most threatened native habitats. Widespread use of these protocols and information networks transforms local groups of volunteers into regional teams of citizen scientists. This workshop will provide an overview of the citizen science programs offered through the Wildflower Center.

The flora of Texas includes more than 5000 native and naturalized plant species. Native plant enthusiasts have many opportunities to promote conservation of native plants and prevent naturalization of additional non-native species. Your decisions to protect or not to protect a native species in your yard and local preserve have long-term consequences at the local level. Our decisions as a group have long-term consequences at the regional level. For the three hundred plant taxa that are endemic to Texas, our decisions will decrease or increase their vulnerability to extinction.

The Invaders of Texas Program is an innovative campaign whereby volunteer citizen scientists are trained to detect the arrival and dispersal of invasive species in their own local
areas. That information is delivered into a statewide mapping database and to those who can do something about it. The premise is simple. The more trained eyes watching for invasive species, the better our chances of lessening or avoiding damage to our native landscape. The program is a collaborative project managed by the Wildflower Center with support from the U.S. Forest Service, Texas Forest Service, and Texas Parks and Wildlife Department. During the program’s first five years, the program hosted 31 workshops and trained over 700 citizen scientists. These citizen scientists logged over 3,300 hours in the field and collected over 8,000 species observations.

More than one of these citizen scientists noted a desire to learn about the rare plants that they might see on their scouting trips and to increase the chances for the long-term survival of these rare species. Out of these comments, a new program is taking shape. The goals of the Endemic Plant Increase Consortium (EPIC) are to train citizen scientists in each ecoregion to recognize endemic species, to make high-quality seed collections for local use and to monitor wild populations for current and potential threats. EPIC follows the protocol developed by the Bureau of Land Management and the Royal Botanic Gardens, Kew’s Millennium Seed Bank for the Seeds of Success program. Our goals for the 2012 growing season include collaborating with citizen scientists and natural resource managers in each ecoregion to select one target species and to establish one additional population of each target species.

The Invaders of Texas program and the Endemic Plant Increase Consortium provide effective tools to promote the conservation of native plants and native plant habitats. If your local chapter of the Native Plant Society is interested in sponsoring a workshop on either program, please contact the Wildflower Center.
An Overview of Leaderweb – NPSOT’s Chapter Management Tool

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Abstract
Leaderweb is an electronic utility residing on the NPSOT website that provides various tools for chapter leaders to manage their membership rolls, communicate with their members via email or mailings, and submit chapter financial reports amongst many other capabilities. Additionally, chapter leaders have access through Leaderweb to much needed reference information such as NPSOT by-laws, State Board information, State Board contacts, and other vital information. An overview of the capabilities of this important utility will be provided to chapter leaders which will help improve their efficiency and effectiveness as NPSOT leaders.
What on Earth Are We Doing with Texas?

Bill Neiman,
Founder and Owner of Native American Seed
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info@seedsource.com

Abstract

With a tour around the eco-regions of our Lone Star state, Neiman shares a lifetime wealth of experience. Harvesting, planting and long term management of native habitats including the Trans-Pecos, Brush Country, Edwards Plateau, Black-lands, Cross Timbers, Piney Woods, and finally zooming in on the Coastal Prairies. Practical hands-on actions will provide inspiration and encouragement for all who are engaged in sustainable land management. Your ability to take measurable steps at home will lead others by example in building a better future.

Texas, with its historically abundant clean rivers, native woodlands, grass/rangelands and coastal marshes, provided easily exploitable natural resources. Sadly, not much of our huge region remains in big, unbroken parcels. Texas, with strong pro-property rights ethos, is comprised of over 95% private lands. Unfortunately, our great state ranks 50th in its ability to provide open space to its burgeoning citizen population. The early stages of common urban sprawl are often overlooked while large-scale fragmentation of our ecosystems is exponentially increasing.

If anything is going to change this picture in Texas, it must come from the stewardship of individual landowners. What remains of the Texas landscape is nothing short of ecological treasures worthy of celebration.
Avian Responses to a Changing Coastal Prairie

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Abstract
The Coastal Prairie has been greatly modified by Anglos and there are few examples of large blocks of native grasslands greater than 10,000 ha remaining. Standard 40 km U.S. Geological Survey Breeding Bird Survey routes were used to compare breeding bird density in a former Coastal Prairie (McFaddin) that contained 12% native grasslands to those in a nearby (5 km) large block of actively managed Coastal Prairie (Goliad) that contained 75% native grasslands. Both routes averaged 52 species during annual surveys. The Goliad route averaged more Mottled Duck, N. Bobwhite, White-tailed Hawk, Scissor-tailed Flycatcher, Cliff Swallow, Cassin’s Sparrow, Dickcissel and E. Meadowlark which are species better adapted to large grasslands with little brush. The McFaddin route averaged more Inca Dove, Barred Owl, Great Crested Flycatcher, White-eyed Vireo, Carolina Chickadee, Carolina Wren, Bewick’s Wren, E. Bluebird, N. Mockingbird, Lark Sparrow, N. Cardinal and Brown-headed Cowbird which are species better adapted to brush and forest lands. Thirty additional species did not occur at significantly higher numbers on either route.

Lehmann (1941) indicated that 93% of the six million acres of coastal prairie in Texas had been lost by 1937. Coastal prairie loss continued through the remainder of the 20th century and Smeins et al. (1991) estimated that <1% of the coastal prairie ecosystem remained in relatively pristine condition. Near Victoria, Texas, the Coastal Prairie has been characterized as large expanses of grasslands with occasional mottes of trees situated between forested river bottoms (Pierce and Maloney 1894). It has changed dramatically since the development of Anglo settlements during the 1900’s. Most native grasslands have been converted to row crops, residential/industrial areas, and pastures of introduced grasses. Much of the remaining native grasslands have been allowed or encouraged to be invaded by brush. This change in
land use has resulted in only about 35,000 ha of Coastal Prairie remaining in large blocks (Ortego et al. 2009) and they are located south of the San Antonio River.

The first major native grassland habitat restoration efforts near Victoria started with the formation of the Coastal Prairie Conservation Initiative (CPCI) in 1999. The CPCI focused resources of multiple agencies in a planned effort to enlarge and connect blocks of existing coastal prairie. The CPCI is a good example of landscape scale habitat restoration requiring partnerships of federal, state, private organizations, and private landowners to foster conservation on the ground at a scale that is meaningful to bird populations. The CPCI is a partnership of the U.S. Fish and Wildlife Service, USDA Natural Resource Conservation Service, Texas Parks & Wildlife Department, The Nature Conservancy, and Grazing Land Conservation Initiative pooling their resources to assist private landowners retain family ownership, maintain historic values, profit from agriculture and conserve wildlife while achieving a collective goal of restoring the Coastal Prairie and re-establishing Attwater’s Greater Prairie-Chicken.

I initiated monitoring of breeding birds in the vicinity of these conservation actions at a landscape scale.

METHODS: Two standard 40-km U.S. Geological Survey Breeding Bird Survey routes (http://www.pwrc.usgs.gov/BBS/) were conducted annually from 2006 thru 2011. Each route was essentially parallel to each other on opposite sides of the San Antonio River spaced at about 5 km. Each route consisted of 50 stops spaced at 0.8 km intervals along public roads with birds identified by site or hearing during 3 minutes at each stop. One route (McFaddin)
was established north of the San Antonio River in former Coastal Prairie where changing land use has resulted in 66% of the landscape being brush/forest, 22% being row crops, and 12% being native grasslands with 14% of the stops being near residences. The other route (Goliad) was established south of the San Antonio River in existing Coastal Prairie where changing land use has resulted in 76% native grasslands, 22% brush/forest and 2% row crops with 8% of the stops being near residences.

Species which had an average density of at least one bird per year on one of the routes were analyzed to determine if there was a route preference with a T-Test (www.online-data-analysis.com).

RESULTS: An average of 52 avian species was found on each route annually. Twenty of 50 species with an average abundance of at least one bird for a route appeared to show location preferences (Table 1). Thirty additional species did not appear to show any preferences (Table 2). Seven of the 8 species selecting for the Goliad route were identified by Texas Parks and Wildlife Department (http://www.tpwd.state.tx.us/publications/pwdpubs/pwd_pl_w7000_1187a/) as Species of Conservation Concern. Only one (Lark Sparrow) of the 12 species selecting for the McFaddin route was a Species of Conservation Concern. Mottled Duck, N. Bobwhite, White-tailed Hawk, Scissor-tailed Flycatcher, Cassin’s Sparrow, Dickcissel and E. Meadowlark preferred the Goliad route and are species which are adapted to occupying large blocks of native grasslands. Major national declines in native grasslands has caused their populations to decline as well (Rich et al. 2004). The populations of species showing
preferences for the McFaddin Route which is dominated by mesquite and huisache shrub communities are regionally much more secure.

