2003

2nd Lone Star Native Regional Plant Conference

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In Association with the Cullowhee Native Plant Conference

Proceedings of the 2nd Lone Star Regional Native Plant Conference

Hosted by Stephen F. Austin State University

Pineywoods Native Plant Center

Nacogdoches, TX

May 28-June 1, 2003

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WELCOME TO THE SECOND

CULLOWHEE LONE STAR REGIONAL NATIVE PLANT CONFERENCE

MAY 28 - JUNE 1, 2003

Dave Creech and Paul Cox

ACKNOWLEGEMENTS: The Cullowhee Native Plant conference began a little over twenty years ago with the University of North Carolina at Cullowhee serving as the host institution for an annual multi-day celebration of native plants. The conference is a unique mixture of plant enthusiasts, nurserymen, landscapers, botanists, academics, and horticulturists. Speakers address native plant concerns, research projects, conservation efforts and landscape use topics. It's a great conference. In fact, the annual July conference has been such a success that the 450 "slots" that the conference can support fill up in just a few days. That response prompted the creation of three satellite conferences representing their specific region. The regional conferences allow for nationally known speakers to address region-specific topics and for participants from near and afar to enjoy the local flora.

The Pineywoods Native Plant Center is proud to host the second Cullowhee Lone Star Regional Native Plant Conference. Please thank the speakers for taking time to share with participants. The SFA Mast Arboretum Volunteers deserve a big round of applause for handling so much of the workload that goes into putting on a conference of this scale. Elyce Rodewald, the Mast Arboretum's educational programs coordinator, did a masterful job dealing with registration and program details. Peter Loos, a volunteer for the PNPC, deserves special thanks for helping with speakers and many program details. Dawn Parish, Matt Welch and the SFA Mast Arboretum student workers deserve thanks for pitching in to bring the plant sale to reality and for sprucing up the PNPC gardens. Finally, make sure you thank Lance Craig, the on-the-ground Research Associate for the Pineywoods Native Plant Center, and all the PNPC student workers, for bringing the gardens and facilities up to presentation quality. I know they'll be glad to get back to gardening!

THE LOGO: Paul Cox, horticultural guru of the San Antonio Botanical Garden, must be given complete credit for coming up with the slogan for this year's Cullowhee Lone Star

Regional Conference. I fought "Sex in the Garden" as a theme simply on the grounds that it seemed a bit bold and could be misconstrued by various university, civic and religious groups as offensive. I know we're not talking about anything risqué here. Simply said, Paul and I have enjoyed numerous dialogues on all kinds of fascinating native plants and their breeding habits and opportunities. Germplasm, genetic drift, bigeneric hybrid possibilities, botanical nomenclature confusion, and breeding goals were common topics. Lance Craig, the PNPC Research Associate, thought "Sex in the Garden" as a theme couldn't offend anyone, and if it did, they should get a life. In the Arboretum, Dawn Parish and Matt Welch came in with a "hey, that's fantastic." The SFA Mast Arboretum Board of Advisors voted a big yes for the slogan. The final straw: even Ms. Elyce Rodewald, our talented, conservative and socially correct educational programs coordinator supported the theme vigorously. Elyce, a Purdue trained biologist, had a talented Art major, Rhamel Miranda, as an intern in her program who was enthusiastic about tackling the project and she was convinced he could do a great job producing a cartoon for the Proceedings cover and our T-shirt. He did. In spite of my serious reservations, the vote was against me. The only negative reaction I had was from my mother. That was not enough to counter the wave of support for a "Sex in the Garden" theme. I was overruled. So the topic of Paul's banquet talk and mine is Sex in the Garden. But don't expect anything off color or offensive from either of us – ever. It's not our style. We're talking Native plants, endangered plants, germplasm pools and what we do with them.

<u>THE NECHES RIVER ROSE MALLOW</u>: The inspiration for the conference theme is based on a wonderful plant, *Hibiscus dasycalyx*, the Neches river rose mallow. This is one of the most endangered and least understood plants in Texas. A woody based, many-stemmed perennial readily recognizable by its very narrow leaf blades and pubescent calyx. Height is to four foot with branched spreading stems. Flowers are present June to late September (may bloom into October) and are ivory-petaled bell-shaped blooms about three inches in diameter. The throat of the flower is deep pink to maroon with light pink to lilac pollen borne on pinkish anthers. Calyces are very hirsute pubescent, thus the name *H. dasycalyx*. Fruit is a rounded capsule containing approximately twenty-seven seed. The seed are densely covered with rust to brown colored stiff hairs.

There has been little work done with *Hibiscus dasycalyx*, mainly due to its rarity. An article by Blake in 1958 describes *H. dasycalyx* by comparing its foliage to that of *H. coccineus* and its corolla to that of *H. laevis*. This species is "distinguishable from all other United States Hibiscus species by its densely spreading hirsute calyx". This description was written by Ivan Shiller in 1955 who visited the Highway 94 colony in Trinity County, Texas while doing research on the pink bollworm, *Pectinophora gossypiella*, one of the greatest insect enemies of the genus *Hibiscus*.

An entire thesis from Cornell University by Orland J. Blanchard Jr. was devoted to *Hibiscus* section *Trionum Sensu Lato* in 1976. This body of work includes morphological descriptions, systematics, hybridization studies and distribution/habitat information for Hibiscus including *H. dasycalyx* found in section *Muenchhusia*. Section *Muenchhusia* includes five species (*H. moscheutos, H.laevis or militaris, H. grandiflorus, H. coccineus and H. dasycalyx*) that are almost entirely confined to the conterminous United States extending from coastal Massachusetts south, mostly along the Atlantic coastal plain to peninsular Florida and across to Texas. Inland the plants of this section occur from eastern Texas north to Canada and east. All of the species in this section are hydrophytes in the wild but it has been observed that they can survive drainage of their habitat. It is suggested that under cultivation they actually prefer well drained rather than wet soils. Seed dispersal would appear to be almost entirely water dependent. Even though there is a problem with interspecific hybridization, *H. dasycalyx* is facultatively self-pollinating. That is, its stigma recurves into the anther mass toward the end of the day. In 1976, Blanchard reported all Hibiscus in section *Muenchhusia* have chromosome counts of nineteen. The confusion between *H.laevis, H. dasycalyx* and *H. militaris* is a matter of much debate.

Hibiscus laevis was the name originally published by Allioni in 1773. It therefore predates Cavanilles' *H.militaris* and is retained as the name for *H. laevis*. *H. laevis* is also known as the Halberd-leaved Marsh Mallow or the Halberd-leaved Rose Mallow. *H.laevis* and *H. moscheutos* subspecies *lasiocarpos* are found in proximity of the *H. dasycalyx* colony at the Highway 94 site. If this site were the only *H. dasycalyx* site it might have been treated as a chance hybrid between the two. However, some genetic stability can be expressed by plants grown from wild collected seed. There is one colony of Hibiscus in Brazos County, Texas that would appear to represent a hybrid between *H. laevis* and *H. dasycalyx* even though the nearest known true colony of *H. dasycalyx* is eighty miles away from the site. Further investigation of the surrounding area seems to be warranted.

In 1988, a seed collection trip by Paul Cox of the San Antonio Botanical Garden and Dr. Elray Nixon, Botany Professor at Stephen F. Austin State University, Nacogdoches, Texas, resulted in disappointment and discovery. The *H.dasycalyx* colony near a roadside park had mostly been mostly destroyed. However, upon further investigation twelve or thirteen more plants were discovered. Cuttings were taken for plant establishment at the San Antonio Botanical Garden Endangered Plants garden. Seed from these plants were then stored in the seed banks to prevent the probable extinction in nature of *H. dasycalyx*.

The Neches river rose mallow is a herbaceous perennial preferring full sun in open marshy areas that experience periodic flooding. Tolerance to standing water is present during the dormancy period but not during growth. The initiation of flowering can be delayed if water levels remain high into mid spring. The sawfly, *Atomacera decepta*, is known for causing the most damage in the wild to both foliage and seed. This white-flowering, extremely narrow-leafed mallow is known globally from only five sites in East Texas. The genetic status of all sites is uncertain due to the encroachment of other Hibiscus species. In general, the species is under threat because of inter-specific hybridization with more aggressive species, *Hibiscus laevis*, and *H. moscheutos* in particular, as well as habitat and biotic changes along the Neches River watershed. The plant is far more threatened than its listing indicates and deserves immediate attention. SFA State University scientists in cooperation with the U.S. Fish and Wildlife are currently cooperating on a project that will define the genotype via morphological and DNA analysis protocols, a step that is essential if the species is to be successfully reintroduced into appropriate habitats on public lands.

WILDFLOWERS OF LOUISIANA

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The Flora is primarily a Coastal Plain one that is overlain with elements from the Western U.S., the Tropics, and introduced species. The western elements are mainly in western Louisiana especially in the northwest corner north of Shreveport while the Tropical ones are mainly along the coast but the introduced ones are scattered all across the state. The vegetation zones in the state follow closely the geology and soil and are usually divided into five major zones: marsh, prairie, pine, bottomland hardwoods, and upland hardwoods.

The marsh zone lies adjacent to the Gulf of Mexico and extends inward irregularly. Most of the area is true marsh with wet soil conditions and is dominated by graminoids (grasses, sedges, and rushes), and other non woody plants. There are a few shrubs within the true marsh but a number of shrubs, trees, and woody vines are found on the elevated areas of coastal dune shrub thickets, the chenieres, and the man made spoil banks. The coastal dune thickets are narrow strips of shrubs vegetation usually parallel to and very close to the Gulf of Mexico. The chenieres are dominated by hackberry and live oak and in recent year is being invaded by Chinese tallow tree. The man made spoil banks include many *Baccharis halimiifolia* and recently many many Chinese tallow trees. A few of the interesting plants of the marsh include: Salt Marsh Mallow (*Kosteletzkya virginica*); Catchfly Prairie Gentian (*Eustoma exaltatum*); Carolina Wolfberry (*Lycium carolinianum*); and Lawn Orchid (*Zeuxine strateumatica*).

Moving inland from the marsh in western and central Louisiana, the next vegetation zone encountered is the prairie. The prairie includes the large Cajun Prairie near the coast and the small inland prairies many of which are very similar, if not the same, as the Blackland Prairies of Texas, Mississippi, and Alabama. Cajun Prairie once covered 2.5 million acres in southwestern Louisiana but now a few railroad remnants are all that remain of this ecosystem. The three top families in Cajun Prairie are the Grass, Sedge, and Aster. The top grasses include big Bluestem, little bluestem, switch, Indian, and Eastern Gamma that are also very common in Midwestern prairies plus slender bluestem which adds some uniqueness to the Cajun Prairie. A couple of interesting species include button snakeroot (*Eryngium yuccifolium*) with its white flowers and Agave *or Manfreda virginica* with red stigmas. And in the Bean or Legume family the false indigoes with one white (*Baptisia alba*) and several yellow (*Baptisia bracteata* ssp *laevicaulis*, *Baptisia nuttalliana* and the spectacular *Baptisia sphaerocarpa)*. Other beans include Sampson Snakeroot (*Psoralea psoraloides*) and sensitive briar (*Schrankia*). The aster or sunflower family include a lot of yellow rayed species like golden asters, hairy sunflower, blackeyed susan, and compass plants, *Silphium*. But the star of the Cajun Prairie is blazing star or *Liatris*. The inland prairies are small and scattered through central and northern Louisiana with the largest three being Copenhagen in Caldwell Parish, Keiffer in Winn Parish, and Anacoco in Vernon Parish. Some interesting plants of these include the purple cone flower (*Echinacea purpurea*), the rare, *Heliotropium tenellum*, prairie acacia (*Acacia angustissima*); purple prairie clover (*Dalea purpurea*) and white prairie clover (*Dalea candida*), and yellow powder puff (*Neptunia*). Other interesting ones are the prairienymph (*Herbertia lahue)*, Celestial lily (*Nemastylis geminiflora*), camassa lily (*Camasa scilloides*, and snow on the mountain (*Euphorbia bicolor*).

The most extensive vegetation region in the state is the pine region and it can be subdivided into a hilly section to the north and flatwoods to the south. The hilly section is on the Tertiary Uplands and older Pleistocene Terraces and the flatwoods section is on those younger Pleistocene Terraces that have soils derived from Pleistocene and Tertiary materials. Many of the true pine forests are replanted and replanted and replanted loblolly pine (*Pinus taeda*) plantations. Some species of the pine forest are pinewoods lily or pleatleaf (*Alophia drummondii*); pale coneflowers (*Echinacea*); Indian Blanket (*Gaillardia aestivalis*); flowering spurge (*Euphorbia corollata*); and mountain mint (*Pycnanthemum albescens)*. The most common vegetation type within this area is obviously, pine (*Pinus* spp.), forests but there are several vegetation types that are not dominated by pine. These include small patches of prairie as mentioned earlier or strips of upland forests along the slopes near streams or even strips or blocks of bottomland hardwood forests in wet areas long the streams or in depressions. There are also other vegetation zones within the pine region such as sandy woodland, baygalls, and bogs. The sandy woodlands are on the highest, driest, and sandiest sites mostly in northwest Louisiana but some in the central and west central area. There are a few pines but the areas are dominated by oaks (*Quercus*). A common soil type for sandy woodlands is Betis loamy fine sand. Some species of the sandy woodlands include: Red Penstemon (*Penstemon murrayanus*);

buckwheat (*Eriogonum multiflorum*; jointweed (*Polygonella americana*); bull nettle (*Cnidoscolos texanus* and *stimulosus*); firepink (*Silene subciliata*); and coral bean or Mamou (*Erythrina herbacea*). A baygall is the vegetation developed along sandy bottom streams with acid ph soils in southeastern, southwestern, and west central Louisiana. The woody vegetation includes some trees but mostly evergreen small trees and shrubs including gallberry, white bay, red bay, baygall blueberry, baygall waxmyrtle; note the bay or gall names. The woody vine, *Smilax laurifolia*, is often very dominant in the baygall. The herbaceous species list is mainly ferns but a few flowering plants are here including Joe-pye weed (*Eupatorium fistulosum*); Death camassa (*Zigadenus*); sweet coneflower (*Rudbeckia subtomentosa)*; bunch flower (*Melanthium virginicum*); and pink milkweed (*Asclepias rubra*). The bogs are open areas and are usually associated with a baygall. Bogs are similar to prairie and marsh in being dominated by non woody graminoids but also include a number of carnivorous plants. The four carnivorus genera are: pitcher plants (*Sarracenia*); sundews (*Drosera*); butterworts (*Pinguicula*); and bladderworts (*Utricularia*). Other interesting bog plants are sunnybells (*Schoenolirion croceum*) and a number of orchids; bog pinks (*Calopogon*), yellow fringed orchid (*Platanthera ciliaris*); yellow crested orchid (*Platanthera cristata*), and snowy orchid (*Platanthera nivea*). The flat areas of southeastern and southwestern Louisiana produce the pine flatwoods and the savannahs. Both have an overstory of pines with a few scattered trees and shrubs. The flatwoods is usually drier, has a dense canopy of pines, and the floor has a sparse cover of graminoids. The savannah is wetter, often with bogs especially in southeast Louisiana, is more open and thus the floor has a dense cover of graminoids. The original range of slash pine (*Pinus elliottii)* was in these areas in southeast Louisiana

The bottomland hardwood zone is characterized by many wet or cultivated areas. This region is located in the alluvial plain and part of the deltaic plain. The areas immediately adjacent to the larger streams often develop a vegetation type termed "batture". This is best developed along the Mississippi River and is commonly dominated by cottonwood (*Populus deltoides)*, Sandbar Willow (*Salix interior)*, and black willow (*Salix nigra)*. The most common vegetation type within the floodplain region is the bottomland hardwood forests. These are found on the wet to mesic sites throughout the state but are best developed in the Mississippi and Red River floodplains. There is a wide range of species associations that are controlled by soil type, elevation, geographical location, and human. In the very wet areas (depressions, old ox bow lakes etc.) the swamp vegetation develops. There are not too many attractive flowering species in this zone but some are leather flower (*Clematis crispa*), lizard's *tail (Saururus cernuus*), smartweed or knotweeds (*Polygonum*); and mallow (*Hibiscus*).

The upland hardwood forest vegetation region occurs throughout the state but is only extensive in one area, in the southeast part of the state. This area is known as the Tunica Hills and is north of St. Francisville and east of the state prison at Angola. The other hardwood forests occur as small strips or patches paralleling streams, especially in the pine regions. Some of the interesting plants of this zone are: white milkweed (*Asclepias variegata*); wild comfrey (*Cynoglossum virginianum*); Virginia Pennywort (*Obolaria virginica*; small flowered baby blueeyes (*Nemophila aphylla*); Indian *Pipe (Monotropa uniflora*); Indian pink (*Spigelia marilandica*); Spring Coralroot (*Corallorhiza wisteriana*); green adder's tongue orchid (*Malaxis unifolia*); and lousewort (*Pedicularis canadensis*).