DISCUSSION: While both routes through these different landscapes had essentially the same avian species diversity, the one dominated by native grasslands had many more Species of Conservation Concern. This is primarily due to the rarity of large blocks of native grasslands in the Coastal Prairie.

While most landowners along both routes have a strong interest in wildlife which includes white-tailed deer, Wild Turkey, N. Bobwhite, Attwater’s Greater Prairie-Chicken and other natural resources, the landscape containing each of the bird survey routes appears to have had separate evolutions in ownership and land management even though they were only separated by 5 km.

The McFaddin route which traversed thru large blocks of mesquite and huisache in former Coastal Prairie north of the San Antonio River is characterized by relatively small land holdings with many being about 100 ha. This small landownership shrub/forest setting is fairly common in the Texas Coastal Prairie ecosystem away from locales with a preponderance of row crops in the landscape.

The Goliad route traversed Coastal Prairie south of the San Antonio River and is characterized by relatively large landholdings dominated by native grasslands with many of the ranches exceeding 2,000 ha. Residences near the roads were relatively uncommon and there was only one stop with row crops.
It would be speculative to guess if history of ownership, inheritance, income and life style influenced management decisions. It is clear, however, that the larger landholdings had greater interest and were more successful at managing for native grasslands, and wildlife resources dependent on these grasslands responded positively to their management.

LITERATURE CITED


TABLE 1. Average Density of Birds on Goliad and McFadden Breeding Bird Surveys in Coastal Texas from 2006-2011.

<table>
<thead>
<tr>
<th></th>
<th>GOLIAD</th>
<th>MCFADDIN</th>
<th>T-Test</th>
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<tr>
<td></td>
<td>AVG</td>
<td>STDEV</td>
<td>AVG</td>
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<tr>
<td><strong>MORE ABUNDANT AT GOLIAD</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mottled Duck</td>
<td>1.8</td>
<td>2.2</td>
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<td>77.3</td>
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<td>Goliad STDEV</td>
<td>McFaddin AVG</td>
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<td>Black-bellied Whistling-Duck</td>
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<td>Killdeer</td>
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**TABLE 2.** Average Density of Birds on Goliad and McFaddin Breeding Bird Surveys With Similar Abundance at Each Route in Coastal Texas from 2006-2011.
<table>
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Rare and Endemic Plants of the Gulf Coast Prairies and Marshes

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Abstract
The gulf coast prairies and marshes flora is very diverse and contains a high number of rare and endemic plants. Currently 18 globally rare plants have been documented for this region of Texas. An amazing 63 endemic (found nowhere else but Texas) plants have been documented in this region. In coastal prairies 1170 plant species have been documented. In this talk we will review the status of the coastal prairies and marshes and the land use that has influenced its current state. This regions landscape types (plant communities); topography, geology, soils, and climate will be discussed. The heart of this presentation will be a focused on looking at the unique plant community associations that support many of these rare and endemic plants.

The Gulf Coast Prairies and Marshes occupy about 12,940,491 acres (5,236,831 hectares) of flat to very gently rolling topography along the Gulf Coast from the Louisiana border to Tamaulipas. It includes coastal features such as barrier islands, beaches, estuarine lagoons, saline and brackish marshes as well as inland prairies and woodlands of various sorts. In some places, its inland boundary corresponds to the eastern limit of Pliocene strata (e.g., the Goliad Formation in the Coastal Bend area); in others, such as along the Coastal Sand Plain, the boundary is entirely subjective. The northern boundary is vague and transitional and largely defined by the absence of pines that distinguish the adjacent Piney Woods Natural Region. Elevations in the region are mostly less than 150 feet (46 m).
Most of the region is underlain by poorly consolidated clays, silts, and sands of Pleistocene or Holocene age. Closest to the coast lies the Beaumont Formation, which often appears as a featureless plain of black clay. However, sandy materials of point bars, levees, and other depositional environments are also present. While scarcely perceptible topographically, such sands have a major effect on the local diversity of vegetation. Also of note from the Beaumont era is a series of Pleistocene barrier islands that lie on the current shoreline rather than offshore. The Flour Bluff, Live Oak, and Blackjack peninsulas make up what is sometimes called the Ingleside Barrier, and sands of that system support many species that occur neither on Beaumont clays to the west nor on the strip of modern barrier islands to the east. Inland from the Beaumont Formation is the Lissie Formation, which typically has a loamier, sandier surface and a very gently rolling topography. Both the Beaumont and Lissie formations routinely exhibit pimple mounds, some as much as 25 feet (8 m) in diameter and 3 feet (1 m) in height.

Climate of the region is classified as humid subtropical. Summers are warm on the upper coast and hot on the lower coast; relative humidity is almost always high. Mean annual precipitation ranges from 59 inches (150 cm) in Orange County to 28 inches (71 cm) in Kleberg County. The average growing season ranges from 240 days in Orange County to 341 days in Cameron County (Natural Fibers Information Center 1987). Hurricanes are relatively rare but exert a profound influence on regional vegetation.

The region's vegetation is varied. Barrier islands, which parallel most of the coast in the
southern half of the state, typically have, on their coastal face, a beach community composed of beach morning-glory (*Ipomoea imperati*), goat-foot morning-glory (*Ipomoea pes-caprae*), and sea purslane or cenicilla (*Sesuvium portulacastrum*). Inland are one or more low sand ridges covered with rhizomatous perennials, most notably sea oats (*Uniola paniculata*) and bitter panicum (*Panicum amarum*); sometimes sedge-dominated freshwater wetlands occur in swales between the ridges. Behind the dunes is a strip of upland coastal prairie dominated by seacoast bluestem (*Schizachyrium scoparium* var. *littorale*) and gulf dune paspalum (*Paspalum monostachyum*). As elevation approaches sea level, this prairie gives way to grasslands of marshhay cordgrass (*Spartina patens*); gulf cordgrass (*Spartina spartinae*) often dominates clayier sites. Tidally inundated loamy flats support bands or colonies of a few low succulent halophytes such as saltwort (*Salicornia virginica*), seepweed (*Suaeda* spp.), and vidrillos (*Batis maritima*). Tidal marshes composed mostly of smooth cordgrass (*Spartina alterniflora*) are often present, particularly from Nueces County northward (Judd et al. 1977; Bezanson 2000). Away from the shoreline on the west side of the bay, there is usually a broad band of gulf cordgrass grassland or "salty prairie". Where barrier islands are absent or erosion is active, this community extends almost to the shoreline. Diversity increases as soil salinity decreases inland, and eventually salty prairie is replaced by upland coastal prairie dominated by little bluestem or seacoast bluestem, brownseed paspalum (*Paspalum plicatum*), big bluestem, Pan American balsamscale (*Elionurus tripsacoides*), crinkleawn (*Trachypogon spicatus*), and numerous forbs. Oaks, mostly coastal live oak (or an ecological equivalent) and post oak, occur as mottes in some parts of this prairie, particularly over the Lissie Formation. More extensive woodlands or forests are developed in several areas. Woodlands dominated by coastal live oak (or an ecological equivalent) and
post oak are fairly widespread, particularly on sandy uplands on the Lissie Formation. The
Ingleside Barrier is largely covered with a maritime evergreen forest or woodland of live oak
and red bay (*Persea borbonia*); sunny openings in this system are rich in arenophilic
endemics. The Columbia Bottomlands near the Brazos River in Brazoria County are typified
by forests of coastal live oak (or an ecological equivalent), pecan, sugar hackberry (*Celtis
laevigata* var. *laevigata*), water oak, Shumard red oak, and many other trees. Dwarf palmetto
(*Sabal minor*), a common shrub, and Spanish moss (*Tillandsia usneoides*), a conspicuous
epiphyte, exemplify this community's affinity to coastal forests in the southeastern United
States. Deciduous riparian woodlands of various types are also present. Baldcypress
woodlands are restricted to stream bottoms in the northern part of the region and often do not
occur along the stretch of river nearest the coast.

Rare plant species are scattered across this varied landscape. In general, shorelines, tidal
flats, marshes, sand dunes, and interdunal wetlands are devoid of rare species. One notable
exception is the lomas, or clay or clay-sand dunes in and along tidal flats and hypersaline
lagoons at and near the mouth of the Rio Grande. Thornscrub and mixed thornscrub-
halophyte communities on these lomas support populations of lila de los llanos (*Echeandia
chandleri*) (Ewing 2000). The recently described Green Island echeandia (*E. texensis*) and
the uncommon Texas stonecrop (*Lenophyllum texanum*) occur in similar loma habitats.
Kleberg saltbush (*Atriplex klebergorum*) occurs sparingly on similar hummocky saline clay
along Laguna Madre a bit to the north.