Like every state, there are a number of disturbed areas especially along highways and these are the home of a number of species some introduced and some native. Some include hairyfruit chervil (*Chaerophyllum tainturei*); straggler daisy (*Calyptocarpus vialis)*; horseweed *(Conyza canadensis);* fireweed *(Erechtites hieracifolia*); camphor weed (*Pluchea*); ditch daisy or yellow top or sneeze weed (*Senecio glabellus*); sow thistle (*Sonchus*); Venus looking glass (*Triodanis* or *Specularia*); southern rockbell (*Wahlenbergia marginata*); mouse eared chickweed (*Cerastium glomeratum*); chickweed (*Stellaria media*); cypress vine (*Ipomoea quamoclit*); goatweed, or wooly croton (*Croton capitatus*); wild geranium (*Geranium carolinianum*); poke (*Phytolacca americana*); blue fieldmadder (*Sherardia arvensis*); and corn salad (*Valerianella radiata*).

Just like all states, Louisiana has plants that are rare or interesting but could be common in other states. One is broadleaf Barbara's buttons (*Marshallia trinervia*) with two reported populations in Louisiana, one in the SE and one in the SW with the latter being discovered in recent years. The orchids, as always, are interesting with yellow fringeless orchid (*Plantanthera integra*) a rare species in Louisiana but with a couple of known locations in the Ft Polk area. Another interesting orchid is wild coco (*Eulophia (Pteroglossaspis) ecristata*) that is known from several locations in western Louisiana including prairies and pinelands but is temperamental in that is visible some years but not the next. The bog flame flower (*Macranthera flammea*) with its beautiful orange flowers is a semiparasite and is found only in the extreme SE corner of Louisiana. Another species that only enters Louisiana in the extreme

SE corner is Indian *Cucumber (Medeola virginiana)*, a member of the Lily family. Two other members of the Lily family produce large flowers including Carolina Lily (*Lilium michauxii*) and pine or catesbae lily *(Lilium catesbaei)*. The pine lily is restricted to pine savannahs in se Louisiana while the Carolina Lily is found throughout the state in well drained forests. Our most spectacular orchid is the yellow lady's slipper (*Cypripedium kentuckiense*) with a large flower and limited distribution.

The Louisiana Flora consists of slightly more than 3000 species in about 1000 genera and 200 families (Table 1). Approximately 74.5% of the species are native.

Table 1. Louisiana Floral Summary

Category	Species & Subspecific Taxa	Genera	Families
Pteridophytes (Ferns)	81 (N = 63; I = 18)	34	23
Coniferophyta	12 (N = 10; I = 2)	5	3
Monocots	976 (N = 756; I = 220)	244	34
Dicots	2,180 (N = 1,594; I = 586)	727	139
Total	3,249 (N = 2,423; I = 826)	1,010	199

Does Our Mission Matter?

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In a May 1965 message to the United States Congress, President Lyndon B. Johnson called for a White House Conference on Natural Beauty and outlined the reasons why America should be concerned with the condition of our natural environment.

He noted the increasing urbanization of the American landscape and how, with the growth of cities and suburbs, people were "being cut off from nature." He described the destruction of streams, trees, and meadows along with the expansion of highways, and he observed that "people move out of the city to get closer to nature only to find that nature has moved farther from them." In short, he was describing what we now call "sprawl."

Echoing the alarm of Rachel Carson's seminal book "*Silent Spring*," President Johnson also took note of the "darker side" of industrial progress. He called for an end to uncontrolled waste products and the degradation of the nation's water, soil, and wildlife by "poisons and chemicals which are the byproducts of technology and industry."

To address these problems, President Johnson called for a "new conservation" that went beyond protecting the landscape from destruction. He called for a "conservation of *restoration* and *innovation*" [emphasis added] that dealt with the "total relation between man and the world around him." Under this "new conservation" Johnson painted a vision where the beauty of our landscape would evolve from being "a holiday treat" into being an inherent "part of our daily life."

Johnson's "new conservation" message called for more than the improvement of the environment. It called for the restoration of natural beauty as something *essential* to "the dignity of the man's spirit." This summons to protect and restore the natural beauty of our nation's landscapes and to make contact with nature and beauty an inherent part of life's experience was regarded by President Johnson as a fundamentally important initiative for his administration and for the people of America.

How is it that we found one of the most powerful political leaders of the modern age speaking insightfully and forcefully, 40 years ago, about the importance of our connection to the natural world, and yet today, when this relationship is still in great peril, we find no major political leadership on this issue? Was Lyndon Johnson ahead of his time in placing our relationship with the natural world on the national agenda? If so, it is imperative that we now catch up with him. Although many strides were made toward this "new conservation" in the decade following the Johnson Administration – in both Republican and Democratic administrations – threats to our nation's natural beauty, to the health of our landscape, and to America's biological diversity remain with us, demanding awareness and action. Yet today we seem to be turning away from our commitment to the beauty and quality of our natural environment.

Those of us who work at the Lady Bird Johnson Wildflower Center believe that a strong economy is compatible with strong protection of our natural landscape. Indeed, we believe that a healthy and beautiful land is a *prerequisite* for a healthy society and a healthy economy. The very air we breathe, the water we drink, the formation of soil, and the insects that pollinate many of our food crops are all dependent on healthy native-plant communities. If we become a population of citizens cut off from the beauty of the natural world, if we continue to lose the healthy native-plant communities that comprise the foundation of a healthy environment, then we will diminish not only our human spirits but also the very basis of our prosperity.

There is a unity of vision between President Johnson's quest for a "new conservation" of "restoration and innovation" and the articulated appeal of our founder, Lady Bird Johnson, for a nation that protects and celebrates its natural beauty. We must rebuild the bipartisan consensus on environmental protection that grew out of President and Mrs. Johnson's initiatives. We must help our fellow citizens forge a new partnership with nature. We must build our human communities in such a way that integrates the human community into the wider community of life and in a way that protects the diversity of nature and the ecological processes upon which life depends.

The Lady Bird Johnson Wildflower Center is heir to this unity of vision. Just as our programs in landscape restoration, plant conservation, use of green building technologies, "green gardening" techniques, and environmental education strive to make this vision a reality, so too must we strive to win back an elevated place on the national agenda for the beauty and health of our landscape.

The Role of Organic Materials In Gardening

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SOIL FOOD WEB

A new more powerful and accurate model of soil fertility and health has evolved over the last 10 years. This new model is based on soil biology instead of chemistry and physics and is called the "Soil Food Web."

Over the years we have inched ourselves away from the healthy soil found in nature till we no longer think about the differences. The first slide is a "Family Circus" cartoon that illustrates this point: Is This Soil or Dirt? Healthy soil is alive with over 6 trillion microorganisms per pound while many of the soils we commonly work with in horticulture or in our lawns have only a few million microbes if any (i.e. dirt). This may be due to mis-management, over use of toxic chemicals, chlorinated water in irrigation systems, artificial fertilizers, etc.

In February 2001, the USDA released an introduction to this new model of soil fertility in a booklet called the "Soil Biology Primer." The team leader for the USDA was Elaine Ingham a microbiologist with Oregon State University.

A question one might ask is, Why develop a new model of soil fertility as we already have most of the chemistry and physics figured out? Over the last fifty years as data began to accumulate from around the world, several alarming trends have become apparent. First, it was observed that the natural soils which most of our plants evolved in had very different characteristics than our urban soils in which we are trying to grow plants. It was also noticed that the plants growing in natural soils do not have the disease or pest problems while those growing in urban soils have lots of problems. A second pattern was noticed from global data on agriculture; the chemical approach to insect, disease and weed problems is not working. As more chemicals were applied, the worse the problems have become. The amount of disease and insect pressure (loss) on agricultural crops changed very little for many decades. Then the data shows that problems started increasing dramatically and became increasingly worse after World War

II when factories that made ammonium nitrate for bombs starting making artificial nitrogen fertilizer. Artificial fertilizers kill the soil microbes that prevent soil diseases, and since they are water soluble they pollute the groundwater as well as lakes and streams. A good example of this is the Dead Zone off the mouth of the Mississippi river in the Gulf of Mexico. Another trend seen is an IQ drop in the United States population. This has been shown to be linked to poor quality food, exposure to pesticides (most are neuro-toxins) and other chemicals that affect the nervous system. As IQ drops, problems in society such as crime and violence increase. It was also noticed that fertility problems in young couples have increased dramatically over recent decades. Men's sperm count in the US have dropped over 50% during the last 30 years resulting in many fertility problems for couples. Many pesticides break down into estrogen like hormones and many herbicides cause direct reproductive problems and birth defects.

As a result of the above data, many researchers started looking at why these events were occurring and how they might be prevented. As a result, a new model of soil fertility and management emerged called "The Soil Food Web." This new model is based on biology. Its focus is on understanding why problems occur and preventing these problems rather than treating

them with costly and dangerous chemicals. We have found that this new model works better, is lower in cost, prevents most problems, does not pollute and uses minimal amounts of dangerous chemicals. This model explains why a "good" compost works so well (or that a low quality one does not work at all) and why compost teas work better than most fungicides and at lower cost. It explains why some types of mulch increase problems while other types prevent problems.

The soil food web is a complex interaction of all the lifeforms that live in or on the soil. It is broken into several functional groups where bigger organisms eat smaller ones and their waste products become food for bacteria and fungus starting the process all over. The organisms store important nutrients in their body structure preventing them from being lost due to leaching. When the soil has a healthy and functioning soil food web, we derive 7 major benefits:

1) Disease suppression (competition, inhibition, consumption)

2) Improve nutrient retention in soil

3) Mineralize nutrients and make them available to plants

4) Improve soil structure

5) Decomposition of toxic materials (phenols, tannins, pesticides)

6) Produce plant growth promoting compounds

7) Improve crop quality (flavor, nutrients, yield)

One of the first observations researchers noticed was the direct relationship between the levels, or population density of microbial activity, and the productivity of different eco-systems. As the number of microbes increase, so does the soil productivity. As a result, researchers started testing this observation in the laboratory. This point is illustrated as we measure biomass; in sterile media, with bacteria only, and bacteria and nematodes. The effects of just bacteria and nematodes on plant growth is significant. It was confirmed that plant growth and health is directly affected by the number and variety of microbes in the soil.

Microbiologists started studying individual plant species and several important factors were discovered. They found that every plant lives in a symbiotic relationship with microbes in the soil. This point is illustrated in the slides by a root hair with and without a beneficial fungus. A healthy root system is colonized by beneficial microbes such as this mychorrizae fungi. The next illustration shows how fungi protect root hairs from pathogens, root feeding nematodes, etc. These good guys are killed by many toxic chemicals from artificial fertilizers to fungicides. If a plant's leaves are sprayed with a fungicide, sooner or later (from rain or irrigation) they are washed into the soil where they kill or inhibit the beneficial microbes. The next slide illustrates how the presence of these good fungi affect plant growth. They show a pine tree seedling growing in a sugar sand with and without fungi present. The fungi make a big difference.

We have learned that microbes and other soil organisms put out root growth hormones. These growth hormones help plants survive drought or flooding, withstand wind damage, increase growth and yield, etc.

Another example of this symbiotic relationship we are familiar with is nitrogen fixing rhizobium bacteria that live on the roots of many plants providing free nitrogen to the plant from the air.

The next slide shows a root tip putting out root exudates to attract beneficial microbes. A plant may release over 50% of the energy it receives from sunlight in these root exudates. In general, plants like most grasses, vegetables, and annuals want soils dominated by bacteria. While shrubs, trees, perennials want soils dominated by fungal species. The amendments we apply to the plants and soil, whether chemical or natural, affect, change or disrupt these relationships. Hence, the type of feedstocks and methods used to produce compost affect the microbial content of the compost and thus its uses and the results we achieve. This factor explains why one type of mulch may help one specie of plant yet perform poorly for another species.

Other microbes like protozoa live in healthy soil and compost. Healthy soil has a chemical ratio of carbon to nitrogen of about 30:1. Protozoa also have a 30:1 ratio while bacteria have 5:1! Thus when a protozoa eats one bacteria it has the nitrogen it needs but eats 5 more bacteria to get the required amount of carbon. It now has 5 excess nitrogen atoms that are excreted into the soil. Since bacteria live around the root tips (rhizophere) the plants can easily absorb the nitrogen without leaching. Additionally, some bacteria species have a honeycomb structure which helps hold and store water molecules on their surface.

Many of the microbes in soil prevent disease. This bacteria (Streptomyces) a member of the actinomycete group, eats the fungus that cause brown patch in lawns. This good guy is killed by synthetic fertilizers and chlorinated water (i.e the more water and fertilizer then more disease and insect problems). Compost is a good source of these good guys. Switching to a natural fertilizer, applying 1/4-1/2" compost every year will eliminate most common turf diseases and reduce watering requirements 50% or more.

Some of the larger animals found in healthy soil are nematodes. Over 1,000 species have been identified and only 20 or so eat roots with the rest being beneficial. These worms have a C:N ratio of about 30:1. The next illustrations are of a root feeding nematode that show a small rupture in its side. After the first fungal hyphae finds the nematode other hyphae quickly attack him and the powerful enzymes of the fungus start to digest him. So instead of the nematode eating the roots, the nematode becomes food for the fungus and the plant.

The microbes can break down igneous rocks like granite and basalt releasing the minerals so that plants can use them. Microbes in the soil do the same as these algae growing on igneous rocks. Powerful enzymes released by the microbes can release nutrients even from rock material. The illustrations show plants growing in gravel, from zero microbes to lots of microbes. In all situations microbes make a big difference. A good compost is the best source of these microbes. Another example shows peanuts growing in a sugar sand. In this case a microbial inoculant product called actinovate (one of many brands on the market) was applied to one row.

The next illustrations show how larger soil organisms are extremely important. Earthworms aerate the soil, some species eat weed seeds, some eat pathogenic bacteria and fungus. They all produce chemicals in their mucus called auxins that are plant growth hormones. They increase beneficial microbes 10-100X as the soil passes through their gut (a natural bioreactor). Their tunnels are great for roots to grow down and they also allow water and air to enter the soil (like air ducts in a house). They concentrate nutrients, in a plant available form, in their castings. Earthworms are killed by most synthetic fertilizers, chlorinated water and pesticides, etc. so we loose these important functions when toxic chemicals are applied. Earthworm castings often called vermi-compost, a rich source of microbes and nutrients for plants. Dr. Clive Edwards at Ohio Sate University has written several books on the importance of earthworms in horticulture. A good compost applied to the soil, is a good food source for earthworms and encourages their growth.

One of the larger insects found in the soil are grub worms. Most grub worms prefer to eat decaying organic matter but will eat roots rather than starve to death. They perform useful functions by transporting and spreading many good microbes through the soil. Their tunnels also make very large air ducts for air and water to move into the soil. In healthy soil with a good food web, they can even be beneficial rather than destructive. The next illustrations show a grub worm that came too close to a root protected by mychorrizae fungi. Instead of a grub worm eating roots, the grub worm becomes food for the fungi and plant (the grub worm is totally covered with fungi whose enzymes are breaking it down and digesting it).

A healthy soil has many other larger organisms in it. A few examples are centipedes, millipede, pill bug (isopods) and others.

One of the benefits of a healthy food web is the conversion of organic matter into valuable humus, a complex process. Compost may contain some humic substances, but does not become humus till after the microbes process it.

The next series of illustrations were from the USDA Research Center in Beltsville, Maryland that I visited a few years ago. The USDA performed a lot of studies on why compost works so well and why the use of trace elements were important (granite or basalt mineral dusts). The USDA tested many combinations, using several types of compost from recycled organic matter from yard trimmings to bio-solids.

The soil food web has been used to solve some common problems in horticulture. The first example is from the nursery industry using composted native mulch (supports a healthy soil food web) as a potting media instead of traditional pine bark media. A 100% control of root diseases from microbial action occurred, hence, we did not require any dangerous chemicals lowering production costs. We also found reduced water requirements, faster growth rates and better shaped plants, another economical benefit.

In landscape use, a healthy soil food web makes a big difference and can have long lasting effects. A small 8" tall tree in a yard with little maintenance or care was struggling. It was treated with a few shovelfuls of compost (source of microbes) and then the compost was watered in. The compost tested low in nitrogen, but a strong green up occurred in about 14 days after application of the compost (microbes were making nitrogen available to the plants from the air). The tree was later mowed down by a yard maintenance company, however, the one treated area is still green and much larger even 4 years later after the one application of compost. Nature will heal itself if given the right tools (i.e. a good soil food web).

Other examples of results using a good compost and the soil food web model are:

Germination testing using Marigolds in a compost media

Erosion control test using compost at a landfill on 3:1 slopes

Kumquat test

Hydrangea test

Turfgrass and tree root development test

Rose propagation test turfgrass disease control test

Trace element test

Biological test reports of strawberry production

Compost tea disease control test

The material used in this presentation came from many sources. The Soil Science Society of America, USDA, The Soil Food Web Multi-media CD-ROM by Elaine Ingham, numerous universities, and from the authors personal slide library.

For more information on the "Soil Food Web" model of soil fertility, compost teas, and biological testing analysis of soils, please see "www.soilfoodweb.com." This website is run by Elaine Ingham, PhD one of the leading researchers involved with developing this new model of soil fertility. Dr. Ingham has recorded a series of lectures explaining the soil food web in detail. They are available on audio CD (may be ordered from the website):

1) Introduction To The Soil Food Web
2) The Soil Food Web - A Plant Production Overview
3) Turf Systems and the Soil Food Web
4) The Soil Food Web - The Compost Food Web (compost and compost teas)

Composting [illegible] is a complex process. Compost may [illegible]

The material used in this [illegible] The Soil Food Web [illegible]

Society of [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

1) Introduction to The Soil Food Web [illegible]

2) The Soil Food Web [illegible]

3) [illegible]

4) The Soil Food Web [illegible]

[illegible] long lasting effects. A small 6" tall tree in a yard with little [illegible] was struggling. It was treated with a few shovelfuls of compost [illegible] and then the compost was watered in. The compost tested low in nitrogen, but a strong green-up occurred in about 14 days after application of the compost [illegible] nitrogen available to the plants from the air). The tree was later mowed down by a yard maintenance company; however, the tree treated area is still green and much larger even 4 years later after the one application of compost. Nature will heal itself if given the right tools (i.e., a good soil food web).

Other examples of results using a good compost and the soil food web model are:

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Erosion control test using compost as a berm on a 3:1 slope

Compost test

Hydrangea test

Turfgrass and tree root development test

Rose propagation and turfgrass disease control test

Trace element test

Biological test aspects of strawberry production

THE TEXAS WILDSCAPES PROGRAM

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The thirty students in the classroom sat quietly, observing the photos of various wildlife species on the screen. The students' backgrounds were similar, many from one-parent households and less than idyllic childhoods. One by one, the students identified the animal, its preferred food, and desired habitat type. A photo of a tiny bird with a thin long black beak, shiny green feathers, and red throat feathers popped up on the screen. The room remained silent as the seconds ticked by. Finally one hand raised. "Is it a woodpecker," the student asked. "Good guess because of the beak, but no, look closer. This bird is only about three inches high. It flies incredibly fast," said the instructor. Finally another student hazarded a guess. "Is it a hum-something? It eats the juice in the flowers, right?" No one in the classroom had ever seen a hummingbird except in the pages of a book. There are many children and adults in this world who grow up with no access to natural areas in their neighborhoods. They have never experienced the beauty of a hummingbird, or perhaps a butterfly. These same children will eventually grow up to be habitat stewards in the future, or perhaps not.

Texas Parks and Wildlife Department created and implemented the Texas Wildscapes Program in 1994. The initial idea focused on encouraging the creation of habitats in urban backyards so that urban residents could enjoy the beauty of and learn more about the wildlife and plants commonly found in natural habitats around them. Hopefully in the process of developing the backyard habitat, an appreciation for wildlife and natural habitats would bloom. Urbanization and habitat fragmentation are impacting large chunks of wildlife habitat across the state. With more than ninety percent of Texas land privately owned, action by private landowners is vital for successful habitat restoration. The Texas Wildscapes program has been wildly popular. Due to public demand, the program has expanded to include entire yards, business landscapes, corporate acreage, schoolyards, golf courses, public parks, subdivisions, and other green spaces. Some of those wildscapes serve as public demonstration sites. Certification involves completing an application to describe how the site provides food, water, and shelter, with a predominance of native plant species. The program currently touts over 3,759 certified sites across the state.

WHAT IS A WILDSCAPE?

A wildscape is a habitat for wildlife. The basic components include year-round sources of food, water, and shelter. The size, shape, and plant diversity will vary between locations across the state, but the main focus is to provide an inviting space that attracts a variety of wildlife, such as butterflies, songbirds, and hummingbirds. People living in rural parts of the state probably experience nature up-close each and every day, but there are people living in urban areas who do not have that opportunity. The idea that you can plant specific vegetation to attract wildlife to your urban location is very intriguing to many people. School habitats are particularly popular, with students, teachers, parents, and community partners teaming up to design, plant, and maintain habitats on their school ground.

PROVIDING THE HABITAT ESSENTIALS

Food is the first component of wildlife habitat. Many people erect bird, squirrel, and butterfly feeders, filled with various seed mixes, suet, and nectar. Feeders work well as a supplemental food source, but not as the sole source if your goal is to attract a variety of wildlife. Vegetation should serve as the primary sources of food. Native species of annuals, perennials, grasses, shrubs, small and large trees are recognized by native wildlife as good food sources. Berries, fruit, nuts, tiny and large seeds, leaves, and nectar represent food. Select plants that will provide a variety of food through out the seasons. For the budget conscious, select plants that have multiple benefits for wildlife. As an example, Cherry Laurel (*Prunus caroliniana*) blooms with white nectar-rich flowers in the early spring, attracting bees, butterflies, and other insects. Then in the summer, the plant produces juicy berries used by birds and other wildlife. Because the tree is evergreen, birds may use it as a nesting site or shelter. Native grasses provide several wildlife benefits – nesting material in spring, shelter for small animals in the summer and winter, and seeds in fall and winter. Try to replicate natural habitats in your landscape, especially the diverse edges where two habitat types meet. Layer the vegetation, resembling what you would see in a naturally forested area. Plant tall canopy trees, with smaller trees beneath the larger ones. Then add understory shrubs, perennials, grasses, and groundcovers underneath the small trees. Encourage respect for all aspects of nature in your habitat. The presence of insects in your habitat shows you have been successful in attracting a key component of the food web. Birds, ladybugs, dragonflies, frogs, lizards, spiders, bats, and many more eat insects. By inviting insects to your landscape, you are maintaining a reliable food source for those insectivorous wildlife species.

Shelter is often the second listed habitat component. Shelter includes places to escape predators, avoid adverse weather, build nests, and rest. Again, vegetation is the key. Thick, evergreen vegetation is especially treasured due to its benefits in winter. Clumps, hedges, or thickets of dense vegetation are also prized. Wildlife often use plants like Southern Wax Myrtle (*Myrica cerifera*), Yaupon (*Ilex vomitoria*), Strawberry Bush (*Euonymus americanus*), Coralberry (*Symphoricarpos orbiculatus*), and many others as shelter. Dead trees (often called snags), fallen logs, and other natural cavities provide much desired habitat for several wildlife species. Insect-eating bats, woodpeckers, owls, swifts, martins, bluebirds, and others utilize hollow cavities as shelter and nesting areas. Artificially designed structures and nest boxes may be used as substitutes for naturally occurring cavities. However, each wildlife species has specific size and design preferences for such structures. Rock walls, brick piles, stacked wood, compost piles, overturned flower pots, and such can serve as shelter for small species as well.

Water is the third habitat component. Remember the word "puddle" when providing water for wildlife. Water sources should be shallow with a variety of depths. Less than three inches deep is perfect for most birds, with hummingbirds needing as little as ¼ of an inch. Water should be easily accessible with gently sloping sides. The slope on a pond should be a ratio of 1:3 or more. Animals utilizing the water source should be able to walk into the water like you would the beach. No sharp drop-offs or steps need exist. Water should also be safe, with no predators lurking nearby to catch a bathing bird. Backyard ponds with gently sloping sides work best, but containers like plant saucers and birdbaths can be used as well. With the threat of West Nile Virus and mosquitoes, water in containers and birdbaths should be cleaned and changed frequently. For a pond, the addition of Mosquitofish (*Gambusia* sp.) that eat mosquito larvae will help manage mosquitoes. Ponds should include a variety of vegetation – emergent, submergent, and floating plant species in and around the edges. The plant material will filter the water, anchor the soil, and provide food and shelter for fish and other pond wildlife. The plants also tie up nitrogen and other nutrients in the water, thus reducing the nutrients needed for algae growth. Plants to avoid in your pond include: Alligatorweed (*Alternanthera philoxeroides*), Eurasian Waterfoil (*Myriophyllum spicatum*), Giant Duckweed (*Spirodela polyrhiza*), *Salvinia* species, Hydrilla (*Hydrilla verticillata*), Water Hyacinth (*Eichhornia crassipes*), Rooted Waterhyacinth (*Eichhornia azure*), Water Lettuce (*Pistia stratiotes*), Water Spinach (*Ipomoea aquatica*), Torpedo Grass (*Panicum repens*), Lagarosiphon (*Lagarosiphon major*), and Paperbark Tree (*Melaleuca quinquenervia*). All of these plants are illegal to possess in Texas. Plants that work well around a pond include wetland species, such as Obedient Plant (*Physostegia* sp.), Cardinalflower (*Lobelia cardinalis*), Pickerelweed (*Pontederia cordata*), Swamp Milkweed (*Asclepias incarnata*), Buttonbush (*Cephalanthus occidentalis*), Powdery Thalia (*Thalia dealbata*), *Sagittaria* species, Sedges, Rushes, and more.

BENEFITS OF NATIVE PLANT SPECIES

Native plant species that have survived years of adverse weather and natural climate conditions in your area are the best choices for wildlife habitats. These plant species have developed elaborate relationships with local wildlife species, ones we often do not understand. For best success, select plants that occur naturally in your ecological region and surrounding areas. For example, if you live in East Texas, choose an Arrowwood Viburnum (*Viburnum dentatum*) as a shrub rather than a Texas Sage (*Leucophyllum frutescens*) from West Texas due to the soil type and precipitation in your area. Native plant species are also logical choices for water-conserving landscapes. They generally require less maintenance as well. Properties that apply for wildscape certification need to ensure that at least fifty percent of the plants in their habitat are native to Texas.

WILDSCAPE DESIGN

Wildscape design may or may not be an issue, depending upon where you live. In urban areas with landscape regulations, native plants may be planted in traditional landscape styles. For example, natives might be planted in raised beds with attractive edging. Vines might be trained to a trellis or fence. Wildscaping makes it possible for people to live in harmony with wildlife and each other. Try to maintain your wildscape for your enjoyment and that of your neighbors. A wildscape creates a safe island in which wildlife finds the resources they need. A certified wildscape is not an "official wildlife sanctuary" or an excuse to ignore city or county regulations, or homeowner association agreements.

CONCLUSION

As urban areas continue to expand, wildlife habitats are decreasing. Students and adults are growing up with fewer connections to nature. The Texas Wildscapes Program serves as one solution to those problems. The program provides information and recognition to people that create wildlife habitats at homes, schools, and businesses. People are often amazed to realize that by planting specific plants, "they [wildlife] will come." The students mentioned in the true story above designed and developed a school habitat in 2002. One week after planting, the purple martin house was full of martins and butterflies abounded. A hummingbird was enthusiastically sighted in early 2003. For more information about wildlife or habitat management, the Texas Wildscapes program, and to learn more about the new Best of Backyard Habitats Program, visit the Texas Parks and Wildlife Department web site – www.tpwd.state.tx.us, or call 1-800-792-1112. The Texas Wildscapes: Gardening for Wildlife book by Noreen Damude and Kelly Bender continues to be an excellent reference for people just starting their wildscape. Refer to the Native Plant Society of Texas web site – www.npsot.org – or attend local chapter meetings to learn more about native plant species. And also refer to the National Wildlife Federation web site – www.nwf.org – for additional information.

species. Hydrilla (*Hydrilla verticillata*), Water Hyacinth (*Eichhornia crassipes*), [illegible] ... [illegible] sighted in early 2003. For more information about wildlife or habitat management, the Texas Wildscapes program, and to [illegible]

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Native Plants & the Hydrological Cycle
'Rationale and Techniques
for using regional flora in healing our ailing water cycle'.

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Summary

The aspect of the hydrological cycle discussed here is the water captured, filtered, held and made available in the topsoil and subsoil. The amount of rainfall a soil can receive before runoff, is related to the amount of biologically active carbon in the soil and the soil structure. This paper describes the roll of native plants in building the optimum topsoil for this important part of the water cycle against the background of a set of specific techniques for increasing functional rainfall as illustrated by several projects in Central Texas.

Human activities in the past several hundred years have contributed to the decline of the health of our planets water cycle. In the past, water would enjoy a leisurely journey back to the sea with multiple diversions. The rapid explosion of the amount of impervious cover in the form of pavement and rooftops sends rainwater directly into straightened waterways to move quickly back to the sea. More significant, by an order of magnitude, is the degradation of topsoil integrity due in part to chemical agriculture, forestry, overgrazing and other modern land management practices.

Water issues capture attention more and more as the hydrological cycle degrades. This paper is focused on those interested in making improvements to the land. You may be landowners wanting to steward your acres in the best and most cost efficient ways. Or you may act in the capacity of a consultant, advising stewardship management techniques. In every instance there will be a limited amount of money and effort available which needs to be prioritized to meet land improvement goals. A one-time project that can jump-start natural process, making more water available, while mitigating the extremes of droughts and floods, would be high on the priority list. Especially so, if the project accrued benefits years into the future. This paper describes the basic concepts of several such projects as a backdrop for explaining the roll of native plants in enhancing the water cycle.

The salient attribute of native plants, which make them so vital to this process, is their production of root exudates. Plants in natural ecosystems deposit a significant portion of their products of photosynthesis into the rhyzosphere as root exudates. This nutrient rich soup is by no means wasted. It feeds an enormous cast of characters in the soil. Many members of this Soil Food Web remain unnamed and their functions are poorly understood. It is known however that with a thriving soil food web, comes an increase in biologically active carbon, good crumb structure, mineral and nutrient recycling, good percolation and capillary water transport...in general healthier topsoil. The greater the source of food the more rapidly the topsoil improves.

Native plants are the best choice for building soils for several reasons. Local flora has generally not been subject to fertilization over an extended period of time with soluble NPK chemical salt fertilizers. Many seeds of commercially available non-native grasses and cover crops have been grown on year after year with soluble fertilizers causing the plants grown from these seeds to have a drastically reduced flow of root exudates. Each species of plant produces a different signature of exudates stimulating a different cadre of soil organisms. It follows that local plants will have the best success in culturing the local soil organisms. This also argues for having a healthy diversity of species.

In an effort to improve the functioning of the water cycle several strategies were combined to increase available water, retard erosion, and mitigate the extreme effects of drought and flood. All sites had in common around 35 inches average annual rainfall, a greatly reduced diversity of native plants due to grazing pressure, agriculture and other management practices, depleted mineral profile and low humus levels.

In most cases a major portion of the goal was to create or enhance a pond or wetland as part of a 1-d-1 Agricultural Appraisal Wildlife Management Use plan.

The first phase was onsite examination of the property, topo maps and soil survey maps, to determine the appropriate strategies for the specific properties. In these projects it was decided to use Permaculture swales, diversions, small check dams, perched water tables, soil testing, soil remineralization, inoculation and revegitation.

Permaculture swales are long narrow insoak fields exactly on contour. Although they look like agricultural terraces they differ in design and function in that terraces are designed to drain out one side while swales are designed to fill up and drain into the ground throughout their length. They consist of a berm or levy on contour with a depression on their uphill side. When overflowing in a heavy rain event they can be designed to discharge at any location. As water is captured behind a swale it is slowed and drops its sediment load. Since some of the first soil fractions to erode are humus and clay colloidal material, this sediment is ideal for building fertile soils and is, in effect, a device to harness erosion. In the design of these projects the swales function as diversions during more significant rain events. A possible negative aspect of swales, and any insoak field, is the leaching of nutrients into subsoils and aquifers. In nature this problem is lessened by sequestering nutrients in the bodies of soil microorganisms and plant material. It is therefore critical to inoculate microorganisms if necessary and revegitate with native plant material to provide food for their colonization. The result of greatly increased water availability in the presence of a teaming soil food web and native plants, is the rapid production of fertile topsoil and all its ramifications.

The check dams employed here are small short dams in drainages, dry creeks and small streams which bump off a portion of stream flow into the systems of swales, diversions, wetlands and ponds. In heavy rains the dams are bypassed so as not overburden the system. Where appropriate it is important not to adversely effect downstream riparian areas. When properly designed, check dams function to redirect excess run off water with its load of soil building sediment into the systems of swales, wetlands and ponds, greatly expanding the watershed capture area.

Exclosures were included in some of the projects in order to allow the establishment of a greater diversity and number of native plant species. The swales and wetlands are exceptional locations for exclosures with the added water and remineralization. Construction was accomplished quickly and inexpensively with the cleared brush material from the project. Here in Central Texas, deer were the principal threat to seedling and sapling survival and these brush windrow "fences" proved effective for up to 5 years without the addition of more materials.

Areas suitable for ponds and wetlands were identified through site observation and examination of the engineering soil data included in the USDA soil survey maps. In some cases, pockets of clay were found during construction and a perched water table could be established in that portion of a swale to create a wetland area. On the Edwards Plateau many of the clays are high calcium clays and therefore not suitable for ponds or wetlands. In these cases liners were installed of either local suitable clay, bentonite or the calcium clays were treated with dispersal agents.

Soil testing was done at the beginning of each project to determine the scope and perameters of the remineralization program. It is essential that testing be accomplished at a laboratory which specializes in biological or organic agriculture and the lab understand the unique goals of the project. The challenge of getting meaningful data from a laboratory and choosing the appropriate materials for remineralization is significant. Soil labs have historically recommended a fertility program based on how many pounds of a specific crop you wanted to produce. Biological labs have moved away from that somewhat in that you can specify a portion of the recommended fertility program to benefit the long term improvement of the soil. This situation is unique in that we have only one chance to incorporate materials into the soil and require a recommendation to reflect that.