Loose, well drained or excessively drained soils in openings in live oak-red bay woodlands
on the Ingleside Barrier are the lone habitat for Tharp's rhododon (*Rhododon angulatus*) and one of several homes for the more widespread Elmendorf onion. Oak dodder (*Cuscuta exaltata*), an uncommon parasite of live oak and other trees, is more common on the Ingleside Barrier than anywhere else in its range.

Rare species are scarce in much of the coastal prairie matrix but are locally common in edaphic variants. Sodic or saline soils on upland claypan sites over the Beaumont Formation in the Coastal Bend area support several species of interest, including black lace cactus (*Echinocereus reichenbachii* var. *albertii*) and threeflower broomweed (*Thurovia triflora*). Although not restricted to such sites, Welder machaeranthera (*Psilactis heterocarpa*) is often present, as is the uncommon shortgrass Texas willkommia (*Willkommia texana* var. *texana*). Similar saline hardpans (slick spots) over the Beaumont Formation in the Houston area support another suite of rare species, including threeflower broomweed and the critically endangered Texas prairie dawn (*Hymenoxys texana*), with Houston daisy (*Rayjacksonia aurea*), coastal gay-feather (*Liatris bracteata*), and Texas windmill-grass (*Chloris texensis*) often occurring in the neighborhood.

Prairies on the Beaumont Formation near Kingsville in the western part of the Coastal Bend do have a few rare species, most notably slender rushpea (*Hoffmannseggia tenella*) and South Texas ambrosia (*Ambrosia cheiranthifolia*). These species may tend to occur on lenses of lighter colored and lighter textured soils rather than on the heavy clay soils typical of the formation.
Finally, a few rare species occur in the region's forests. One example is corkwood (*Leitneria floridana*). Although also found in several disturbance types, it seems to be most common in water hickory (*Carya aquatica*) woodlands and other wetlands associated with coastal live oak-pecan forests. Those forests also contain several uncommon taxa, including Texas tauschia (*Tauschia texana*) and Texas pinkroot (*Spigelia texana*).
<table>
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<th>Plant Name</th>
<th>Scientific Name</th>
<th>Endemic Status</th>
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<td><em>Allium canadense</em> L. var. <em>ecristatum</em> (E)</td>
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<td>Elmendorf's onion</td>
<td><em>Allium elmendorfii</em> (E)</td>
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<td>South Texas ambrosia</td>
<td><em>Ambrosia cheiranthifolia</em> (E)</td>
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<td>Kleberg saltbush</td>
<td><em>Atriplex klebergorum</em> (E)</td>
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<td>sand brazosmint</td>
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<td>twoflower stickpea</td>
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<td>littleflower spiderwort</td>
<td><em>Callisia micrantha</em> (E)</td>
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<td>Jones' rainlily</td>
<td><em>Zephyranthes jonesii or Cooperia jonesii</em></td>
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<tr>
<td>Refugio rainlily</td>
<td><em>Zephyranthes refugiensis</em></td>
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Literature Cited


The Coastal Prairie Landscape

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Abstract

The Coastal Prairie Eco-region is one of North America’s most ecologically diverse landscapes. It was historically a matrix of upland tall grass prairies bisected by riverine bottomland forests, bounded by live oak, post oak, and pine savannahs, inclusions of South Texas shrub-lands and a long sinuous transition of estuaries, bayous and coastal marshes along the Gulf. The long growing season of warm temperate to subtropical climates and diverse soils provide for highly productive ecosystems with great floristic and faunistic diversity. While the general pattern of coastal prairie ecosystem still persists, most of it has been greatly altered, fragmented or destroyed by human activity. In spite of these impacts, many opportunities still exist for preservation of remaining semi-natural patches of these ecosystems, and for re-connection and restoration of areas back to semblances of the original natural character of these systems. To accomplish this requires continued education of the public, private individuals, public officials, and agencies dedicated to this cause and the political persuasion to assist in this effort.
Flood Damage Reduction Projects Support Native Habitats

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Abstract
The Texas legislature created the Harris County Flood Control District (HCFCD or District) in 1937 to identify and mitigate flooding problems that plagued the populated coastal plain of the Upper Galveston Bay watershed. In practice, the District achieves flood mitigation by siting, designing, and maintaining flood damage reduction and drainage facilities. These facilities mitigate runoff impacts, reduce peak flows, and in some cases enhance water quality of the storm water discharged from developed areas. Stormwater treatment systems implemented by the District include the creation of wetland areas within wet bottom detention basins and riparian channels. The District initiated a program to revegetate these facilities using native plant species from local sources. The goals of the District's revegetation program include site stability, water quality enhancement, habitat diversity, permit compliance, and reduced maintenance costs. Generally, the District installs plants to create wetlands, riparian corridors, reforestation areas, parkland settings, and coastal prairie habitats. This paper provides an overview of the District's revegetation program, and presents information regarding the installation, monitoring, and maintenance of these habitats. These program elements will be viewed during the Native Plant Society of Texas Symposium field trip to the Willow Waterhole Detention Basin.

Introduction

The Harris County Flood Control District (District) regularly incorporates native wetland, tree, and shrub plant species into the revegetation plans for major capital and maintenance projects. The impetus for developing native habitats includes benefits to water quality, site
stabilization, regulatory requirements, and the District’s mission to provide flood damage reduction projects that work with appropriate regard for community and natural values. This paper provides an overview of one example where the District has actively planted and maintained native wetland, upland, and prairie habitat within southwestern Harris County, Texas.

**Willow Waterhole**

Willow Waterhole Detention Basin is a 279-acre, multi-compartment regional stormwater detention basin designed to provide storage for floodwater within the Brays Bayou Watershed (Figure 1). Stormwater will passively enter the detention basin complex from Willow Waterhole (a tributary to Brays Bayou), the roadside ditch along Chimney Rock, and area sheet flow. This stormwater is then routed through the detention basin compartments and exits the system through culverts located below South Post Oak Blvd. and discharges back to Willow Waterhole. Figure 2 provides an overview of the Willow Waterhole Detention Basin and the water flow through the various compartments.

This detention basin is being constructed in multiple phases over many years. The ultimate storage volume planned for the Willow Waterhole Detention Basin is 1,865 acre-feet of floodwater. To date, approximately 1,100 acre-feet of storage volume has been constructed in Compartments 2, 4, and 5. Construction of the remaining compartments will be completed in the year 2020.
Figure 1. Brays Bayou Watershed, showing location of Willow Waterhole.

Willow Waterhole is being constructed in partnership with the US Army Corps of Engineers as part of Project Brays, which includes many flood damage reduction projects within the watershed. Planting requirements for Willow Waterhole according to the National Environmental Policy Act (NEPA) documentation are summarized in the following table. For purposes of this presentation, we will focus on the first completed area within Willow Waterhole, Compartment 2.

Table 1. Planting Requirements for Willow Waterhole

<table>
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<tr>
<th>Willow Waterhole Area</th>
<th>Acreage</th>
<th>Trees</th>
<th>Shrubs</th>
<th>Woody Plants</th>
<th>Acres of Wetlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compartment 1</td>
<td>18</td>
<td>720</td>
<td>360</td>
<td>1080</td>
<td>1.8</td>
</tr>
<tr>
<td>Compartment 2*</td>
<td>45</td>
<td>1800</td>
<td>900</td>
<td>2700</td>
<td>4.5</td>
</tr>
<tr>
<td>Compartment 3</td>
<td>74</td>
<td>2960</td>
<td>1480</td>
<td>4440</td>
<td>7.4</td>
</tr>
<tr>
<td>Compartment 4*</td>
<td>23</td>
<td>920</td>
<td>460</td>
<td>1380</td>
<td>2.3</td>
</tr>
<tr>
<td>Compartment 5</td>
<td>110</td>
<td>4400</td>
<td>2200</td>
<td>6600</td>
<td>11.0</td>
</tr>
<tr>
<td>Compartment 6</td>
<td>10</td>
<td>400</td>
<td>200</td>
<td>600</td>
<td>1.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>280</td>
<td>11200</td>
<td>5600</td>
<td>16800</td>
<td>27.9</td>
</tr>
</tbody>
</table>

* Planting complete
**Constructed Wetlands**

The District incorporates water quality enhancement features in all projects, where practicable. Mostly the District uses constructed wetlands to treat stormwater that enters detention basins and flows through to streams and bayous.

Stormwater pollutants are primarily removed in wet bottom detention basins through settling in the facility’s permanent pool. Additional stormwater treatment occurs through filtration of suspended solids by vegetation, infiltration, biological uptake and conversion.

Texas native wetland plants are ideal for treating stormwater in the District’s facilities.

In 2008, the District contracted Greenmark Environmental and subconsultant Ecovirons to plant 4.5 acres of native wetlands within Willow Waterhole Detention Basin, Compartment 2. These wetlands not only served to enhance water quality, but also met mitigation requirements for Project Brays. The wetlands areas are managed and maintained as mitigation wetlands.

Plant species included in the original planting are provided below in Table 2.