In all of these projects we were dealing with highly eroded subsoils or otherwise compromised infertile soils with low carbon and little biological life. In these situations it was important to inoculate the soil with native soil microbiology. Inoculation was accomplished in several ways. A mixture of soil and detritus was collected from mostly healthy riparian areas throughout Central Texas over a period of years. These soil/detritus mixtures were added to Biodynamic compost after the high heat phase. In some instances the soil/detritus mixture was cultured along with compost to make compost tea, and added directly to project sites or compost piles. These inoculated composts were also directly applied to project sites. In some instances collected soil/detritus mixtures were brought directly to the site and dug into the soil in pancake shaped ½ to 1 gallon size applications at various intervals. These were then covered with local leaf mulch. On several sites an application of molasses or some other carbohydrate along with fish hydrolysate was sprayed on the soil several weeks later to feed the microorganisms until the vegetation was established.

The establishment of native vegetation was a crucial step to insure long term success of the projects. In all instances the process was ongoing over a period of years. Grasses were addressed first due to their erosion control properties and exceptional soil building qualities. Where commercial seed was used it was attempted to find product not grown as a monoculture field crop with soluble chemical salt fertilizers. In some situations seed was collected locally of grasses, forbs and woody species. Containerized plants were also used. Criterion for plant selection was; locally native, probability of success due to grazing pressure, availability, appropriateness for specific moisture zones and probability of establishment without subsequent watering.

With all components assembled we are left with a zone of the property receiving much more water with excess runoff flowing into swales, diversions, wetlands and ponds. Topsoil rapidly increases in this zone and more biomass is grown with large crops of highly viable seeds. This allows the entire property to benefit from this virtual "seed factory". By stimulating natural processes, benefits increase with each passing season. Springs and seeps become more active and creeks flow for longer periods with their associated vegetation producing more biomass and evapotransporation. A portion of the water that would have run off is now recharging the aquifer. The entire area attracts more wildlife bringing with them seeds from their last stop.

SUMMARY

The ability of native plants to produce copious amounts of root exudates is a key to building healthy topsoil. A topsoil with good amounts of organic matter and a rich soil food web allows for greater insoak during rains and more even distribution of that moisture, while resisting the leaching effect of water percolation and recharging seeps, springs, creeks and aquifers. As these effects build over time more biomass is grown creating greater transporation to fall as precipitation in another county or state. Native plants play and indispensable roll in the highly intricate and interrelated dance, which is the Hydrological Cycle.

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What's Hot Panel Discussion

The Best of the West – A Whole Lot of What's Hot!

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Obviously, color sells! But beyond that what makes plants 'Hot'? All of our most popular plants rely on three fundamental criteria:

Reliability – they need to be durable and grow no matter what
Exposure – they need to be installed well in highly visible landscapes
Marketing – promotion and education, what it will do and how to best use it.

Native plant production has come a long way since Benny Simpson, Lynn Lowery, and other horticulturists across the southwest first started promoting native, adaptable plants as viable choices for landscape ornamentals. It is hard to believe it has taken people so long to come to the notion that native plants can even be considered 'ornamental' (There are some still not convinced). Within the last 10 years; however, the quality and appearance of nursery grown native/adaptable plants has reached a level of sophistication that truly legitimizes their place in the industry as beautiful and versatile landscape plants.

For over 30 years Mountain States Wholesale Nursery has been growing attractive native and non-native adaptable, low maintenance, water efficient plants for Southwestern climates. Demand for this product has been growing steadily for years in response to the realization and awareness that old, intensive horticultural practices in our fast growing urban environments are not sustainable. Culturally, some people have accepted a certain amount of advocacy toward using native plants but first and foremost the demand for these plants is fueled by their own inherent beauty, adaptability, and regional character. In order to stay ahead of the demand we are continually searching for and trailing new plants.

Sometimes we are *not* developing brand new plants; we are exploiting standard plants that have superior qualities and habits, such as with *Anisacanthus quadrifidus v. wrightii* Mexican Fire ™, *Tecoma x* 'Sunrise', *Malpighia glabra* 'Mariquita', or both

Verbena x 'Edith', and *Verbena x* 'Summer Beauty'. We frequently find ourselves trying to bring more obscure plants already or previously in the trade, into more mainstream use. If we believe in a plant we will make the investment of time and space to grow thousands. Then we work to raise awareness and create a market for these plants that we feel have greater potential because of their multiple uses and virtual indestructibility like; *Marsilea macropoda, Malephora lutea, Manfreda maculosa* or *Acalypha monostachya* Raspberry Fuzzies™. But we spend the most amount of time working with and bringing completely new plants to the landscape industry. Plants like, *Calliandra x* Sierra Sunburst p.p.a.f., *Dalea capitata* Sierra Gold™, *Agave geminiflora, Hesperaloe parviflora* 'Yellow', and thornless trees like *Prosopis glandulosa* Maverick™, *Parkinsonia* hybrid 'Desert Museum', and *Prosopis* hybrid Phoenix™

We are constantly searching for plants to fulfill design requirements that reflect the beauty and spirit of the Southwest or simply put, plants that will grow and thrive under the worst environmental stresses imaginable. Our selection process usually follows four basic stages:

1. Research – traits, features, form, habits, bad habits
2. Observation – heat/cold, water/drought, soil type, pests
3. Propagation – seed, cuttings, tissue culture, protocols for each
4. Evaluation – field comparisons, cooperator analysis

The sequence of these stages depends on where the new plant comes from. If they come from someone else and we already have a detailed description and plenty of reliable information about a plant we can usually skip the first two stages. Although most of our new releases have come from our own work and collections, many have also come from other famous horticulturalists, botanic gardens, academia, and of course sharing with other nurseries. All new plants are automatically given the 'West Stress Test' – Heat and Drought, but the large geographic area we cater to dictates that we know a lot more about each plant that we intend to release. We are methodical about our selection and release program trying always to ensure that the plant being marketed and sold will perform the way we say it will.

Our research and development program is the driving force that keeps us ahead of the competition, and adds the element of excitement that helps to make us different. So, what's 'Hot' way out west? We have assembled a list of plants that are so 'Hot' that our production department struggles to keep up with demand and some 'new' plants that we are ready to release that we predict will become just as popular.

They are divided into four categories:

1. **Groundcovers**

   Acalypha monostachya Raspberry Fuzzies™

   Dalea capitata Sierra Gold™

   Malephora lutea

   Marsilea macropoda

   Verbena x 'Edith'

   Verbena X Summer Beauty™

   Zephyranthes X 'Prairie Sunset'

2. **Power Plants**

   Agave americana v. medio-picta

   Agave schidigera Durango Delight™

   Agave geminiflora

   Agave weberi

   Agave murpheyi

   Hesperaloe funifera

   Hesperaloe parviflora

   Manfreda maculosa

   Yucca rostrata

3. **Shrubs**

   Anisacanthus quadrifidus v. wrightii Mexican Fire™

   Calliandra x Sierra Sunburst p.p.a.f.

   Malpighia glabra 'Mariquita'

   Tecoma x 'Sunrise'

4. **Trees**

   Prosopis glandulosa Maverick™

   Prosopis hybrid Phoenix™

   Parkinsonia hybrid 'Desert Museum'

CHIIONANTHUS virginicus: Fringe Tree, Grancy Greybeard, Old-man's Beard – Billowy white fragrant flowers in mid-Sprin Large shrub or small tree to about 30'. They are male and female, the male trees usually giving a better show of flowers. The fe plants are quite ornamental with the seeds looking somewhat like green grapes during summer and turning dark blue in the early They are relished by the birds. Leaves turn yellow in the fall before falling fairly early. Found throughout the southeast Zones 5

CRATAEGUS marshallii: Parsley Hawthorn – A small tree with thorny branches and thin scaly bark to about 25'. White clus flowers appearing in March and April. Fruit 1/3" long, red ; ripening in October and persisting on tree after leaves are shed. Par Hawthorn grows in low woods and wet areas, but is adaptable to average garden soil. Native from VA to FL and west to TX. Zo 6-9.

CYRILLA racemiflora: Titi, Swamp Cyrilla – A small tree or large shrub with nearly evergreen leaves. Very attractive in blo with fragrant white flowers with 1/4" long in spreading to drooping racemes in June. Good fall color. Considered a good honey Will grow in moist areas. Native from VA to FL and west to TX. Zones 6-9.

CYRILLA arida: Arid Cyrilla – Another interesting species with small, evergreen leaves; dense, white flowers and rather wisp habit. Native on arid high ground. Even though native to central FL it is hardy to zone 7. It requires well-drained soil and make rather handsome shrub. Zones 7-9.

ILLICIUM floridanum: Starbush, Star Anise, Stinkbush – An evergreen shrub or small under-story tree to about 10'. Glossy d green leaves that emit an anise-like odor when crushed. Flowers 1 1/2" wide, dark red with many strap-shaped petals, ill-scented; 1 1/4" in diameter, greenish. Dry fruit is many lobed "star-shaped" A great plant for the shade. Grows in moist wooded ravines southwest GA, and the inner FL Panhandle from the Ochlochonee River westward, throughout the coastal plain of AL westward southeast LA. Zones 7-9.

LYONIA lucida: Fetterbush – A 3 to 5' high, arching evergreen shrub. The pinkish white, up to 1/3" long flowers occur in rac from the axils of the leaves are rather pretty. Prefers a moist, well drained soil in at least partial shade. There is a selection that found by Jim Berry near Round Lake, FL, which they have named "Round Lake." It was selected for its compact growth habit a disease resistance. It is a tough little native evergreen shrub, which they say will mature at 3' tall and 3' wide. From what I hav seen, it is going to be a great plant. Native habitat from VA to FL and LA. Zones 7-9.

CLIFTONIA monophylla: Black Titi, Buckwheat Tree – A small nearly evergreen tree to about 24'. Fragrant white flowers, racemes at the ends of the ends of the previous year's twigs, opening in spring before new leaves appear. Fruit small winged dr Grows in acid shrub tree bogs or wet woodlands along stream courses and in flat woods depressions. To my knowledge there ar four that have been found that make pink flowers rather than white. Ruby Williams found the first one I acquired. The next one came from Caroline Dorman's Preserve in North Louisiana. It is planted by her pond; Richard had to go out in the boat to get cuttings, which rooted easily. I purchased the one the Dodd family is growing and also the one that Flowerwood Nursery is growing. The one from Flowerwood was found in Florida and has been named "Chipola Pink" They state the mature height fo is 10-15 feet. Native south central and southeast GA, FL Panhandle, south AL, southeast MS, southeast LA Zones 7 –9.

RHODODENDRON austrinum, canescens: Native or Wild Azalea – Deciduous fragrant flowering shrubs to around 10' in h Both bloom March and April and make a splendid addition to the shrub border. Will bloom much better in the sun. They like moisture but must be well drained. Austrinum color ranges from a soft yellow to orange. Grows from north and west FL to sou GA, south AL and southeast MS Zones 7 –9. Canescens has a tremendous variation in color from white to deep pink. Grows fr NC and TN to north FL, GA, AL, MS, LA and TX Zones 5-9.

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Tree, Shrubs, and Woody Vines of the Northern Florida and Adjacent Georgia and Alabama by Robert K. Godfrey
Landcaping with Native Trees by Guy Sternberg and Jim Wilson

"What's Hot" Panel
Plants With Potential

Jan Midgley
234 Oak Tree Trail
Wilsonville, AL 35186

Botanical Name: ***Eurybia hemispherica*** **'Emmyblue'™**

Common Name(s): southern prairie aster

Family: Asteraceae

Woody: _____ **Herbaceous:** ______ **Perennial:** __X__ **Annual:** _____

Deciduous: _____ **Evergreen:** __X__ **Semi-evergreen:** _____

Height: 2 ft.

Width: 1-2 ft.

Light: Sun: __X__ Shade: ______ Partial: _x_

Bloom Time: Sept.- Oct.

Color: Blue rays on many headed, spiciform panicles, yellow pollen

Leaves: Smooth, blue green, narrowly oblanceolate

Natural Range: GA & FL to TX, WV to KS, prairies, open woods, occassionally low moist areas

Gardening Range: through mid Atlantic states at least

Cultural conditions: Clay or gravely humus, acid, moist well draining or average to dry for clay soils.

Comments: This particular plant of E. hemispherica(Alexander) Nesom (syn. A. hemisphericus, A. paludosus var. hemispherica) is shorter and more evergreen than the rest of the seedlings I have planted. They all tend to be semi-evergreen and below 2.5 ft in ht. The species can be easily grown from seed (which will be fertile if parents are not clones). For clonal reproduction take stem cuttings in spring or divide this tightly rhizhomatous plant.

Aster paludosus is corymbiform and is geographically separate on the Atlantic Coastal plain.

Botanical Name: ***Gaillardia aestivalis*** **(Walt.) H. Rock**

Common Name(s): lanceleaf blanketflower

Family: Asteraceae

Woody: ____ **Herbaceous:** _____ **Perennial:** __X__ **Annual:** ____

Deciduous: ____ **Evergreen:** ____ **Semi-evergreen:** ____

Height: 3 ft.

Width: 3 ft.

Light: Sun: __X__ Shade: _____ Partial: __x__

Bloom Time: June to frost

Color: Rich yellow rays with burgundy disc

Natural Range: NC to IL, MO, KS (not TN) and FL to TX

Gardening Range: ?

Cultural conditions: This Black Belt Prairie plant tolerates heavy or gravely soils, acid to neutral pH and dry to moist conditions. It even withstands overwatering when in the pot in the nursery but can rot in pots over the winter.

Comments: Flowers all summer and fall. Disc remains attractive long after rays dehisce. Many plants of *Gaillardia aestivalis* have no ray flowers but I collected seeds from one that had ray flowers. Seed grown plants have retained ray flowers over five generations. Spreading rapidly by rhizomes and seeds.

Botanical Name: ***Lilium ?***

Common Name(s): Alabama lily

Family: Liliaceae

Woody: ____ **Herbaceous:** _____ **Perennial:** X **Annual:** ____

Deciduous: ____ **Evergreen:** ____ **Semi-evergreen:** ____

Height: 3-4 ft.

Width: 1-3 ft.

Light: Sun: X Shade: _____ Partial: x

Bloom Time: late May to Mid June

Color: Orange with burgundy spots, yellow throat

Leaves: Whorled, mid green, smooth edges

Natural Range: ?

Gardening Range: ?

Cultural conditions: Best flowering occurs in full sun in a seep. Average moisture conditions and half day of light are ok but too much shade results in leaves only, no flowers. Tolerates clay. Acid to neutral pH.

Comments: This lily with reflexed tepals fits no botanical pigeon hole. It has been seen by Weesie Smith in 7 places in Alabama. This nurserymanâ€™s dream plant likes moisture and does not rot in a pot. It also reproduces rapidly by rhizomes and scales. Leaves of young plants go dormant early in the season. Bloom in 3-4 yrs from a scale.

Botanical Name: *Sedum nevii* Gray

Common Name(s): Nevius stonecrop

Family:Crassulaceae

Woody: _____ Herbaceous:______ Perennial:_ X__ Annual: _____

Deciduous: _____ Evergreen:_ X__Semi-evergreen: _____

Height: 2 in. basal rosettes, 6-7 in. flowering stems

Width: Groundcover of 1/2-3/4 in. rosettes

Light: Sun: X Shade:______ Partial:_ x_

Bloom Time: April-June

Color: White

Leaves: Succulent, blue-green, spatulate to elliptic-lanceolate

Natural Range: RARE - AL (Ridge & Valley limestone & shale), GA (Piedmont granitic gneiss), TN (Oconee River gorge quarzitic slate)

Gardening Range: ? (probably very wide since this is likely a relictual species from glacial times)

Cultural conditions: Prolific in any loose well drained medium with adequate moisture. Wide pH tolerance.

Comments: Candidate for federal listing as rare plant. Once again we have a rare plant that flourishes in cultivation. Excellent plant for ornamental containers. Collected by Rev. Reuben Denton Nevius in 1857 on a bluff above the Black

Warrior River, near Tuscaloosa, AL. He also collected *Neviusia alabamensis* (Alabama bridal wreath) at this site.

Botanical Name: ***Zizia aurea*** **(L.) W.D.J. Koch**

Common Name(s): golden alexander, golden zizia

Family: Apiaceae

Woody: _____ **Herbaceous:** ______ **Perennial: X Annual:** _____

Deciduous: _____ **Evergreen:** _____ **Semi-evergreen:** x

Height: 2 ft.

Width: 18 in.

Light: Sun: ____ Shade: X Partial: X

Bloom Time: 2 months late March to June

Color: Multiple bright yellow compound umbels, 1-2in. across

Leaves: Medium to dark green, compound, petiolate

Natural Range: Moist to wet meadow and woodlands, ME to MN, FL to TX

Gardening Range: Could be more if recognized by horticultural trade.

Cultural conditions: Any woodland, wet or dry. Seedling success high in moist soil but can control this tendency by planting in dry areas in shade. pH about 5-6.5.