**Table 2. List of Wetland Plants Installed in Willow Waterhole, Compartment 2**

<table>
<thead>
<tr>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Zizaniopsis milacea</em></td>
<td>giant cutgrass</td>
</tr>
<tr>
<td><em>Scirpus validus</em></td>
<td>softstem bulrush</td>
</tr>
<tr>
<td><em>Juncus effusus</em></td>
<td>soft rush</td>
</tr>
<tr>
<td><em>Thalia delbata</em></td>
<td>fire flag</td>
</tr>
<tr>
<td><em>Pontederia cordata</em></td>
<td>pickerelweed</td>
</tr>
<tr>
<td><em>Panicum hemitomon</em></td>
<td>maidencane</td>
</tr>
<tr>
<td><em>Eleocharis spp.</em></td>
<td>spikerush</td>
</tr>
<tr>
<td><em>Saggittaria sp.</em></td>
<td>arrowhead</td>
</tr>
<tr>
<td><em>Iris virginicus</em></td>
<td>blueflag iris</td>
</tr>
<tr>
<td><em>Hibiscus sp.</em></td>
<td>marsh mallow</td>
</tr>
<tr>
<td><em>Nymphaea odorata</em></td>
<td>white water lily</td>
</tr>
</tbody>
</table>
According to the District’s term contract for wetland planting, the plant species must reach 80% survival within the first 90 days. Monitoring to determine a successful stand is continued through the first year after planting. By summer 2009, the wetlands had been established over approximately 5 acres within the detention basin. Subsequent monitoring is conducted according to the NEPA mitigation requirements.

Tree and Shrub Planting

The District is also required to plant woody species within the Willow Waterhole Detention Basin, as summarized in Table 1. Trees and shrubs were planted at the top of bank, side slopes, and bottom shelf to provide habitat, shading, and stabilize the slopes. Prior to tree planting, the entire site was seeded in bermudagrass, according to the District’s standard turf establishment specification. Woody species included in the original planting are listed below in Table 2.

Table 3. Woody Plant Species Installed at Willow Waterhole, Compartment 2

<table>
<thead>
<tr>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxodium Distichum</td>
<td>bald cypress</td>
</tr>
<tr>
<td>Acer rubrum var. drummondii</td>
<td>swamp red maple</td>
</tr>
<tr>
<td>Nyssa aquatic</td>
<td>water tupelo</td>
</tr>
<tr>
<td>Fraxinus pennsylvanicum</td>
<td>green ash</td>
</tr>
<tr>
<td>Celis laevigata</td>
<td>sugarberry</td>
</tr>
<tr>
<td>Liqueedambar styraciflua</td>
<td>sweetgum</td>
</tr>
<tr>
<td>Platanus occidentalis</td>
<td>eastern sycamore</td>
</tr>
<tr>
<td>Ulmus americana</td>
<td>american elm</td>
</tr>
<tr>
<td>Ulums crassifolia</td>
<td>cedar elm</td>
</tr>
<tr>
<td>Quercus nigra</td>
<td>water oak</td>
</tr>
<tr>
<td>Quercus phellos</td>
<td>willow oak</td>
</tr>
<tr>
<td>Quercus shumardii</td>
<td>shumard oak</td>
</tr>
<tr>
<td>Carya illnoinensis</td>
<td>pecan</td>
</tr>
<tr>
<td>Quercus macrocarpa</td>
<td>bur oak</td>
</tr>
<tr>
<td>Magnolia grandiflora</td>
<td>southern magnolia</td>
</tr>
<tr>
<td>Pinus taeda</td>
<td>loblolly pine</td>
</tr>
<tr>
<td>Quercus flacata</td>
<td>southern red oak</td>
</tr>
<tr>
<td>Quercus muehlenvergii</td>
<td>chinquapin oak</td>
</tr>
</tbody>
</table>
Table 3, cont. Woody Plant Species Installed at Willow Waterhole, Compartment 2

<table>
<thead>
<tr>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quercus virginiana</td>
<td>live oak</td>
</tr>
<tr>
<td>Malvaviscus drummondii</td>
<td>turk's cap</td>
</tr>
<tr>
<td>Cercis canadensis</td>
<td>redbud</td>
</tr>
<tr>
<td>Ilex vomitoria</td>
<td>yaupon</td>
</tr>
<tr>
<td>Myrica cerifera</td>
<td>wax myrtle</td>
</tr>
<tr>
<td>Prunus caroliniana</td>
<td>cherry laurel</td>
</tr>
</tbody>
</table>

Additional trees have been transplanted from other areas within future Willow Waterhole compartments. Several trees were moved from the site of a remnant native coastal prairie, located within Compartment 3.

Native Prairie

Remnants of coastal prairie were discovered within Compartment 3 during the baseline biological assessments conducted in compliance with NEPA regulations. The site of the coastal prairie habitat is isolated from the future detention basin area by a pipeline right-of-way, as shown in Figure 3. Several “rooms” of native prairie were mapped within the heavily wooded site. These “rooms” represented remnant wet coastal prairie and coastal prairie habitats.

Coastal prairie plants found within Willow Waterhole, Compartment 3 include those listed in Table 3.

Table 4. Partial List of Coastal Prairie Plants Willow Waterhole, Compartment 3

<table>
<thead>
<tr>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon Gerardii</td>
<td>Big Blue Stem</td>
</tr>
<tr>
<td>Schizachyrum Scoparium</td>
<td>Little Blue Stem</td>
</tr>
<tr>
<td>Tripsacum Dactyloides</td>
<td>Eastern Gamma Grass</td>
</tr>
<tr>
<td>Panicum Virgatum</td>
<td>Switchgrass</td>
</tr>
<tr>
<td>Sorghastrum Nutans</td>
<td>Yellow Indian Grass</td>
</tr>
<tr>
<td>Paspalum plicatum</td>
<td>Brownseed paspalum</td>
</tr>
<tr>
<td>Rudbeckia texana</td>
<td>Coneflower</td>
</tr>
<tr>
<td>Eryngium Yuccifoium</td>
<td>Rattlesnake Master</td>
</tr>
<tr>
<td>Liatris pycnostachya</td>
<td>Gayfeather</td>
</tr>
</tbody>
</table>
Table 4, cont. Partial List of Coastal Prairie Plants Willow Waterhole, Compartment 3

<table>
<thead>
<tr>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rudbeckia hirta</td>
<td>Brown eyed Susan</td>
</tr>
<tr>
<td>Arnoglossum plantagineum</td>
<td>Prairie plantain</td>
</tr>
<tr>
<td>Ascepias viridis</td>
<td>Green milkweed</td>
</tr>
<tr>
<td>Coreopsis lancelata</td>
<td>Tickseed Coreopsis</td>
</tr>
<tr>
<td>Ratibida columnifera</td>
<td>Mexican Hat</td>
</tr>
<tr>
<td>Gaillardia pulchella</td>
<td>Firewheel</td>
</tr>
<tr>
<td>Dianthelium ssp</td>
<td>Rosette grass</td>
</tr>
<tr>
<td>Cyperus odoratus</td>
<td>Flatsedge</td>
</tr>
<tr>
<td>Helianthus mollis</td>
<td>Ashy sunflower</td>
</tr>
<tr>
<td>Muhlenbergia capillaris</td>
<td>Long-awned muhly</td>
</tr>
<tr>
<td>Solidago odorora</td>
<td>Fragrant Golden-rod</td>
</tr>
<tr>
<td>Bouteloua curtipendula</td>
<td>Sideoats grama</td>
</tr>
<tr>
<td>Helianthus maximiliani</td>
<td>Maximillian sunflower</td>
</tr>
</tbody>
</table>

In 2010, the District cleared most of the woody vegetation from the site. Currently the District is managing the woody vegetation through spot herbicide treatment, hand cutting, and mowing. Future work will include segmenting the site into management units to allow a rotating cycle of mowing. In addition the District will continue to monitor the plant diversity and rehabilitation of the coastal prairie remnant.

Several volunteers and the District contractor, ChipCo have been actively transplanting prairie grasses and forbs from the future detention basin area within Compartment 3. As additional coastal prairie remnants are discovered within the area, the District hopes to transplant additional native plant material to this site.

Summary

The Harris County Flood Control District has many opportunities to create native habitats. In particular stormwater detention basins offer ideal locations for wetlands that not only provide habitat but also enhance stormwater quality. Side slopes, uplands, and bottom areas
within detention basins are ideal for tree and shrub plantings. These woody species provide habitat, stabilize slopes, and banks, and offer shade to cool the surface water.