Comments: Host for the black swallowtail butterfly. Seeds require 4 months cold stratification. Rosy winter leaves. Natural companions: *Phlox divaricata, Zephyranthes atamasco, Tradescantia spp., Claytonia virginica.*

"Running Wild with the Public" (Mainstreaming Texas Natives)

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Thanks to visionaries like Caroline Dorman, Lynn Lowrey, Benny Simpson, Barton Warnock, and Carol Abbott, the native plant movement reached a milestone peak in the 1990's. I had the fortunate opportunity of inheriting the remnants of the native plant program at Lone Star Growers in San Antonio, Texas. A combination of factors forced them to do away with the program before my tenure there started. The primary factor was poor sales due to questionable selections and problems with consumer appeal and marketability.

Though the overall program was a failure, a number of noteworthy native introductions made it into the public gardening domain. Plants like Texas mountain laurel, Texas bluebonnet, desert willow, 'Texas' Gold columbine, Texas redbud, 'Gold Star' esperanza, and mealy cup sage became major players in the Texas nursery scene.

For "undiscovered" native plants to become accepted as mainstream landscape plants, we must learn from our mistakes of the past. It's extremely important to remember that regardless of the origin of a plant, it must be reasonably easy to propagate and most of all, it must have consumer appeal at the retail level. Like it or not, the nursery industry is a business.

We owe it to our past Texas native legends to build on what they started and move forward into a new age of environmentally friendly gardening.

Natural Historians of Texas

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The study of natural history requires the reporters of such – the natural historian. Their recorded observations range from diaries, official reports and travelogues to herbarium sheets and meteorological data. A coherent natural history of Texas can be constructed from these many diverse sources. New discoveries add more pieces to the puzzle of early Texas.

The Spanish were the first western Europeans to record their experience in Texas. Cabeza de Vaca entered Texas by water (Galveston island) on November of 1528. He journeyed through large swaths of Texas and was restored to christendom in 1536. His narrative is rich in information concerning the natural history of Texas. Cabeza de Vaca's accidental tour was followed by the expedition of de Soto. This expedition (begun in Florida in the Spring of 1639) arrived in northeast Texas and stopped in/around present day Waco. A small party explored the Brazos watershed up to the Llano Estacado. De Soto retraced his route through the Texarkana area to leave Texas. Coronado further explored the Panhandle region in 1540. The de Soto and Coronado accounts lack much detail concerning the character of early Texas. The lack of gold or silver deterred further interest in the "New Philippines".

A little known party of individuals crossed Texas during the 16th Century. A handful of English sailors –survivors of the Hawkins/Drake foray into the new world- crossed North America (from Tampico to the St. Laurence Seaway) in the 1560's. Three lived to tell the king of England of their journey.

Spanish interest was next roused by reports of the presence of a French colony in east Texas. This brought the first *entrada* into Texas. Seeking to control the mouth of Mississipi river La Salle began his misplaced colony in early 1685. Alonso de Leon, then the governor of Coahuila, led the first organized and chronicled entrada into Texas in 1689. De Leon found the French fort in ruins. The governor returned the following year. Accounts of this episode are many – from Henri Joutel of La Salle's expedition to several diaries of the de Leon entrada. These two expeditions explored much of the southeast and coastal Texas. The return of this entrada included several survivors of La Salle's ill-fated colony.

In an effort to both christianize the indians, and to assert Spanish rule, the 1691-1692 Teran de los Rios expedition was organized. The king ordered that the character of the land, types of plants and animals as well as climactic conditions be duly noted. In 1693, Gregorio de Salinas Varona traveled in his third trip through Texas to present day Houston. The Catholic priest Espinosa begins his many travels in Texas. His extensive diaries provide a wealth of detail concerning early Texas.

The next entrada returned to Texas in 1716. The Ramon entrada explored as well as founding missions and presidios (such as San Antonio de Bexar in 1718). Accompanying this expedition was the Frenchmen Louis St. Denis and Father Espinoza. The exploration and mapping of the Texas coast was nearing completion. At long last maritime access to Texas was possible. The 1721-1722 entrada, led by Marque de San Miguel de Aguap explored the Blackland Prairie up to the Waco area. The eastern and southern rim of the Edwards Plateau was explored. The inspection tour of Rivera in 1727 consolidated the loosely settled Texas into San Antonio, Nacadoches, and La Bahia. The 1767 entrada by the Marque de Rubi explored the Edwards Plateau extensively.

These entradas and the surviving documentation provide a detailed picture of Texas as the domination by native Texas Indians faded. It is believed that over 90% of the native peoples of Texas perished by 1800. This drastic drop in population surely affected the landscape and animals. Soon Anglo-Americans would begin their colonization of Texas.

This pre-Linnean and colonial phase of Texas would soon end. The U.S. acquired a large block of territory with the Louisiana Purchase of 1803. Jefferson sent Lewis and Clark on their "voyage of discovery" in 1804. Zebulon Pike entered Spanish territory (1806), was imprisoned in Chihuahua and returned through San Antonio (1807). Stephen Long explored two rivers of the central plains in separate expeditions by 1820. Mexico gained independence from Spain in 1821. The colony of San Felipe was begun by the "Old 300" in 1822. Several filibusters had occurred by 1830 in Texas.

The first botanist proper to enter Texas was Jean Louis Berlandier (1805?-1851). Berlandier studied natural history under de Candolle in Geneva. The French-born naturalist traveled to Mexico as a member of a survey commission of 1826. The next four years find him southern third of Texas. He made many collections of plants and animals and took special interest in the native peoples. He collected many Indian artifacts and clothing. He returned to Matamoros and supported himself as a pharmacist. He made extensive collections of the flora and fauna of northern Mexico. He died by drowning in 1851. Darius Couch purchased Berlandier's extensive collections from his widow. His once far-flung collections and manuscripts have been consolidated into several large collections. His two books are readily available today.

In March 1833 Thomas Drummond entered Texas. Sir John Hooker of Glasgow supported Drummond. Drummond collected in southeast Texas and made one foray into the Lampasas Cut Plains. He left Texas in December of 1834 and traveled to Cuba. Drummond died in early 1835 in Havana.

James Audubon visited Texas in 1837. Audubon's brief visit was on and about Galveston Island. Audubon's contributions to the natural history of Texas are minor.

The revolution supporting Texas independence attracted a diverse spectrum of males to Texas. Ferdinand Jacob Lindheimer left the Jalapa area and arrived the day after the decisive battle at San Jacinto. He was already a practiced naturalist. He began to botanize southeast Texas under the sponsorship of George Englemann of St. Louis. He accompanied the first shipload of German immigrants from the coast to New Braunfels in 1844. He began to collect the Hill Country for both Englemann and Asa Gray. He quit professional botanizing in 1851 in financial desperation. He served as a newspaper editor until his retirement. He died on December 2, 1879 at 78 years.

Charles Wright came Texas in 1837. His stay was long and productive. He was the first Ph.D. to teach natural history/science at the first college in Texas (Rutersville College). He left Texas as a member of the boundary survey commission in 1851. Wright traveled and collected a large portion of Texas in his 14 years residency. He supported himself in many ways during his tenure. He died in 1885 in Connecticut.

Dr. John Riddle made two visits to Texas in 1839. He first explored Trinity County in southeast Texas for three weeks. Later that year he traveled to the Llano Uplift and Hill Country areas of Texas. Although his contributions to Texas natural history are tenuous his trip diary is quite accessible and entertaining.

The most recorded naturalist to live in Texas is Gideon Lincecum. Lincecum's contributions to the state of Texas are many. He was a product of the American frontier. Born in 1793, young Lincecum grew up among the Choctaw Indians in western-ward expansion of the frontier. A self-trained naturalist, his wide-ranging interests supported him as a doctor, pharmacist, and farmer. He first entered Texas in 1835 and traveled from southeast Texas through to the western portion of the Hill Country. He returned to Mississippi after over seven months in Texas. He returned to Texas in 1848 to settle near Long Point in Washington County. His interests included everything from ants to grasses. As with many disgruntled southerners he placed himself in exile in Tuxpan, Mexico by 1868. He returned to Texas in 1872 and died in December 1874. His extensive collection of correspondence and manuscripts reflect his wide ranging interests. His legacy is the most thorough and reliable record of antebellum Texas.

Our final naturalist to be cited is Julien Reverchon. He arrived at La Reunion (present day Dallas) at the age of 19 in December 1856. He botanized south and west of Dallas. He also collected along much of the northern Edwards Plateau. He traveled along the Sabinal River as far south as Uvalde. His collections dates range from 1877 through 1885. He died in Dallas in 1905. The 20th Century brought about the university supported naturalist and the end of the contract naturalist.

No mention of the natural history of Texas is complete without mention of the guidebooks encouraging immigration to Texas. Mary Austin Holley began this class of books in 1831. She was a cousin of Stephen F. Austin, who invited her to San Felipe in 1831. Her publication of "Texas" in 1833 as a series of letters was updated after the successful rebellion. This and other books soon to follow extolled the virtues for Texas. The climate, lands, mineral, and timber resources are discussed as well as geography and rivers. The peculiar value found in this general of books regards land use by early colonists. These books discuss every respect from choice of land to grazing potential of

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TEXAS ROADSIDES: AN ENDANGERED SPECIES?

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Like plant communities, the road system has undergone succession through the decades. Eisenhower and the 1950s were the beginning of the interstate system in the United States, and having just come out of World War II, the only concern was the efficient movement of armies and tanks. This meant straight and homogenous. The farm to market road system was also given great impetus to help move goods and services from the rural areas to the cities. During the 1960s, Lady Bird Johnson implemented wildflower seeding on roadsides and the highway beautification movement was underway. Then, in the 1990s, President Clinton reinforced existing beautification efforts by mandating the use of native plants on federal jobs or anywhere federal funds are used. Now, modern roadside managers must contend with integrating all this and much more.

With the ever-looming threat of urban sprawl comes the need to address infrastructure and how we, as a society, can continue to grow. No doubt our road system is a huge part of this expanding infrastructure. Even though endangered plants on Texas roadsides exist, the real charge here is to suggest that our Texas roadsides, like so many other ecosystems, are imperiled and thus need protection. Roadsides are a natural resource, an asset, and represent a sense of place.

Roadsides, especially secondary roadways are refugia, sometimes the last vestige for native plant communities. Islands of remnant vegetation survive because cattle, sheep, goats, and agriculture have been excluded. In Texas, our roadsides, that is the rights-of-way (ROW), total 1.4 million acres (B.Cogburn, personal communication, 1995), making the Texas Department of Transportation (TxDOT) the steward of a sizable tract of public land. According to Federal Highway Administration figures, 10 million acres exist in the highway rights-of-way across this nation. Since only 2-3% of land in Texas is public, appropriate management becomes even more crucial. So, what do we mean by appropriate management? Using an integrated approach that maximizes the native species potential and minimizes possible detrimental effects. Natural resource issues in the roadside context is a complex topic with many contributing external and internal factors.

With respect to the well being of our roadsides, external factors are the most visible and publicly accessible areas of concern. Examples include road building processes, road usage demands, utility easement issues, and vegetation management techniques. Internal factors relate to organizational structure, management and the charter of TXDOT, roadway design, and the concept engineers have of the roadside environment (J.Schutt, personal communication, 1999). Each of the above has the capacity to negatively impact the character of our great Texas roadside vegetation. Management decisions are not made in a vacuum. Tensions between external and internal factors are always at play (Ibid). It is a desire to highlight these factors and hopefully generate dialog so a fuller understanding and appreciation of the highway right-of-way can be reached.

Without a doubt, road building processes have the most obvious impact. Roadways, and thus roadsides, are a highly engineered environment, and for a very good reason—structural integrity and safety for the motoring public are of utmost concern. Heavy equipment clears from fence line to fence line. Roadbed preparation and drainage work requires massive grading and compaction of soil. Additional non-native soil is usually imported to the site. Needless to say, this process is not forgiving. Little existing vegetation can be expected to survive, but from a Department of Transportation (DOT) engineers point of view this is the most cost effective and durable method.

Road usage demands are consumer demands, and consumers drive the market place. We, the motoring public, need to realize this fact because how, why, when, and where we travel takes on a whole new aspect. There are two components to road usage demands—flow and volume. Flow, or the "get there faster mentality," encompasses road straightening and paving of surfaces; chiefly unpaved rural county roads. Volume has to do with too many automobiles and not enough infrastructure. Many cities, counties, and states are dealing with an inadequate road system. Not only are new roads needed, but maintenance of existing roads is never ending. Here in Texas, TxDOT is responsible for more rural road miles than the whole country has interstate miles (Texas DOT, Strategic Plan 2003-2007). As this system expands it will implicate surrounding vegetation, but from the DOT engineers view point, increasing capacity will provide safety, comfort, and the highest level of customer satisfaction.

Utility easement issues most often have to do with entities other than a DOT, but the department still has direct oversight of any activity within the ROW. Oil/gas, water, electricity, and telecommunications are the primary entities utilizing the ROW. Construction techniques and maintenance procedures are often overly aggressive and hard on vegetation. In addition, the lack of an effort to coordinate installations creates repeated disturbance. Keep in mind from a DOT point of view the whole right of way is an easement, per se. These easements are purchased largely for future road expansion, safety buffers, and installation of utilities (J.Schutt, personal communication, 1999). Since land acquisition is so costly, little extra is purchased for "non-utilitarian" use.

Vegetation management is probably what interests most botanically inclined individuals, and mowing constitutes the largest portion of roadside vegetation management. Good vegetation management is the foundation for a healthy roadside ecology—without it, all additional efforts will be diminished. To quote a state highway commissioner, "the roadsides are the ribbons that tie the whole package together." This is a marvelous analogy. Unfortunately, the context of the above quote has more to do with the "tidy" look of freshly mowed roadsides and less to do with the idyllic vision of beautiful native grasses and wildflowers swaying in the breeze. We must remember that both visions are legitimate, and that ultimately, it comes down to context. It is appropriate and necessary for certain areas to be mowed more frequently. While "no mow" areas are valued, the associated connotation often becomes "no management", and this hands off approach is not wise, nor sustainable.

Any land is a direct reflection of the type of management it receives. Safety, ease of maintenance, cost, durability, and customer satisfaction drive roadside vegetation management decisions (Ibid). Beauty, aesthetics, wildlife habitat, and biodiversity play a role, but are much more subjective and hence, usually more of a tangential bonus—not a prime directive. Still the majority of calls to DOT offices are complaints asking for additional mowing (B. Cogburn, personal communication, 1995). Federal and state environmental laws and regulations, especially those relating to the Clean Water Act, are forcing DOT's to address compliance issues and to come up with a more integrated approach. A huge problem with transportation project planning has been not including environmental studies until the end of the process (Washington State DOT). When this occurs, there is little room for incorporating these vital aspects into a project. Expect environmental issues - water quality, soil stabilization/erosion control, endangered species, and invasive species - to play a much larger role in directing future roadside operations. This trend has all ready taken hold in parts of the country like the Pacific Northwest where endangered species and water quality issues are forcing DOT's to adapt.

As can be seen, the roadside environment is tremendously complex. Many factors, both external and internal, play into the decision making process. Understanding what drives the decision-making process means understanding the issues (economic, political, cultural), circumstances, and decisions facing the DOT and their roadside managers. Only by standing in someone else's shoes can we begin to grasp the reality facing that individual. Before constructive dialog between native plant advocates and roadside managers can take place, questions must be asked and understood. What is the highway and roadside for? Why do they build roads like they do? A common ground and a common language must be found. Jim Schutt, Texas Transportation Institute, says it best, "there is a need for better clarification of goals for the roadside and how these may be integrated with the transportation function of the highway".

The roadside environment and its botanical wonders are worthy of preservation. Of course, this enthusiasm must be tempered with the understanding that all cannot be saved. Like landscaping, roadside vegetation should support local heritage by reflecting a sense of place. Through collaboration of various institutions, agencies, organizations, and individuals, much can be accomplished to make our Texas roadsides ecologically and aesthetically unique while providing the utmost safety for the motoring public.

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ACKNOWLEDGEMENTS

I would like to express my gratitude to the many people that provided support and encouragement. Their contributions and insight into this process broaden my understanding of the complexity of roadside issues and the roadside environment. Jackie Poole, Dana Price, Jason Singhurst, Sandy Birnbaum—Texas Parks and Wildlife Department—for photos, insight into previous and ongoing ROW efforts, and access to databases. Dennis Markwardt, Karen Clary, David Dunlap (former)—Texas Department of Transportation—for their great capacity to listen and willingness to discuss Texas roadside issues, programs, and collaborative potential. Jim Schutt—Texas Transportation Institute—the Zen master, thank you for your thought provoking dialog, intimate knowledge of roadsides, institutions, and resource agencies. Your patience and uncanny ability to see a subject from all angles has opened my eyes and my mind.

FUNGI-PLANT RELATIONSHIPS
(MYCORRHIZA)

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"That land is a community is the basic concept of ecology"

Aldo Leopold, *A Sand County Almanac*

...Soil is not just ground-up rock. It is a living system, which includes, for instance, the mycorrhizal fungi, which play a very critical role in transporting nutrients from the soil into many trees. You go into some forests and you think the dominant plants are trees, but actually, they are the mycorrhizae. If the mycorrhizal fungi died, the trees would disappear. But sadly, our understanding of soil ecosystems remains extremely poor....

Paul Ehrlich, 31 October 1983

This statement by Paul Ehrlich is as true today as it was 20 years ago.