While regulatory requirements dictate minimum efforts needed, the District often goes above and beyond by including addition native plantings and habitats within the District’s rights-of-way.
Figure 2. Willow Waterhole Detention Basin Compartments showing the Flow of Stormwater through the System.
Figure 3. Willow Waterhole Compartment 3 showing Prairie Remnants and Monitoring Transects
Biographies

Dr. Fred Smeins is Professor of Ecology in the Ecosystem Science and Management Department at Texas A&M University. His research and teaching interests center on understanding the structure and dynamics of rangeland (grassland, wetland, shrub-land, and savannah) plant communities as influenced by herbivory, soil, fire and climate. He has conducted research in tall grass and mixed grass prairies, oak savannas, Chihuahuan desert, longleaf pine savannah, prairie pothole and coastal marshes of North America, and savannah/shrub-land systems of Kenya, Morocco and Venezuela. He teaches undergraduate and graduate courses in Natural Resource Ecology and Management.

Cecil Carter has been a management consultant to colleges and other non-profit organizations working in this sector for the past 12 years. Mr. Carter is a member of 6 different non-profit boards, including the Trinity Forks Chapter of the Native Plant Society of Texas. Besides being a NPSOT member, he has served as chapter publicity chairman and Program Chairman. He served as the chairman of the photography contest at the 2010 Symposium. He is currently the chapter’s President Elect. Mr. Carter has delivered over one thousand papers, workshops and seminars on various management subjects. For 20 years, he served on the adjunct faculty of Oklahoma State University’s Oklahoma City branch.

Jane Crone has been the President of the Fredericksburg NPSOT Chapter on two separate occasions while maintaining her NPSOT membership for over 10 years. She was a founding member of the Hill Country Master Naturalist Chapter and has continued to hold the Master Naturalist certification through her on-going community service work involving naturalist projects. Ms. Crone is on the Board of Directors of the Friends of the Fredericksburg Nature Center and is a member of the Texas Ornithological Society.

Jim Dobberstine is a member of the environmental science faculty at Lee College. He is the former Land Conservation Programs Manager for the Galveston Bay Foundation and currently serves as the president of the Texas Association of Environmental Professionals.

Katy Emde graduated from USC with a B.A. in Telecommunications and has been a member of the Native Plant Society since the mid-1990's. She is also a member of the Audubon Society and the Outdoor Nature Club – Botany Group. She serves on the Memorial Park Conservancy Conservation Committee and on the Advisory Board of the Bayou Land Conservancy. In addition to being a Master Naturalist with the Gulf Coast chapter, she operates a small native plant nursery, MD Native Plants.

Carolyn Fannon is a published photographer with a lifelong interest in grasses and insects and who has been photographing Texas Coastal Prairie for the past 15 years. For the last few years, she has photographed areas of The Big Thicket. Carolyn is a member of the Native Plant Society of Texas, Native Prairies Association of Texas, and Coastal Prairie Partnership.

Diana Foss is an Urban Wildlife Biologist with Texas Parks and Wildlife Department where she has worked for 18 years. Prior to that, she was the Education Director for the native animal Texas Zoo for 10 years. She has a Bachelor’s degree in Wildlife and Fisheries Science from Texas A&M University, College Station. She specializes in habitat development projects, often working with landowners, cities, counties, and schools to
conserve or enhance existing habitat, as well as to create habitats for student learning. Ms. Foss monitors wildlife populations, including bats, and coordinates the Houston Bat Team, a group of community volunteers dedicated to education about bats and monitoring bat populations in the greater Houston area. She is also a member of the Texas White-nose Syndrome Task Force (bats). In 2002, she was honored with the TPWD Employee Recognition Award for Community Education, and in 2009, she was a member of the Urban Wildlife Program that was awarded the TPWD Employee Recognition Team Award. In 2008, she was awarded the Citizens’ Environmental Coalition Synergy Award for Environmental Education.

Carol Fraser has a doctorate in law and an undergraduate degree in English. She works for Harris County Water Control and Improvement District (WCID) 132 as a designer/manager for water conservation demonstration and their research garden, that is participating as a pilot site for the Sustainable Sites Initiative sponsored by the National Botanical Garden, the Lady Bird Johnson Wildflower Center and the National Association of Landscape Architects. She is a Master Gardener and chair of the speaker’s bureau for Harris County Master Gardeners. Ms. Fraser is also a Master Naturalist with the Gulf Coast chapter and a member of the advisory board for the National Gardening Association’s web site. She is a frequent speaker in the Houston area on gardening topics and can also be viewed on YouTube presenting educational tutorials related to gardening.

Jaime Gonzalez, Community Education Manager of the Katy Prairie Conservancy, is responsible for developing and implementing an annual schedule of activities and outreach programs to augment public access and awareness of the prairie. Mr. Gonzalez’s duties also involve expanding collaborative efforts with other organizations and agencies, including local universities. He earned a Master of Education in Curriculum & Instruction – Science Education at the University of Houston-Main Campus (2007); he also received his B.S. Biology (1996) from the University of Houston-Main Campus.

Mr. Gonzalez has been awarded the Elizabeth Hull Abernathy Award (2011) from the Garden Club of America for outstanding contribution to the environmental education of youth and the Army & Sarah Emmott Conservation Award (2009) from the Citizens’ Environmental Coalition for his prairie conservation efforts. He is President of the Coastal Prairie Partnership, a grass-roots coalition comprised of local, state, federal, and non-profit institutions, private landowners, individuals, businesses, and educators working to achieve common prairie conservation, restoration, and educational goals. Additionally, he serves as a Steering Committee member for the Texas Children in Nature Coalition.

Cullen Hanks studied Biology at Cornell University and received a master’s degree from the University of Texas where he studied biodiversity conservation and wildlife exploitation. He has extensive experience collecting biological data in the field in Texas and Latin America. Currently, he works for the Texas Parks and Wildlife Dept. on the Texas Natural Diversity Database (TXNDD) where he compiles information, and provides training on the use of GPS and GIS when monitoring rare species.

Cindy Howard is a professor of biology and environmental science at UHCL, where she teaches ecology, environmental toxicology courses. She has been studying the coastal marsh ecosystems of Galveston Bay for over 20 years and also leads annual research and natural history study expeditions to the Brazilian Amazon.

Dr. John Jacob is the director of the Texas Coastal Watershed Program, and holds a joint appointment with the Texas A&M Sea Grant Program and with Texas Agri-Life Extension Service through the Department of Recreation, Parks, and Tourism Science. He has coastal-wide responsibility for inland environmental problems that have a direct impact on the quality of our bays, estuaries, and coastal waters. Preeminent among these issues are the mitigation and abatement of runoff pollution from both rural and urban sources, and the preservation and restoration of valuable natural habitats such as wetlands. His current project, Coastal CHARM
(Community Health and Resource Management), focuses on enabling coastal communities in Texas to improve quality of life in cities and towns while preserving and enhancing the natural coastal environment.

Mr. Jacob holds B.S. and M.S. degrees from Texas Tech University, and a Ph.D. from Texas A&M University, all in soils and natural resources. He is registered as a Professional Geoscientist with the State of Texas and is a Professional Wetland Scientist. Mr. Jacob is a recognized expert on Texas wetlands, having been active in consulting and research aspects of wetlands for more than 20 years, and is coauthor of Texas Sea Grant Resilient Coast series on the built environment and wetlands.

Kay Jenkins is a Texas Parks and Wildlife Department State Parks Regional Natural Resources Coordinator who has worked as a coastal ecologist on the upper and lower coasts of Texas, and currently works in East Texas. She has a BS and MS in Forestry from Stephen F. Austin State University and a MS in Environmental Science from Texas A&M University-Corpus Christi. She is the past-president and current treasurer of the Friends of Connie Hagar, Inc. in Rockport, a board member of the Texas Society for Ecological Restoration, and president-elect of the Tyler chapter of NPSOT.

David Kee is Asst. Professor/Research Scientist, Harold and Pearl Dripps Dept. of Ag. Sci, McNeese State University. He holds a Ph.D. in Crop Management, Auburn University, 1994. Dr. Kee has 30 years of experience in Pasture, Range and Crop Management. Since joining McNeese State University in 2008, he has been actively involved in the Louisiana Native Plant Initiative. His primary responsibility has been to develop best management practices to establish, manage and utilize native plant species for use in southwest Louisiana and southeast Texas.

Mark Kramer is the Stewardship Coordinator at Armand Bayou Nature Center. His job includes all aspects of land management, wildlife management, habitat restoration and environmental education. Mr. Kramer is a Pasadena native and began exploring Armand Bayou in his youth. He currently participates as a Board Member and Steering Committee member of several organizations including the Environmental Institute of Houston, Galveston Bay Estuary Program’s Invasive Species Work Group, and the Armand Bayou Watershed Partnership. He enjoys speaking about topics including habitat restoration, the use of prescribed fire and wilderness preservation.