There are numerous types of fungal-plant relationships, but for this presentation I will concentrate on a specific type, mycorrhiza.

Basic biology

Plants are autotrophic organisms, and produce sugars and other complex organic compounds from water, carbon dioxide, trace nutrients and sunlight. They contain chlorophyll, have a vascular system, a stationary life style, and reproduce by seeds. They are the primary source of food for other species.

Fungi are heterotrophic organisms that decompose complex organic molecules to be reused by plants. They function as pathogens, saprophytes, and symbionts. Typically they lack chlorophyll, have no vascular system, and reproduce by spores.

Mycorrhizal types

Mycorrhiza is an intimate and mutually beneficial relationship between ninety percent of plants and certain groups of fungi. It is a unique feature of terrestrial ecosystems. The literal meaning of mycorrhiza is "fungus root" (singular). The mycorrhiza is considered an organ that is part plant and part fungus. The extensive fungal mycelium in soil allows plants access to the abiotic environment. There are seven basic types of mycorrhiza:

a) Endomycorrhiza orVesicular-arbuscular

b) Ectomycorrhiza

c) Ericoid

d) Monotropoid

e) Arbutoid

f) Orchid

g) Ectendomycorrhiza

Endomycorrhizal relationships include mostly herbaceous plants, a few species of trees and the Endogonaceae fungi. Physically the root is not swollen, but the fungal hyphae penetrate the cell walls and are in direct contact with the plant cell's cytoplasm. Structures called vesicles and arbusculars are prominent features within the plant cells.

Ectomycorrhiza includes forest trees, basidiomycete and ascomycete fungi. Physically the mycorrhiza produces a swollen root tip and the fungus produces a sheath around the root, the Hartig net. The fungal hyphae do not penetrate the cell walls of the plant but spread between the cells.

The ericoid mycorrhizas include heath plants and ascomycete fungi. Physically they appear as dense coils of hyphae in the outermost layer of root cells. Typical ericoid plants include Vaccinum and Rhododendrons.

Monotropoid mycorrhizas include the family Monotropaceae and basidiomycete fungi such as the genera Russula, Suillus and Rhizopogon. These plants receive their nutrients from the mycorrhizas.

The ericeous plants Arbutus (madrone) and Arctostaphylos (manzanita) and basidiomycete fungi form Arbutoid mycorrhiza.

Orchid mycorrhiza includes orchids and basidiomycete fungi such as the genus Armillaria, which is considered a plant pathogen.

Ectendomycorrhizas have been found between conifers and certain basidiomycete fungi. They are the least understood.

Benefits of mycorrhizas

Mycorrhizas provide plants with protection from pathogens. The surrounding fungi detoxify soil and sequester toxic metals. The extensive fungal mycelium network enhances the uptake of water, phosphorus, nitrogen and trace elements. Nitrogen-fixing bacteria are stimulated. Generally plants with mycorrhizal fungi have enhanced growth rates and are more resistant to drought.

Fungi receive sugars and other organic compounds from the plants, and the plants provide protection by shielding the mycelium from harmful ultraviolet light.

Nutrient cycling

Phosphorus is limited in ecosystems and is required for energy. It is recalcient, and fungi are needed to render it useful for plants. Fungi have phosphatase enzymes that solubilize it, and it is stored in the fungal mycelium and the mycorrhiza, until needed by the plant.

Nitrogen is more abundant than phosphorus, but must be in a correct form to be utilized. Nitrogen is tied up with organic compounds such as proteins and amino acids, and found as ammonium, nitrite, and nitrate ions. Fungi are important in breaking down nitrogen and making it accessible to the plants.

Carbon is the most important element in living systems, and plants are the primary producers of organic compounds. In mycorrhiza, sugars produced by plants are shunted to the fungi, being converted from glucose to trehalose. Plant roots produce organic acids and hormones that stimulate microorganisms in nutrient cycling.

Ecology

The mycorrhizal fungi are an important component of the rhizosphere, which is the habitat around roots. Bacteria, algae, actinomycetes, nematodes and microarthropods are also part of this complex ecological niche.

Forest mycology

Forest mycology is the realm of the ectomycrorrhizal fungi. Ectomycorrhizal forest trees include the families Pinaceae, Fagaceae, Betulacaea, and Myrtaceae and Salicaceae. Important genera of ectomycorrhizal fungi are Amanita, Cortinarius, Lactarius, Russula, "the boletes", Tricholoma, Laccaria, Pisolithus, Tuber and many others.

VEGETATION OF EAST TEXAS

by

Elray Nixon, James Neal, Lee Rayburn, Doug Hine and Peter Loos

INTRODUCTION

In a broad sense, the forested East Texas area is located within the Eastern Deciduous Forest Formation as depicted by Braun (1950). Although within this formation, it is generally a pine-hardwood forest. Within Texas, it has been placed in the Post Oak Savannah and Pineywoods Vegetational Areas (Schuster and Hatch, 1990).

Topographically, East Texas is a land of rolling hills which are transected by many creeks and rivers. Elevation ranges from 61m to 213m (Godfrey et al., 1973). Upland soils in the area are mostly acid sands or sandy loams whereas bottomland soils are usually acid to slightly basic loams (Schuster and Hatch, 1990; Ward and Nixon, 1992). Eastern Texas has a subtropical humid climate most noted for warm summers and mild, moist winters (Larkin and Bomar, 1983). Mean annual temperature ranges from 18°C in the north to 20°C in the south while mean annual precipitation ranges from 99cm at the western border to 140cm at the southeastern border (Larkin and Bomar, 1983).

The purpose of this work is to characterize the vegetation of East Texas with emphasis on the woody component. To accomplish this, analyses of 193 forested communities by E. Nixon and others, which occurred over a period of 25 years, were grouped and summarized. These communities were selected from various habitat types ranging from dry uplands to swamps and bottomlands. Also included were studies of some specialized habitat communities. The habitat types are mainly a result of variation in topography, soil, and climate (mainly moisture). Indicator species were important to community site selection.

METHODS

When describing plant communities, three aspects are of importance: (1) the distribution of the plants (frequency) (2) the number of plants (density) and (3) the size of the plants (basal area). The plot method was used to collect data employing 5 x 5m quadrats. Frequency, density and basal area data were gathered and recorded for each species in each community. Frequency is the percentage of total quadrats which contain at least one rooted individual of a given species. Density is the number of individuals per unit area; the number of plants rooted in each quadrat. Basal area is the area outline of a plant near the ground surface. It is obtained through diameter at breast height measurements at about 1.4M above the ground. Importance values were used to produce a polar ordination (PO) of the 193 forested communities (Cox, 1980). Importance value is a measure of the overall importance of a species in a community, determined as the sum of relative frequency, relative density, and relative basal area. Polar or community ordination involves the arrangement of communities in a two axis system based on differences in community composition as expressed by community similarity coefficients.

RESULTS AND DISCUSSION

The PO shows that the 193 forested communities generally cluster into six groups (Fig. 1). Using an ecologically based classification, these groups were associated with dry upland, mesic upland, mesic creek bottom, wet creek bottom, river bottom and swamp habitat types. A discussion of the various groups of forest communities follows.

Dry Upland Communities

The dry upland habitats are mostly a result of the rather deep, sandy to sandy loam soils which occur there. Although precipitation is quite high, water moves rapidly downward leaving

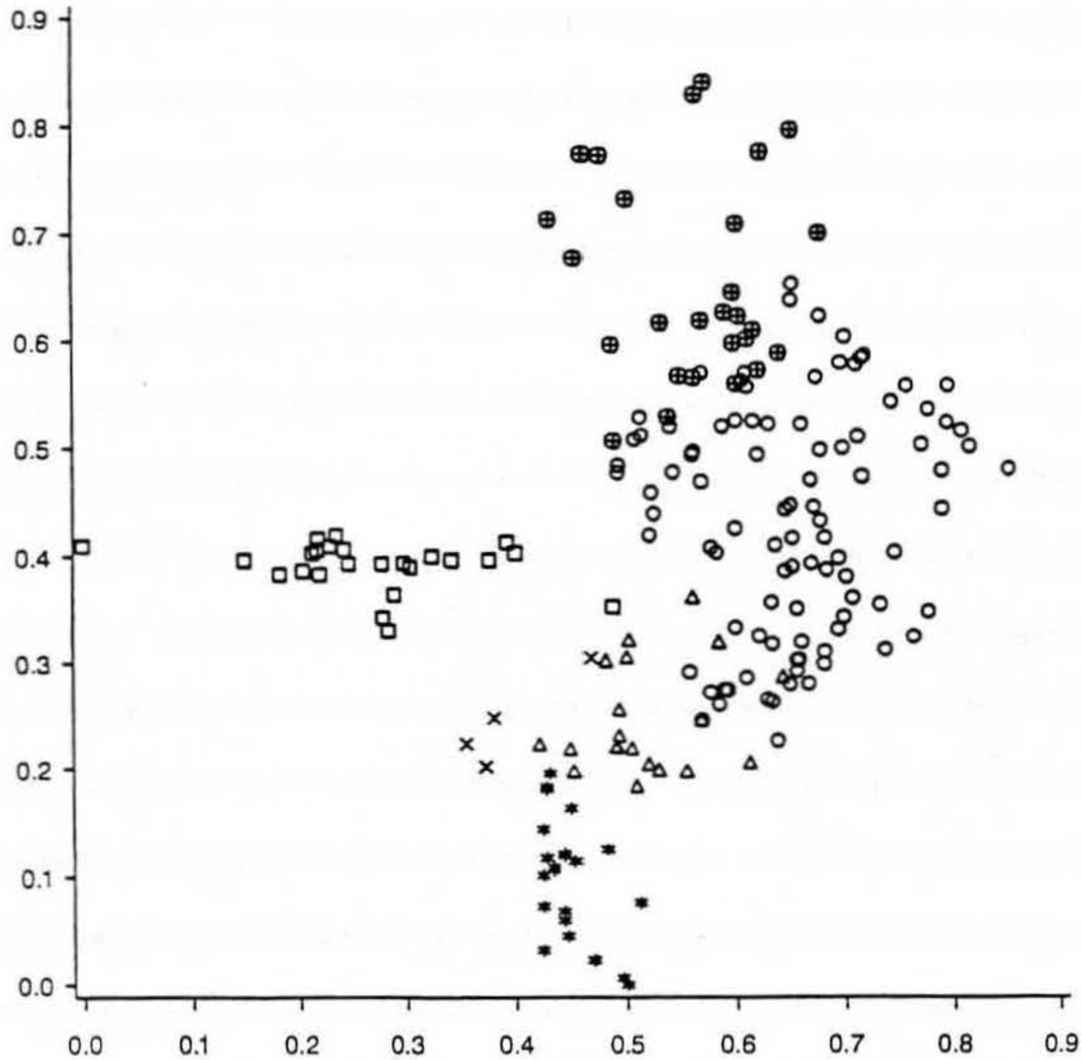

Figure 1. Polar ordination of the 193 communities: Dry Uplands □, Mesic Uplands x, Mesic Creek Bottoms △, Wet Creek Bottoms ✱, River Bottoms ○, Swamps ⊕.

little moisture in the upper horizons. The woodland communities are more open on these sites and are dominated by post oak (Quercus stellata), sandjack oak (Q. incana), blackjack oak (Q. marilandica), and black hickory (Carya texana) (Marietta and Nixon, 1983; Ward and Nixon, 1992). The occurrence of these taxa in dry upland communities in eastern Texas is quite predictable. Other species that occur on these sites are shortleaf pine (Pinus echinata), longleaf pine (P. palustris), and black oak (Quercus velutina) in the overstory and yaupon holly (Ilex vomitoria), farkleberry (Vaccinium arboreum), and rusty blackhaw (Viburnum rufidulum) in the understory. The most common vine is summer grape (Vitis aestivalis). Some of the species present in dry uplands are occasionally found on more mesic sites, and some mesic area species sometimes occur on dry upland sites.

Mesic Upland Communities

The mesic upland sites contain mostly moist sandy loam soils and the forests are more dense than those in the dry uplands and have larger and taller trees. Because of disturbance associated with these upland sites, only four of these communities were analyzed. Dominant species include mockernut hickory (Carya alba), flowering dogwood (Cornus florida), sweetgum (Liqudambar styraciflua), southern red oak (Quercus falcata), loblolly pine (Pinus taeda), and winged elm (Ulmus alata) (Sullivan and Nixon, 1971; Langston, 1974). Fringe tree (Chionanthus virginica) and the vine, Alabama supplejack (Berchemia scandens) are also common. Community composition appears to be more variable on these sites. Due to the variability of the four stands and the small number of sites available for analysis, no meaningful differentiation could be made of the mesic upland communities.

Mesic Creek Bottom Communities

The moist sandy loam soils of the mesic creek bottoms and lower slopes provide habitats for the growth of more varied communities. The creeks often have rather high banks and the bottomlands may be narrow to broad.

Although the mesic creek bottom communities generally clustered, there was some overlap, especially towards bottomland communities (Fig. 1). Creek bottom sites are usually dominated by American hornbeam (Carpinus caroliniana), sweetgum, water oak (Quercus nigra), white oak (Q. alba), eastern hophornbeam (Ostrya virginiana), and blackgum (Nyssa sylvatica) (Nixon and Raines, 1975; Nixon et al., 1987). Other studies indicate the importance of American beech (Fagus grandifolia), American holly (Ilex opaca) and loblolly pine (Nixon et al., 1983; Neck, 1986). Shrubs and vines such as American beautyberry (Callicarpa americana) and muscadine grape (Vitis rotundifolia), respectively, are often present. Some mesic creek bottom species such as loblolly pine, sweetgum, American holly, and American beautyberry also occur in mesic upland communities, while American hornbeam and water oak, for example, are commonly found in river bottoms.

Wet Creek Bottom Communities

Variously located in the East Texas area are wet creek bottom communities. The bottoms are usually wide with winding, shallow creek channels. Seepages may occur both within the bottom and marginal. Thus these bottoms are usually wet year around and support rather unique floras. In these bottoms there is a large degree of association among the species present. The communities cluster out with little overlap (Fig. 1) as ecotones are often abrupt (Brooks et al., 1993). They are usually dominated by blackgum, sweetbay magnolia (Magnolia virginiana), and red maple (Acer rubrum) in the overstory and American cyrilla (Cyrilla racemiflora), baygall holly (Ilex coriacea), Virginia sweetspire (Itea virginica), waxmyrtle (Myrica heterophylla), Arkansas blueberry (Vaccinium arkansanum), and possomhaw viburnum (Viburnum nudum) in a rather defined shrub layer (Nixon et al., 1980b; Nixon and Ward, 1988; Brooks et al., 1993). Although the composition of these wet creek bottom communities is very predictable, some species occur elsewhere. Blackgum, and red maple, for example, can be encountered in mesic creek bottoms and river bottoms. There is also a distinct north-south variation within East Texas. The overstory dominants are similar, but red maple, waxmyrtle, alder (Alnus serrulata) and Virginia sweetspire tend to be found as associates to the north with Laurel oak (Quercus laurifolia), American cyrilla, and baygall holly as associates in the southern part (Brooks et al., 1993).

River Bottom Communities

Dominant species in the river bottoms of eastern Texas are green ash (Fraxinus pennsylvanica), cedar elm (Ulmus crassifolia), Texas sugarberry (Celtis laevigata), water oak, willow oak (Quercus phellos), overcup oak (Q. lyrata), American elm (Ulmus americana), sweetgum, and water hickory (Carya aquatica) (Nixon and Willett, 1974; Powell, 1992). Variation exists because flats alternate with higher ground. Flats are wet areas with poor drainage and thus standing water usually occurs during late winter and spring. In these flats, species composition is quite consistent. They are characterized by overcup oak, green ash, red maple, willow oak, water hickory, and water elm (Planera aquatica) (Chambless and Nixon , 1975; Nixon et al., 1977; Powell, 1992). More consistent higher ground species are American hornbeam, Texas sugarberry, water oak, sweetgum, and deciduous holly (Ilex decidua). Bottomland flat communities generally clustered as the upper portion of the bottomland communities in the ordination graph (Fig. 1). They are more closely related to the swamp communities because of the overlap in distribution of such species as water hickory, water elm, and green ash. Higher ground communities are more closely related to the mesic creek bottom communities due to the common occurrence of species like sweetgum, water oak, and American hornbeam.

Swamp Communities

Species composition is generally quite predictable in swamps. The same kinds of species tend to occur together although in variable associations. Ecotones are usually quite abrupt. Species characteristic of East Texas swamps are bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), swamp blackgum (Nyssa biflora), green ash, water locust (Gleditsia aquatica), water hickory, water elm, swamp privet (Forestiera acuminata), and the shrub common buttonbush (Cephalanthus occidentalis) (Nixon and Willett, 1974; Burandt et al. 1977.

Specialized Habitat Communities

Pitcher Plant Bog Communities

Of interest in connection with dry uplands are pitcher plant bogs. The water that seeps through the sandy soils is sometimes stopped by an impermeable subsoil causing the water to move laterally and emerge on lower slopes of hills. Here pitcher plant bogs occur. These are wet, open sites dominated by pitcher plants (Sarracenia alata) and contain other showy herbaceous species such as the grasspink orchid (Calopogon tuberosus). Woody associates, which are usually marginal, are the trees sweetbay magnolia and red bay (Persea borbonia), the shrub waxmyrtle and the vine laurel greenbrier (Smilax laurifolia) (Nixon and Ward, 1986).

Catahoula Prairie-like Communities

There are present in eastern Texas, often in association with dry upland woodlands, communities which are devoid of woody vegetation and thus prairie-like. These openings appear to be a result of edaphic factors associated with the Catahoula Geologic Formation. The soils are shallow and usually rest upon a hardpan. Thus they are quite impermeable and are wet during winter and early spring. In contrast, they may become very dry and hard during late spring and summer. These conditions seem to inhibit tree growth. Some of the more important species onthese sites are slender bigelowia (Bigelowia nuttallii), little bluestem (Schizachyrium scoparium), and common goldstar (Hypoxis hirsuta). Less common species are Texas sunnybell (Schoenolirion wrightii) and krameria (Krameria lanceolate) (Marrieta and Nixon, 1984).

Weches Formation Outcrop Communities

The Weches Geologic Formation is a marine deposit formed during the Eocene Epoch, and runs in a line generally paralleling the coast from Sabine County in East Texas to Atascosa and Frio counties in south central Texas. Erosional activity has exposed small outcrops of this formation which usually occur naturally on the slopes of hills. Generally, these sites are about five to 20m wide and not more than 100m long. They occur in isolated outcrops or as segmented strips (George and Nixon, 1990). Because the Weches Formation is generally impermeable, downward percolating water runs out over the Weches exposures forming wet sites, especially in the spring.

In contrast to the acid soils of East Texas, the Weches soils are basic ranging in pH from about 7.6 to 8.2. This results in a rather unique flora including two Weches endemics, white bladderpod (Lesquerella pallida) and Texas glade cress (Leavenworthia texana). In Texas, Texas stonecrop (Sedum pulchellum) appears to occur only on Weches outcrops. Also of interest are three Weches disjuncts from central Texas, which are calylophus (Calylophus berlandieri), narrowleaf gayfeather (Liatris mucronata) and broom nailwort (Paronychia virginica) (George and Nixon, 1990).

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Natural Patterns in the Landscape

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There is a good deal of interest these days in natural, or naturalized, landscape design. The reasons for that interest include:

1) environmental restoration and reconstruction activities
2) creation of wildlife habitat
3) promoting the use of native plants
4) outdoor educational programs
5) personal aesthetic preferences
6) gardeners who want to do something different

Whether it's called a native landscape, a natural landscape, a wildscape, or something less flattering, there are some characteristics most people recognize, some people understand, and some simply hate. We've spent several thousand years modifying the world around us, and while there are a lot of naturalists, there are also plenty of modernists who like things just fine the way we made them. If for no other reason than to maintain a civil debate, let me try to define what I'm talking about when I use the term "natural design."

As I see it, a natural design reflects the arrangement of landscape elements as they would occur without human intervention. To a lot of people, that implies a lack of structure bordering on chaos, and it's guaranteed to make some people uneasy…even angry, because we have an innate need to perceive order in our environment. But structure is everywhere in nature, even though many times it isn't easy to see it from up close. It takes the form of patterns that are rarely discrete and tend to overlap and melt together to form an even larger pattern. In that way natural patterns resemble a multicolored tapestry or an impressionistic painting. How do you design a landscape that mimics Mother Nature's apparent whimsies, and still provide enough structure so that it makes sense to those who aren't on a first-name basis with her? My mother is from

Louisiana, and she says the first step in Cajun cooking is to make a roux. When it comes to designing a natural landscape, the first step is to pick a pattern.

Natural patterns occur mainly in two forms: either as a gradient (continuum) or a mosaic (Forman, 1997). Gradients are harder to observe, because they tend to occur at larger scales. An example would be the character of cloud formations during periods of unsettled weather. The shapes, textures, and colors change gradually from one horizon to the other, with regions that are distinct from each other to some degree, but have indistinct boundaries.

Mosaics occur at virtually any scale, and consist of a matrix, patches, and patches that are bunched or aggregated to form corridors. Again, scale is critical. Think of a beach, where individual particles of sand have their own character when viewed on hands and knees with the help of a magnifying glass. If you stand up (increase the scale) the individual grains become indistinguishable from each other, and what you see is simply… a beach. That's a matrix. The individual shells, starfish, and kelp plants are patches, and the areas where they've been concentrated are corridors. If viewed from an ever-lengthening perspective (increasingly large scale), the beach becomes a corridor, then a patch, and, finally, a single grain of sand in the matrix. In a forest, the matrix consists mainly of trees; in a prairie it's largely grasses. Patches and corridors occur where conditions favor certain species enough to increase their relative frequency and allow them to form contiguous colonies. Examples of natural landscape patterns include streams, bogs, deserts, rock outcrops, prairies, savannas, forests, etc. The design may represent one of these, or it may represent a specific plant community, ecotype, or stage of vegetative succession.

There's a lot of…discussion any time a group of people with different views about the justification for natural design get together. Some feel more strongly about creating or restoring native plant communities than about aesthetic considerations, some feel the economic impact is more important than the environmental one, still others believe the true value lies in educating people about the natural world. I try to design with specific plant communities in mind and match them to the soil, topographic characteristics, sunlight and moisture regimes present in different areas of the landscape. For example, on a large enough site there may be conditions suitable for xeric upland, mesic upland,

and mesic slope communities. Not only does each provide a different aesthetic appeal and value as wildlife habitat, using them in close proximity offers enhanced opportunities for educational experiences and a greater sense of environmental diversity.

Once you've selected either a mosaic or gradient as your pattern, establishing the matrix and a proper scale is critical. There are dominant species in every community, and those species serve as the matrix for the design. Sometimes you have to manipulate relative frequencies and spatial distribution to do that (Dube, 1997). You may only have room for three large trees, for example, so they have to represent an entire canopy. A handful of shrubs or small trees becomes the understory, and a meadow consists of five grass species rather than a dozen. In other words, it's more practical under most conditions to create a landscape pattern than it is to try and re-create an exact copy of a naturally occurring plant community. Mother Nature has tools like time and fire at her disposal and, unless circumstances permit the establishment of a truly "wild" landscape, some other form of maintenance will have to be substituted. If the aesthetic character of the design is more important to the neighbors than its environmental accuracy, a pattern simplifies maintenance requirements.

One of the most obvious differences between an urban landscape and a wilderness area is the frequency of straight lines and hard edges (Diekelmann and Schuster, 1982). Both are rare in the natural world, and to me, eliminating them is probably the single biggest step toward creating a natural design. The edges of beds and the plantings within them should be soft and curvilinear. By soft I mean they have irregular or indistinct boundaries, which tend to melt together and create movement. Soft, irregular edges encourage movement across them, while hard edges encourage movement parallel to them.

Native plants tend to be less conspicuous than their domestic counterparts, and the range of color and texture is more limited. To achieve visual impact, it's important to use masses and contrast as much as possible. If you wish to use a variety of wildflowers, for example, cluster them together in specific areas rather than scatter them singly throughout the planting. This also helps with the maintenance, since it'll be easier to identify weeds. I've tried the randomizing approach, and found out that even the most conscientious maintenance crew invariably weeds out some species. Since many herbaceous natives are here-today-gone-tomorrow, I like to place them in pockets surrounded by species with a longer growth period, so they can be seen when in bloom and hidden from view at other times.

In this region, we only have a few native evergreen trees and shrubs other than pines to work with: *Myrica cerifera* and *Myrica pusilla*, *Ilex vomitoria* and *Ilex opaca*, *Magnolia grandiflora*, and *Sabal minor*. I lean on them heavily, since evergreens provide most of the color and wildlife cover in the winter landscape.

Another part of the plant palette we're somewhat challenged in is groundcovers. I've found that grasses perform admirably in this role because they provide wildlife food and cover, a texture that contrasts well with other herbaceous and woody species and lasts well into the winter, and many have an attractive bloom. Favorites of mine include *Muehlenbergia capillaris* and *Muehlenbergia filipes*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Andropogon ternarius*, *Panicum virgatum*, and *Chasmanthium latifolium*. Other species I like to use as groundcovers *include Symphorocarpus orbicualatus*, *Coreopsis lanceolata*, *Verbena Canadensis*, *Viola missouriensis*, and *Polystichum acrostichoides*. I'm also excited about the potential of *Antennaria phalax*, a little-known species native to shady pine woodlands that seems to love a little attention. For a more complete list of natives useful in landscapes in this area, visit the Pineywoods Native Plant Center website.

I'd like to add a cautionary note to anyone interested in designing with native plants: Be careful with that water hose! If your natural design is composed of natives, remember that in this zone they're used to going without water for extended periods. In my opinion, native plant landscapes and automated irrigation systems don't mix very well. There's too much temptation to set the scheduler and forget about it. Water them deeply but less frequently than might be appropriate for domesticated species. Unless you're using plants normally found in saturated soils, allow them to dry out between watering. I recommend watering no more than once a week…they'll let you know if they're drought-stressed in time to rescue them with an extra irrigation. Fertilization is another place you can get into trouble with natives, especially herbaceous species. Many don't utilize high levels of nitrogen well, and will become leggy, rank, and fall over if too much is applied.

"There are two things modern man has never adjusted to: bipedalism...and domesticity." --- Courtesy of Elyce Rodewald

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Where Do Texas Plants Come From?

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Two years ago the first Lone Star Native Plant Conference closed with a remarkable presentation on the flora of northern Mexico given by Carl Schoenfeld. To me this was one of the highlights of the conference, with beautiful images of Mexico's varied plants and romantic landscapes. Some time afterwards I spoke with David Creech and he remarked that many attendees were confused by this lecture; they couldn't understand why a program on Mexican plants would be part of a conference on Texas native plants. This paper will introduce plant geography of the past to show how knowledge of Mexican plants can inform an understanding of the origins of Texas plants and the ecological communities of which they are components.

Let's begin about 100 Ma, in the middle of the Cretaceous period. The Edwards reef complex was building across central Texas and newly evolved flowering plants were spreading over the landscape, displacing the formerly dominant cycads and conifers. This was a time of active continental movement and sea floor spreading. Shallow seas covered much of what is now Texas and dinosaurs dominated the land areas. The old supercontinent, Pangea, was on its way to breaking up into the continents we recognize today, but could still be divided into a connected northern landmass (Laurasia) and a southern continent (Gondwanaland). Some North American fossil plants of the upper Cretaceous appear to be distant relations of modern sycamores (*Platanus spp.),* tulip trees (*Liriodendron sp),* and moonseeds (*Cocculus spp.*), all recognizable as plants common to the northern hemisphere today. Likewise, the progenitors of early African, South American, and Australian floras were spreading across the connected southern continents at this time.

The climate of the upper Cretaceous seems to have been milder than at present, and after the K-T extinction event this mild period appears to have resumed and continued until the end of the Paleocene, about 55.5 Ma, when temperatures worldwide heated up dramatically as the oceans turned over, deprived of oxygen like an overheated farm tank in summer.

This ushered in the Eocene, a time of worldwide moderate climates when many of the tree species we recognize today and modern orders of mammals established themselves. Eocene Texas was a home to palms, tree ferns, various bay trees *(Phoebe spp.)* and other plants typical of present tropical environments. Eocene fossils from as far north as the Aleutian Islands included cycads (*Dioon sp.& Ceratozamia sp.)* and bamboo (*Otatea sp.)* now found in south central Mexico. Above the Arctic Circle a thick forest of the deciduous conifer, *Metasequoia*, dominated lands bordering the ice-free Arctic Ocean.

Recognizably "Texan" plants appear in the fossil record towards the end of the Eocene, about 35Ma, but not growing in Texas. A glimpse at a late Eocene community of plants growing around the rising Rocky Mountains in south central Colorado, near Florissant, includes several plants that closely resemble species now common to the Edwards Plateau. Progenitors of the escarpment live oak (*Quercus fusiformis)*, prairie flame sumac (*Rhus copallina v. lanceolata)*, and agarita (*Berberis trifoliolata)* occur here and might seem to give the Florrisant flora a "Texan" feel, but they keep company with plants of Californian affinity like *Sequoia* and Mexican plants like *Bursera.* Along with these grew several genera now restricted to parts of Asia. *Ailanthus, Daphne, Koelreuteria, Mahonia, Pyrus*,and *Zelkova* are a few of the "Asian" plants that grew alongside early "Texan" plants in latest Eocene Colorado.

The transition period from the Eocene to Oligocene (about 34 Ma) saw North America becoming cooler and increasingly drier as the Rocky Mountains continued to rise, restricting precipitation and dividing the continent into eastern and western plant communities. Grasslands and prairies appeared at this time along with the first ungulate grazing animals. Camels, llamas, and horses roamed the early North American prairies. The more varied communities of plants common in the Eocene retreated to milder, wetter areas remaining along the Pacific and in the rising mountains of Mexico. Fossils show that plants similar to the "cowcumber tree", *Magnolia macrophylla,* now restricted to the southeastern US, grew at this time as far west as central Idaho. Today a close cousin of the "cowcumber tree", *M. dealbata*, occurs in the states of Queretaro and Hidalgo in eastern Mexico. DNA recovered from the Oligocene magnolia fossils shows little change between the ancient trees and present day *Magnolia macrophylla* and *M. dealbata*.

This suggests that some woody plants surviving in the temperate highlands of Mexico may represent remnants of the Eocene world, a sort of "Flora Madre" of North America. Several genera of plants now regarded as "Asian"(i.e. *Abelia, Buxus, Sarcococca*) persist in Mexico and highland Guatemala, though presently absent elsewhere in North America. Mexico also remains the center of diversity for important North American trees such as pines (*Pinus spp*) and oaks

(*Quercus spp.*). The flora of the eastern Sierra Madre shows strong affinities to the southeastern U.S., with dogwoods (*Cornus sp.)*, redbuds (*Cercis sp.)*, yew (*Taxus sp.*), magnolias, witch hazels (*Hamamelis sp.),* sweet gums (*Liquidambar sp.)*, anise trees *(Illicium)*, beargrass (*Nolina sp.),* false agave (*Manfreda sp.),* and yuccas all typical of Mexico as well as the southeastern U.S. Central Texas plants like snowbells (*Styrax platanoides*), bigtooth maple (*Acer grandidentatum),* and Lacey oak *(Quercus laceyi*) show parallels with "ancestral " Mexican species such as *Styrax youngii, Acer skutchii,* and *Quercus glaucoides.* Close, possibly ancestral relatives of Texas wildflowers like bluebonnets (*Lupinus sp.),* Texas star *(Lindheimeria sp.),* joe pye weed (*Eupatorium sp.)* and many cacti also occur in Mexico.

One of the curious aspects of modern Texas flora is that several species and genera are shared with parts of South America, especially Argentina. "Texas" plants like mesquite (*Prosopis sp.),*huisache (*Acacia sp.),* creosote (*Larrea sp.)* and goat-bush ((*Castela sp.)* have their closest relations in South America. "Texas" bulbous species like crow poison *(Nothoscordum bivalve),* copper lily (*Habranthus tubispathus),* and prairie nymph (*Herbertia lahue)* appear to be direct imports to North America from the prairies of Argentina and Uruguay. How did they get here? One possible answer relates to continental drift during the Oligocene, when a piece of what is now Ecuador broke from the then isolated South American continent. This "raft" of land migrated northwards, briefly joining with Mexico before occupying its present position as the island of Cuba; it may have carried some South American plants along with it to new homes in Texas and the Southwest.

Gradually, during the Oligocene and Miocene, and then more suddenly at the advent of the Pliocene (about 5Ma), worldwide climates cooled, foretelling the even colder Pleistocene (ice age) to come. Simultaneously, the Coast Ranges rose as rain-blocking mountains and western North America developed a dry-summer Mediterranean climate. Colder, more arid conditions spelled the end for several erstwhile American plants unable to find refuges in Mexico, California, or the Southeast. Genera now known from Asia like *Cercidiphyllum, Koelreuteria, Pterocarya, Zelkova, Ginkgo, Metasequoia, Cunninghamia, Glyptostrobus*, *Lygodium*, and *Keteleeria* perished, although they had grown successfully in North America for tens of millions of years.

About 1.8Ma the Pleistocene ice ages went into high gear, with massive ice sheets covering parts of North America and much of Europe. Plants now known as natives in warmer parts of North America or Asia, like palmetto palms (*Sabal spp.)* and magnolias disappeared forever from Europe as the ice sheets advanced. In central Texas near Gonzales and in Lee County on Yegua creek the Soefje and Patschke bogs showed fossil pollen of fir (*Abies sp.),* spruce (*Picea sp.),* and alder *(Alnus sp.),* suggesting that ice age Texas had a much different flora from present. As worldwide sea levels dropped 430 feet, the Gulf of Mexico receded offshore to the edge of the "continental shelf" and Texas rivers cut deep valleys into the coastal plain, creating "ice age refugia" for the retreating North American flora. The occurrence of "Appalachian" species like *Stewartia malacodendron* in eastern Texas and the widespread, but intermittent ranges of trees like nutmeg hickory *(Carya myristicaeformis*) and Durand oak (*Quercus durandii*) may be remnants of plant distribution from this period.