Bill Lindemann graduated from the University of Texas with BS and MA degrees in geology and worked for 32 years with Exxon as an Exploration Geologist, working extensively in the Far East. He was twice President of the Native Plant Society of Texas (2001 and 2006) and in 2003 was awarded the Nancy Benedict Memorial Award by NPSOT for an act of Conservation/Public Service in establishing the Fredericksburg Nature Center and the Friends of the Fredericksburg Nature Center organization. Subsequently, in 2006, he was also awarded the Benny J. Simpson Fellows Award by NPSOT for service by a member for the enrichment of the society. He has written a weekly birding column in the Fredericksburg Standard Radio-Post and the Kerrville Daily Times since 1997. He currently serves as the President of the Board of Directors for the Friends of the Fredericksburg Nature Center and as President of the Hill Country Land Trust while also serving on the Board of Directors for the Hill Country Historical Foundation. In 2006, the Gillespie County Historical Society awarded him a “Star of Texas” award for his work in creating the Fredericksburg Nature Center and for the preservation of the natural and historical heritage of the Texas Hill Country. Mr. Lindemann is a frequent speaker in the Hill Country on natural history subjects to schools, garden clubs, professional and service organizations, teaches classes on birding and nature at nature centers and adult education schools, and actively promotes historical and natural
preservation in the Texas Hill Country through education, outreach and example.

**Shelly Maher** lived under East Texas red oaks until she transplanted to South Texas to attend college at Texas A&M University-Kingsville. She graduated with a degree in Horticulture in 2000, and received a Masters of Biology in 2008. Ms. Maher has worked as a research scientist with the USDA Natural Resources Conservation Service, E. “Kika” de la Garza Plant Materials Center in Kingsville since 2002. In her work, she performs greenhouse plantings, field evaluations and seed germination tests on native Texas plant species. The research at the PMC leads to commercial seed releases and technology for restoration and conservation across the United States. Ms. Maher lives in Bishop, Texas, with her husband, Christopher.

**Minette Marr** is a plant conservationist for Lady Bird Johnson Wildflower Center. As a graduate student at Southwest Texas State University, Ms. Marr managed a wetlands restoration nursery near the headwaters of the San Marcos River and surveyed the flora of a natural area along the Lower Colorado River. Loss of floristic diversity at both sites highlighted the need for controlling invasive species and re-introducing endemic species. Her position in the Conservation Department at the Wildflower Center allows Minnette to collaborate with land stewards and citizen scientists to increase the sustainable use and conservation of native plants and landscapes.

**Pam Middleton** is the State Coordinator for the NPSOT state office located in Fredericksburg.

**Bill Neiman**, along with wife Jan, is the founder and owner of Native American Seed (NAS) of Junction, Texas, which is the principal supplier of native wildflower and grass seeds in Texas. In addition, NAS provides grass seed and consulting services for many prairie-restoration projects being done by national and state agencies as well as private landowners. The Neimans are leaders in the movement to conserve natural resources and to restore and maintain the health of the environment and are dedicated to educating the public about ecologically-sensitive land management. Mr. Neiman is an inspirational and entertaining speaker, who spends most of his precious little free time talking to school classes and adult groups on these topics. Bill and Jan Neiman were honored with the Benny J. Simpson Award for special service to NPSOT in 2011.

**Brent Ortego** is a Wildlife Diversity Biologist for the Texas Parks and Wildlife Department. He has worked for TPWD since 1982 in a variety of roles mostly associated with nongame and habitat management. He has worked for the last 11 years assisting landowners with Coastal Prairie restoration as part of the Coastal Prairie Conservation Initiative.

**Cecilia Richmond** is Nursery Manager, Louisiana Environmental Research Center. BS Wildlife Management, McNeese State University. CiCi is a marsh raise girl from Cameron Parish. Her love for all things prairie and marsh has developed into a full time passion and career. She is responsible for the collection and propagation of native plants utilized by the Louisiana Native Plant Initiative at McNeese State University. She leads the effort in southwest Louisiana to deliver viable planting material to seed and nursery producers. This, in turn, will provide native plants for restoration and revegetation efforts in southwest Louisiana and southeast Texas.

**Jason Singurst** received a B.S. and M.S. in Agricultural Science from Stephen F. Austin State University, Nacogdoches, Texas. He has conducted field research on vegetation ecology of the West Gulf Coastal Plain for the past 14 years. His expertise includes natural areas inventory, plant community ecology, and plant taxonomy. He has served as a Texas Parks and Wildlife Department botanist/ecologist in Texas for the past 13 years. He has extensive field knowledge with rare plant species in eastern and central Texas. He has authored or co-
authored over 40 scientific publications and in 2007 co-authored a book on Rare Plants of Texas. He has described two plant species new to science that are endemic (restricted) to Texas. Mr. Singhurst has in-depth experience with vegetation mapping, descriptive vegetation classification, and natural resource surveys on public and private lands. Jason has a strong interest in prairies and prairie fens (prairie wetlands) as he has conducted many botanical surveys of these floristically rich plant communities in Texas, Oklahoma, and southeastern Kansas where he was raised and spends as much time with his family as he can. He has concentrated the past few years on rare and endemic plant surveys of coastal prairies, including defining a few un-described prairie swale plant communities in the Coastal Bend region of Texas.

Dr. Fred Smeins is Professor of Ecology in the Ecosystem Science and Management Department at Texas A&M University. His research and teaching interests center on understanding the structure and dynamics of rangeland (grassland, wetland, shrub-land, and savannah) plant communities as influenced by herbivory, soil, fire and climate. He has conducted research in tall grass and mixed grass prairies, oak savannahs, Chihuahuan desert, longleaf pine savannah, prairie pothole and coastal marshes of North America, and savannah/shrub-land systems of Kenya, Morocco and Venezuela. He teaches undergraduate and graduate courses in Natural Resource Ecology and Management.

Carolyn White is a Project Manager for the Harris County Flood Control District Environmental Services Division. She currently manages projects under the water quality and re-vegetation programs, including wetland planting for water quality enhancement, detention basin layout, ongoing water quality monitoring, and preparation of landscape and planting plans for capital improvement projects. Prior to joining the District, she was an environmental consultant at ENTRIX, Inc. for 11 years. Ms. White holds a Master’s Degree in Landscape Architecture/Environmental Planning from The University of California – Berkeley and a Bachelors of Arts Degree in Geology from Carleton College, Northfield Minnesota. She is chair of the Restoration Committee of the Coastal Prairie Partnership.

Janet Woolman is the Director of Research and Tech Transfer, Director of the Louisiana Environmental Research Center (LERC), and Associate Professor of Library and Information Science at McNeese State University. She holds a Master’s degree in Library and Information Science from Louisiana State University and has extensive experience writing proposals and administering federal and state grants. She oversees education and training related to grant writing, grant-writing activities, and monitors compliance and regulation issues dealing with OMB, FAR, and other applicable laws and regulations. She also works with university administration and local and state elected officials to support research and economic development in Southwest Louisiana. As Director of the Louisiana Environmental Research Center (LERC), Janet’s responsibilities include: providing administrative oversight and direction, gathering and compiling report information for ongoing LERC related projects, approval of expenditures, and all other Chenier Plain Initiative related activities. She works with researchers at McNeese and partners with such entities like the Port of Lake Charles, the Coalition to Restore Coastal Louisiana, National Resources Conservation Service (NRCS), LNPI, CPC, Nicholls, UL-L, and companies such as LA Ash. She serves on the Chamber of Commerce’s Environmental Committee and volunteers for other community related activities.
FIELD TRIPS

THURSDAY FIELD TRIPS (2)

#T1 Site: Warren Ranch Preserve - Katy Prairie Conservancy Lands
Date: Thursday, October 13
Description: Warren Ranch is the largest remaining cattle ranch in Harris County. At nearly 6,500 acres, this sprawling preserve is home to several plant communities including coastal prairie remnants, oak mottes, riparian forest, farmland, and saline barrens - geologically fascinating areas that are home to an odd assortment of plants typically found on the coast, in west Texas, or even the barrens of the great north. Mid-October is a great time to explore Warren Ranch and field trip attendees are likely to be treated to fall-blooming tall-grasses and wildflowers as well as wetland plants if sufficient rains fall. In addition, participants will also have a wonderful opportunity to spot the many animals that call the ranch home including migratory birds that flock to our area at this time of the year.
Website: [http://www.katyprairie.org](http://www.katyprairie.org)
Leader: Wes Newman, KPC Land Manager
Jaime Gonzalez, KPC Community Education Manager

#T2 Site: Edith L. Moore Nature Sanctuary (self-guided)
Date: Thursday, October 13
Description: The Edith L. Moore Nature Sanctuary in West Houston is a 17.5 acre wooded sanctuary along Rummel Creek with a restored log cabin that is owned and managed by Houston Audubon as an urban wildlife sanctuary. In 1932, Edith Moore and her husband Jesse hand-constructed a log cabin on the banks of Rummel Creek using trees they harvested from the surrounding forest. In 1975, to ensure future generations would walk through her woods and learn about nature, Edith Moore willed 17-acres of land and her log cabin to Houston Audubon, on the condition it be maintained as a perpetual sanctuary. Rummel Creek runs through the sanctuary that is a popular birding destination.
Website: [www.houstonaudubon.org/default.aspx/MenuItemID/883/MenuGroup/Sanctuaries2.htm](http://www.houstonaudubon.org/default.aspx/MenuItemID/883/MenuGroup/Sanctuaries2.htm)
Leader: Self-guided

FRIDAY FIELD TRIPS (8)

#F2 Site: Edith L. Moore Nature Sanctuary (guided)
Date: Friday, October 14
Description: The Edith L. Moore Nature Sanctuary in West Houston is a 17.5 acre wooded sanctuary along Rummel Creek with a restored log cabin that is owned and managed by Houston Audubon as an urban wildlife sanctuary. In 1932, Edith Moore and her husband Jesse hand-constructed a log cabin on the banks of Rummel Creek using trees they harvested from the surrounding forest. In 1975, to ensure future generations would walk through her woods and learn about nature, Edith Moore willed 17-acres of land and her log cabin to Houston Audubon, on the condition it be maintained as a perpetual sanctuary. Rummel Creek runs through the sanctuary that is a popular birding destination.
Website: [www.houstonaudubon.org/default.aspx/MenuItemID/883/MenuGroup/Sanctuaries2.htm](http://www.houstonaudubon.org/default.aspx/MenuItemID/883/MenuGroup/Sanctuaries2.htm)
Leader: Don Gray, Lead Naturalist for the Audubon Docent Guild
**#3 Site:** Attwater Prairie Chicken National Wildlife Refuge  
**Date:** Friday, October 14  
**Description:** Attwater Prairie Chicken National Wildlife Refuge (NWR), located approximately 60 miles west of Houston, Texas, is one of the largest remnants of coastal prairie habitat remaining in southeast Texas and home to one of the last populations of the critically endangered Attwater prairie-chicken, a ground-dwelling grouse of the coastal prairie ecosystem. Formerly occupying some 6 million acres of coastal prairie habitat, the Attwater prairie-chicken was once one of the most abundant resident birds of the Texas and Louisiana tall grass prairie ecosystem. Presently, less than 200,000 fragmented acres of coastal prairie habitat remain, leaving the birds scattered among three Texas counties. The refuge is one of a handful of national wildlife refuges managed specifically for an endangered species. However, recovery activities for this imperiled bird and management of its declining ecosystem go beyond the refuge’s boundaries. Much of the refuge consists of virgin prairie, never plowed or converted to croplands. However, you’ll find formerly cultivated fields on their way to becoming prairie too. The refuge staff first harvests native grass seeds from the virgin prairie in the fall, then distributes them in the old fields. Returning that field to a prairie takes years, but slowly the dedicated effort is paying off.  
**Website:** [http://www.fws.gov/southwest/refuges/texas/attwater](http://www.fws.gov/southwest/refuges/texas/attwater)  
**Leader:** Terry Rossignol, Refuge Manager, Attwater Prairie Chicken NWR

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**#4 Site:** Columbia Bottomlands Units of the San Bernard NWR  
**Date:** Friday, October 14  
**Description:** Columbia Bottomlands hardwoods feature old growth forest and associated wetlands containing unique and endemic arboreal species such as Nuttall’s Oak, Cherrybark Oak, Bur Oak, Durand’s Oak, and Corkwood among others. This site offers a preview of pristine bottomland habitat. Boots and insect repellent are recommended when entering these forested wetlands.  
**Website:** [http://www.fws.gov/southwest/refuges/texas/texasmidcoast/sanbernard.htm](http://www.fws.gov/southwest/refuges/texas/texasmidcoast/sanbernard.htm)  
**Leader:** Tom Adams, Biologist, San Bernard NWR

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**#5 Site:** Brazoria Palms of San Bernard NWR  
**Date:** Friday, October 14  
**Description:** This population of naturally occurring uniquely trunked *Sabal Palmettos* are currently of un-substantiated taxonomic origin and stand in a mesic bottomland forest sanctuary in southwestern Brazoria County, Texas. The Brazoria Palmettos in this tract of the San Bernard National Wildlife Refuge range in height up to 27 feet. The tallest has been estimated to be about 150 years old. Genetic tests are in progress to determine the lineage of these reproducing native palms found nowhere in the wild outside of Texas. Access is through dense flats of dwarf palmetto and poison ivy in the understory. Boots and insect repellant are also recommended.  
**Website:** [http://www.fws.gov/southwest/refuges/texas/texasmidcoast/sanbernard.htm](http://www.fws.gov/southwest/refuges/texas/texasmidcoast/sanbernard.htm)  
**Leader:** Warren Pruess, Sandy Elsik NPSOT Members, Houston Chapter
**Site:** Armand Bayou Nature Center  
**Date:** Friday, October 14  
**Description:** Armand Bayou Nature Center is a 2,500-acre preserve in the center of a highly urbanized area between NASA/Johnson Space Center and the Bayport Industrial District. ABNC protects remnants of this region’s original ecosystems including wetlands, bottomland forest, and tall grass prairies. This environmentally significant area has been designated as one of only four Texas State Coastal Preserves and is one of the last bayous in the Houston area that is not channeled. In addition, ABNC is the recipient of the Lone Star Land Steward Award sponsored by Texas Parks & Wildlife Department recognizing excellence in wildlife habitat management and conservation on private lands.  
**Website:** [http://www.abnc.org/](http://www.abnc.org/)  
**Leader:** Mark Kramer, Stewardship Coordinator, ABNC

**Site:** Willow WaterHole Greenway (Harris County)  
**Date:** Friday, October 14  
**Description:** This site is a 60 acre park in southwest Houston where Harris County Flood Control District Environmental Services Div. has used native plant re-vegetation as part of their flood mitigation system. While still under construction, this site is an excellent example of a governmental entity re-creating native plant habitats to control storm-water run-off. Carolyn White will be presenting on this topic at a Saturday break-out session.  
**Leaders:** Carolyn White, HCFCD Project Mgr, Peter Loos, NPSOT VP Environmental Liaison NPSOT

**Site:** Russ Pittman Park (City of Bellaire)  
**Date:** Friday, October 14  
**Description:** Russ Pitman Park is an urban oasis smack in the middle of the city of Bellaire with four acres of heavily wooded grounds, which make it a haven for birds and other animals. Originally a large estate owned by one family, its manor, the beautiful 1920's-vintage Henshaw House, still stands as the park’s community outreach center, the Hana and Arthur Ginzberg Nature Discovery Center. The park includes an excellent example of a pocket prairie created with specimens and seeds collected from local coastal prairie locations and thus demonstrates the value of using prairie plants in a wildscapes garden setting. The pocket prairie was created and is maintained by volunteers.  
**Leader:** Donald Verser, Pocket Prairie Docent

**Site:** Wildlife Habitat Federation Prairie Corridor (Colorado County)  
**Date:** Friday, October 14  
**Description:** The Wildlife Habitat Federation (WHF) is a federation of private land-owners who own and synergistically manage a 7-mile corridor of prairie habitat running from the WW Ranch to the northern gate of Attwater Prairie Chicken NWR. The Wildlife Habitat Federation (WHF) was formed in 2004 to bring together the best specialists and techniques for restoring and preserving wildlife in South Central Texas. WHF’s aim is to provide individuals and wildlife associations or cooperatives with the right facts on how, when and where to plan and implement wildlife habitat restoration programs. WHF’s specific objectives are 1) to restore and enhance contiguous tracts and corridors of native habitat in the Lower Colorado River Basin and adjacent areas; and 2) to provide educational opportunities to assist landowners in optimizing productive use of their resources while significantly enhancing habitat. WHF uses a combination of activities for restoring native grasses on the ranches. They are also assisting landowners representing some 12,000 acres in other areas though Habitat Action Team (HAT) strike forces. HATs provide on-ground equipment and technical assistance.  
**Website:** [http://whf-texas.org/](http://whf-texas.org/)  
**Leaders:** Kathy Burris  NPSOT & WHF Member, Dr. Fred Smeins, TAMU Professor of Ecology, Jim Willis, President – Wildlife Habitat Federation
**SUNDAY FIELD TRIPS (7)**

**#S10 Site:** Nash Prairie in Brazoria County  
**Date:** Sunday, October 16  
**Description:** Nash Prairie is over 300 acres of very special coastal tall grass prairie acquired by the Nature Conservancy of Texas in January, 2011. This prairie is a rare remnant of the coastal prairie that once covered over six million acres of Texas and Louisiana. In the fall of 2003, Dr. David Rosen, botanist and plant taxonomist with the U.S Fish and Wildlife Service began his survey of the Nash Prairie. The Nash Prairie is a 300 acre remnant Coastal Tall Grass Prairie that is managed as a native hay meadow for the ranch. The topography of the Nash Prairie is intact. Most noticeable are the many pimple mounds, indicating that the Nash hay meadow has probably never been grazed or plowed. David’s survey of the vascular flora of the Nash Prairie has resulted in a checklist of almost 300 native species of plants and the list is growing.

**Website:** [http://www.stmaryswestcolumbia.org/index_files/Page551.html](http://www.stmaryswestcolumbia.org/index_files/Page551.html)  
**Leader:** Susan Conaty, Former Preserve Docent  
Dr. David Rosen – Botanist/Taxonomist who did first survey of Nash Prairie

**#S11 Site:** Mowotony Prairie  
**Date:** Sunday, October 16  
**Description:** Mowotony Prairie is a coastal prairie remnant, located just south of Brazos Bend State Park, was acquired by the Nature Conservancy of Texas in January, 2011. This 79 acre remnant hayfield is a window into our past. Recognized by botanists and environmentalists as one-of-a-kind and irreplaceable, Mowotony is brimming with rare, endemic native wildflowers, grasses and sedges that support a suite of birds, amphibians, insects, reptiles, and mammals. It is adjacent to the Columbia Bottomlands, and serves as a model for prairie restorationists.

**Leader:** Bill Carr, Texas Nature Conservancy, Co-author of “Rare Plants of Texas”

**#S12 Site:** Fleming Prairies – Sam Houston National Forest  
**Date:** Sunday, October 16  
**Description:** Fleming Prairies are a globally rare prairie type restricted to very western Louisiana and southeast Texas. These calcareous prairies follow a narrow band of geology called the Fleming Formation (see Map 1.), which starts west of Huntsville, Texas and follows an arc just south of Livingston and through Jasper to just below Toledo Bend Reservoir near Burkeville, Texas on the Texas and Louisiana state line. The soils are deep clays and these prairies are often on high uplands and the heads of creeks - often dissected by naturally eroded gullies and calcareous (‘calciphile’) hardwood forests. The flora of these calcareous clay soil prairies are generally strongly differentiated from that of almost all of the mostly sandy acidic soil communities of southeast Texas. Very few Texans have encountered this rare prairie type due to limited access as most sites are located on timber company lands. Fleming Prairie site is a great place to see prairie species such as Texas gramma, side oats gramma, compact prairie clover, purple prairie clover, purple coneflower, fox glove, prairie gentian, Maximilian sunflower marbleseed, false guara, Indian plantain, blazing star, and the Missouri coneflower - all atypical plant species of the Pineywoods.

**Leader:** Peter Loos, NPSOT VP Environmental Liaison

**#S13 Site:** Peckerwood Gardens  
**Date:** Sunday, October 16  
**Description:** Peckerwood Garden is an outstanding repository of rare and unusual plants from the United States, Mexico, and Asia; and exhibits a unique collection of folk art from Mexico. Balancing artistic expression and scientific discovery, it fosters educational and scientific programs, and encourages greater knowledge and appreciation of horticulture. The Peckerwood Garden Conservation Foundation was established to preserve existing collections; support continued plant explorations and trials; and develop, maintain and preserve the land and facilities of Peckerwood Garden. There are many ways to describe Peckerwood Garden: it is a collection of more than 3,000 plants including...
many rarities; it is a conservation garden containing examples of numerous threatened species, many of which are no
longer found in the wild; it is a laboratory garden testing a wide range of "new" plants and Mexican discoveries.

Website:  www.peckerwoodgarden.org
Leader:  Peckerwood Garden Docent

Site #S14:  Sheldon Lake State Park and Environmental Learning Center
Date:  Sunday, October 16
Description:  Only 18 miles from downtown Houston, a 400-acre coastal prairie, including 20 "prairie pothole" ponds, is
being restored to demonstrate what was once the predominate landscape in this area. Texas Coastal Watershed
Program staff and volunteers collect, propagate, and plant more than 30 species of native wetland plants appropriate to
the site. Concurrently, prairie restoration is being done by the Texas Master Naturalists. Attendees can also walk a 1 mile
wooded trail through a series of former fish hatchery ponds, and see varying environments from American lotus-
bedecked ponds to emerging forest. A new 65' accessible observation tower provides an overview of the prairie,
woodlands, and Sheldon Lake reservoir, with downtown Houston visible on the horizon.
Website - Park site:  http://www.tpwd.state.tx.us/spdest/findadest/parks/sheldonlake/
Wetland restoration site:  http://wetlandteam.ning.com/
Leader:  Kelly Norrid, TPWD

Site #S15:  Mercer Arboretum and Botanic Gardens - Endangered Species Garden
Date:  Sunday, October 16
Description:  In 1974 Thelma and Charles sold Harris Count Precinct 4 their 14-acre homestead and gardens along
Cypress Creek. Mercer Arboretum and Botanic Gardens has grown to ~325 acres of east Texas piney woods and
showcases the region's largest collection of native and cultivated plants. In keeping with Thelma and Charles' work to
preserve native plant species, Mercer is one of 36 participating botanical institutions that comprise the national Center
for Plant Conservation (CPC  http://www.centerforplantconservation.org/). Several of the 24 rare native species that
Mercer maintains for the CPC are displayed in Mercer's Endangered Species Garden. Interpretive signage identify
common Texas natives used to complement the rare native species on display. The Endangered Species Garden is
certified by the North American Butterfly Association and as a Best of Backyard Habitat Demonstration Garden by Texas
Parks and Wildlife and the National Wildlife Federation. The Endangered Species Garden demonstrates the use of
permanent water and food sources, composting and organic management methods for the benefit of wildlife. Prior to
the tour, attendees are invited to meet in Mercer's Visitor Center and attend an informative presentation about the rare
native plants that Mercer maintains for the CPC.
Website:  http://www.hcp4.net/mercer/
Leader:  Anita Tiller, Mercer Botanist

Site #S16:  Spring Creek Greenway Nature Center & Peckinpaugh Preserve
Date:  Sunday, October 16
Description:  Peckinpaugh Preserve is a 25 acre bottomland hardwood area which has a thick understory containing a
number of trees and plants similar to the east Texas Big Thicket. Therefore this area is often called “The Little Thicket”,
as it is the western-most edge where the vegetation of the Big Thicket survives. The Preserve borders Spring Creek and
provides habitat for a variety of native terrestrial and non-terrestrial species as well as stop-over habitat for migrating
waterfowl. The tract has a high diversity of native tree species including Black Gum, Hercules Club, and a notable
Magnolia specimen.
Website:  http://www.springcreekgreenway.org/naturecenter.htm
Leader:  Teri MacArthur, Manager of Spring Creek Greenway Nature Center
#52 Site: Edith L. Moore Nature Sanctuary (self-guided)
Date: Sunday, October 16
Description: The Edith L. Moore Nature Sanctuary in West Houston is a 17.5 acre wooded sanctuary along Rummel Creek with a restored log cabin that is owned and managed by Houston Audubon as an urban wildlife sanctuary. In 1932, Edith Moore and her husband Jesse hand-constructed a log cabin on the banks of Rummel Creek using trees they harvested from the surrounding forest. In 1975, to ensure future generations would walk through her woods and learn about nature, Edith Moore willed 17-acres of land and her log cabin to Houston Audubon, on the condition it be maintained as a perpetual sanctuary. Rummel Creek runs through the sanctuary that is a popular birding destination.
Leader: Self-guided

ANYTIME FIELD TRIP (1) –
This self-guided field trip may be attended anytime during the symposium

#TFS17 Site: Constructed Demonstration Meadow at Houston Arboretum and Nature Center (self-guided)
Date: Friday, October 14
Description: The Houston Arboretum & Nature Center (HANC) is a 155-acre non-profit urban nature sanctuary located on the western edge of Memorial Park. It is managed by the HANC Board of Directors and staff under an agreement with the City of Houston Parks and Recreation Department. The Meadow at the Houston Arboretum & Nature Center is a constructed demonstration grassland habitat surrounded by hundreds of acres of loblolly pine-mixed hardwood forest. In the late 1970's - after a multi-year drought similar to the one we are experiencing now - a stand of pines were killed by pine bark beetles. Since a soil survey of the area suggested that a natural Gulf Coast Prairie once existed here, a 4-acre area was subsequently cleared and excavated to create a demonstration meadow and pond. Plants endemic to area prairies were both seeded and transplanted. Thirty years later and the continued presence of pine-specific soil fungi and the absence of large grazers such as deer and buffalo make it necessary to maintain this constructed meadow by occasional mowing, reseeding and transplanting. Among the prairie plants we have established are sunflowers, liatris, bluestem grasses, asters, coreopsis, gaillardia, and basketflowers. Additionally, visitors can enjoy over 5 miles of nature trails, including forest, pond, wetland and meadow habitats.
Leader: Self-guided
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