The fluctuating sea levels also created new land bridges, connecting North America with Asia across the Bering straits ("Beringia") and, beginning about 3Ma, joining Central America with South America over the isthmus of Panama. North American mammals (horses and camels) migrated east to Asia and south (llamas, pumas, jaguars, foxes, and tapirs) to South America, while South American mammals (sloths, armadillos, porcupines, glyptodonts, and opossums) came north. Mastodons crossed from Asia to North America about 5Ma and Mammoths crossed the Bering land bridge from Asia about 1.5 Ma, evolving first into the Columbian mammoth (*Mammuthus columbi)*, with the better known wooly mammoth (*Mammuthus primigenius)* not crossing into Alaska from Siberia until about 100,000 years ago.

During La Brea time (about 25,000 years ago) North America saw the first invasion of buffalo (*Bison)* from Asia, and not long thereafter, the first humans. By the time the last ice age was drawing to a close (12,000 years ago) many of the large mammals that had dominated the North America landscape began to disappear. The increasingly adept human populations almost certainly hastened these extinctions: 2 species of mammoth, 1 mastodon, 3 genera of giant ground sloths, glypodonts, giant armadillos, saber tooth cats, lions, camels, llamas, and horses all disappeared from North America at this time.

The effect of this loss on North American flora must have been tremendous. One can only speculate on the effects that herds of mammoths and mastodons must have had on the ice age plants; it is well known that modern elephants regularly lay waste to large areas of woodland, reshaping the landscape on a grand scale. A special relationship is believed to have been present between many of the large-fruited North American plants and the giant herbivores that died out at the end of the Pleistocene. Avocados, for instance, may have been the primary food of giant sloths, and these trees might have become extinct after the disappearance of these animals if not for the activity of humans, who find the fruits equally attractive.

A Texas-specific case is the Osage orange, or Bois D'Arc (*Maclura pomifera).* When first discovered by early French explorers, who named it "bow wood" for its strong, elastic branches, this rugged tree occurred naturally only along the Red River in north Texas and parts of adjacent states. Yet, fossils from the last interglacial, the Sangamonian period from about 130,000 to 75,000 years ago, show that this tree previously ranged as far north as Minnesota and all over the plains states, the same areas where it has been commonly planted since the 1800's as a hedging plant. What happened? Why didn't *Maclura* recolonize its native range after the last ice age? This odd native tree is famous for the huge "hedge-apples" produced by the female trees each fall, and it remains a mystery as to what animal made use of the hard, round fruits (other than young boys, who find them ideal missiles). One theory is that this tree's fruit may have been the favored food of the American mastodon *(Mammut americanus*). Without this animal to redistribute the tree's seeds its native population dwindled to a small range until discovered by settlers. Cultivation and luck preserve this native species now.

Human interactions with the native flora continue to change it. There is only a small amount of evidence for agriculture in Texas prior to the arrival of Spanish colonists, but it seems likely that some agriculture, involving the cultivation of domesticated crops like corn, beans, and squash was practiced both by settled peoples of the Caddo culture in east Texas and by outlying settlements of the Casas Grandes culture of Chihuahua in the Rio Grande Valley near El Paso and perhaps by Puebloan peoples controlling the Alibates flint quarries. The Texas gourd (*Cucurbita texana),* a rare endemic annual vine first discovered by Ferdinand Lindheimer along the Guadalupe river and other central Texas rivers, seems suspiciously like a food plant gone wild and is closely related to *C. pepo*, the cultivated squash. It may represent the remnant of an early, non-specialized agriculture practiced in this region, persistent along local streams. If so, this might be the first plant introduced to the Texas flora by humans.

With European conquest and settlement the indigenous grazing animals (pronghorn antelope, elk, bison, and prairie dogs) have been largely eliminated or displaced by introduced cattle, sheep, horses, and goats, who remain fenced in enclosures, grazing the land much more heavily. Predators such as mountain lions, bears, jaguars and screwworm, which formerly limited deer and jackrabbit populations have been removed, allowing these animals to exert severe pressure on the native flora. Overgrazing, the plow, herbicides, and introduced fires have created a disturbed environment, now often filled with grasses and forbs introduced for agricultural purposes and soil stabilization. In the "politically correct" language popular at native plant conferences these introduced plants are often referred to as "invasive exotics", although in recent botanical texts they have customarily been designated as "naturalized species". Since much of the habitat occupied by these modern introductions remains in perpetually disturbed condition it is difficult to assess their long term role in Texas and whether they will become permanent parts of the flora.

Finally, much has been said about fire and its role in shaping Texas flora, and it has become a popular tool for "restorationists", especially those working with prairies. However useful fire may be for clearing brush, it is doubtful that its natural role in Texas was especially significant. Biologist Del Weniger, in *The Explorers Texas* states clearly that there is no evidence for fire as a common natural phenomenon in Texas prior to European contact. Nor (as has been suggested by some) is there evidence for its use by indigenous peoples in Texas during the prehistoric period. There are abundant records, however, to show its overwhelming use during the early settlement of Texas by the Spanish, by native peoples introduced to its use by the Spanish, and by English speaking settlers. In fact, nearly the whole state seems to have been burned off at this time.

In Summary:

1.) Many species of Texas plants have been on earth for 35MY

2.) Some plants surviving in the mountains of Mexico may represent relics of early North American flora

3.) Texas had a tropical climate prior to about 34Ma and few of the species now native to Texas grew there before the Oligocene.

4.) Several Texas plants show strong South American affinities

5.) Many plants now considered Asian grew in North America until the Pliocene, about 5Ma.

6.) Texas native plants grew elsewhere during the ice ages, with some retreating towards the Gulf or south into Mexico. A few, like small cacti , bulbs, and annual species may have evolved in the last 12,000 after the most recent ice age.

7.) Spruce and fir grew in central Texas 15,000 years ago.

8.) 23 species of large mammals once played a part in the Texas landscape and went extinct at the end of the ice age, around the time that humans arrived.

9.) Horses, camels, and llamas are originally North American

10.) Bison are from Asia.

11.) There is no documented evidence for fire playing a strong role in Texas native plant communities.

12.) There is no documented evidence that indigenous peoples burned Texas prairies prior to European contact.

13.) The Spanish and Anglo settlers of Texas made abundant use of fire to clear pastures, kill wildlife, harass enemies, and provide entertainment.

14.) Ma stands for *Mega annuum* and means "millions of years before present"

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Viral Resistance, Gene Flow, and Risk Assessment

Natives as Cut Flowers

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The cut flower industry is big business here in Texas. We are spending over $200 million dollars in fresh flowers every year. Unfortunately, less than half a million dollars of cut flower product is grown in Texas. Most cut flowers are grown and shipped from out of the United States. There is a large market niche waiting to be filled with Texas grown cut flowers. With the popularity "green" tourism, wildflower trails and festivals, and tremendous pride for our home state, why not fill that niche with our own native flowers?

"The grass is always greener on the other side." This has been our general belief when selecting and buying cut flowers. It's taken breeders from Japan, England, and other states in the US to realize the potential of many of our own native plants. Many varieties bred by outside sources like *Eustoma grandiflora* (*Lisianthus*), *Phlox drummondii*, *Salvia farinacea*, *Gaura lindheimeri*, and *Physostegia*, all Texas natives, are staples in the cut flower industry, but few if any are grown in their home state. We should be on the lookout for potential cut flowers to select and breed for cut flower production.

Texas grown flowers have an advantage in that they can be harvested and delivered to local markets in often less than 48 hours. This increases the range of potential varieties that are delicate and don't ship well and for flowers with a short vase life.

A note of caution… In no way is this encouragement to harvest flowers or greenery from the wild for market purposes. As stewards and supporters of our precarious native habitat it is imperative to only harvest and market farm raised flowers.

The following table provides a quick look at native flowers that have potential or are established in the cut flower industry.

Trees, Shrubs, and Vines	
Aesculus pavia	Red Buckeye
Bignonia capreolata	Cross Vine
Callicarpa americana	Beauty Berry
Cercis canadensis	Redbud
Cornus florida	Dogwood
Gelsemium sempervirens	Carolina Yellow Jessamine
Ilex decidua	Possumhaw Holly

Itea virginica	Sweetspire
Lonicera sempervirens	Honeysuckle
Magnolia grandiflora	Southern Magnolia
Myrica cerifera	Wax Myrtle
Rhododendron canescens	Hoary Azalea
Rhus glabra	Smooth Sumac
Sabal minor	Dwarf Palmetto
Sambucus nigra var. canadensis	Elderberry
Sophora secundiflora	Texas Mountain Laurel
Vitis rotundifolia	Muscadine Grape
Wisteria frutescens	Wisteria
Annuals and Perennials	
Aquilegia chrysantha	Columbine
Asclepias tuberosa	Butterfly Weed
Baptisia alba	False Indigo
Baptisia australis	False Indigo
Camassia scilliodes	Wild Hyacinth
Centaurea americana	American Basket Flower
Coreopsis lanceolata	Tickseed
Coreopsis tinctoria	Plains Coreopsis
Echinacea sanguinea	Coneflower
Erigeron spp.	Fleabane
Erythrina herbacea	Coral Bean
Eupatorium coelestinum	Blue Mistflower
Eupatorium fistulosum	Joe Pye Weed
Eupatorium serotinum	Lat Flowering Boneset
Eustoma grandiflora (Lisianthus)	Bluebell
Gaillardia aestivalis var. winklerii	Winkler's Firewheel
Gaillardia pulchella	Firewheel
Helianthus maximiliani	Maximalian Sunflower
Ipomopsis rubra	Standing Cypress
Liatris mucronata	Cusp Blazing Star
Liatris pycnostachia	Prairie Blazing Star
Lobelia cardinalis	Cardinal Flower
Monarda citriodora	Lemon Mint
Monarda fistulosa	Wild Bergamot
Nelumbo lutea	Lotus
Phlox drummondii	Drummond Phlox
Phlox pilosa	Prairie Phlox
Physostegia intermedia	Slender False Dragonhead
Physostegia virginiana	Obedient Plant
Ratibida columnaris	Mexican Hat
Rudbeckia hirta	Black-eyed Susan
Salvia farinacea	Mealy Cup Sage
Solidago canadensis	Goldenrod
Solidago odora	Sweet Goldenrod
Spigellia marilandica	Indian Pink

Prairie Restoration

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There are many prairie restoration projects in Louisiana and Mississippi. The U.S. Forest Service has maintained prairies and other grasslands in the National Parks for many years, concentrating mainly on the management of existing prairie remnants. Examples are the inland prairies of Ft. Polk, Louisiana, Kieffer Prairie in Kisatchie National Forest near Winnfield, Louisiana and Harrell Prairie in Bienville National Forest near Forest, Mississippi. The U.S. Fish and Wildlife Service and the National Resource Conservation Service have ongoing research on different aspects of prairie establishment. There are also nonprofit groups established such as the Cajun Prairie Habitat Preservation Society in Eunice, Louisiana and The Friends of the Black Belt in Starkville, Mississippi that protect and preserve a small part of a prairie habitat. And there are individuals who have established or preserved plots on privately owned property. Everyone who considers starting a wildflower patch, a butterfly garden, or low maintenance method of maintaining open, sunny land can learn a lot from the work of prairie restorers. The oldest example of a prairie restoration in the United States is the Curtis Prairie at the University of Wisconsin-Madison Arboretum. The work to establish this prairie began in 1935 with volunteers and Civilian Conservation Corps workers providing years of hand labor. This initial work was greatly aided by the pioneering experiments by John Curtis using controlled burning as a part of the annual maintenance regime. Today over three hundred species of plants are found there.

The Cajun Prairie Restoration Project in Eunice, Louisiana is the best representation of a restored prairie in Louisiana or Mississippi. Initiated in 1989 by Dr. Charles Allen, Dr. Malcolm Vidrine, and countless volunteers over the years, this restoration project began with transplanting and seed collecting and has now grown into a relatively mature prairie representation. Along with wholesale introduction of desirable species into Eunice Prairie, particular attention has been given to the collection of unique genetic variations of individual species from the many of the remaining Cajun Prairie remnant sites. The ten-acre Eunice project has been the impetus for numerous regional prairie restoration projects. A large-scale restoration based on the Eunice prototype was started by Vicki Graffe, of the U.S Fish and Wildlife Service and Dr. Charles Allen in 1996. Known as Duralde Prairie, it is just ten miles north west of Eunice and encompasses three hundred acres. It was originally overgrown with Chinese Tallow tree (Sapium sibiferum) and was cleared of these woody exotics in 1996 by using heavy machinery. Immediately after clearing the land, planting work began by introducing seed and transplanted clumps of prairie from nearby remnant strips. Each successive year work has been done to increase genetic diversity. Several research plots have been set up to help answer questions regarding prairie establishment.

Larry Allain, a researcher with the National Wetlands Research Center in Laffayette, Louisiana and Betty Vidrine, environmental director of the City of Laffayette, Louisiana have worked together to establish prairie plots on the site of the former city landfill. The use of prairie at this steep-sloped garbage graveyard solves some of the problems the maintenance crew faces. A low growing permanent prairie cover crop provides much- needed erosion control and an extremely low maintenance requirement. Controlled burns are used annually to rejuvenate the plantings. Methane vents built into the landfill are simply closed prior to burning.

The home garden of Dr. Malcolm Vidrine southwest of Eunice is an incredibly diverse combination of prairie, marsh, and butterfly gardens intended for much personal enjoyment and a limited amount of public access. Set on an acre of land in what was formerly a rice field, Dr. Vidrine, with the assistance of his wife, son, and daughter, has achieved a high level of aesthetic enhancement. Over the years Dr. Vidrine has written observations on the activities and development of the plantings. Although a prairie restoration/grassland replication is not applicable in every landscape situation, it can be used as a low maintenance method of increasing biological diversity, enhancing botanical enjoyment, and encouraging judicious land use. By Charles Allen, Peter Loos, Marc Pastorek, Malcolm Vidrine

Plant Propagation and Production at TreeSearch Farms

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Slide List

1. Welcome to Tree Search Farms
2. Blush witch-hazel, "Farming in a Bucket"
3. "Plants bring people together"
4. Great need for unusual plants for different landscape situations, Reeves Garden
5. Specialty and native plants meet in a well-designed border: Oto-hime Japanese maple, gingers, native sedges, silver mist juniper, rainlilies, and Japanese variegated *Miscanthus*
6. Mixed borders for butterfly gardening, Mexican sage, *Buddleia*, *Pentas*, verbena, roses Dahoon holly backdrop
7. What we grow: natives—longspire sweetspire
8. Herbaceous perennials—Hinckley columbine, leopard *Ligularia*
9. Intercropping of Louisiana iris and Mexican sycamore
10. Shade plants-ferns, lace ferns
11. Half-hardy plants-variegated spiral ginger
12. Fruit and nut trees for the Gulf Coast-'Meiwa' kumquat
13. Plants for vertical gardening-red crossvine
14. Antique roses-Belinda's Dream
15. Heirloom and native bulbs-Johnson's amaryllis
16. Plain vanilla color-'Homestead' verbena
17. Ornamental grasses-'Adagio' *Miscanthus*, 'November Sunset' *Miscnathus*
18. Shade trees-polymorpha oak, Mabel's maroon verbena
19. Oranmental trees-Japanese maples, silverbell fringe tree, *Sinojackia*
20. We also grow some other good friends-*Indigofera*
21. We also promote the use of "art" in the landscape. Bamboo muhly, skyflower vine, Mexican flame vine
22. Propagation and Production Intro
23. Let's talk fertilizer, organic program. Dry products, top dressing and premixing, micro-life ultimate 8-4-6, micro-iron, eco-min rock dust at label rates
24. Conventional products
25. Liquid organic products-Ocean Harvest, Super Seaweed, humic acid, compost teas, injected throughout the nursery one-two times per month
26. Batch mixer
27. Propagation soil 1:2:1-Fison's #1 plug mix:coarse perlite: fine screened pine bark and 3-5 lbs. Florida special Osmocote/cubic yard
28. Nursery soil mixes-tree mix, general nursery mix, perennial mix, citrus mix. Various ratios of fine screened pine bark, pine bark, compost, coarse sand, and organic premixed fertilizers

29. Insect and disease program: good culture + good fertility + proper irrigation + moving product in a timely manner= less disease and insect pressures
30. Propagation disease and insect control—Zerotol, Consan Diseases, Gnatrol, molasses, Triact 70, pyrethrums insect control
31. Cleaning flats, recycling, cleaning work areas, and mist benches.
32. Greenhouse facilities
33. Mister controls—user friendly a must
34. Hurricanes and back-up power
35. Bottom heat on mist benches
36. Bottom heat in greenhouse floors
37. Supplemental lighting in propagation houses
38. American hornbeam
39. Variegated *Ligularia*
40. Red spider lily, *Lycoris radiate*
41. Introduction seed propagation—Vietnamese good luck tree
42. Native seed sources and availability getting better, but most is collected in house. Home Depot Burpee display.
43. Know and research plant from as many sources as possible. Checking seed for ripeness
44. Coral bean seed, scarification, hot water, humic acid, vinegar
45. Cleaning dry seeds vs. fleshy seed
46. Shangtung maple, chittening
47. Coral bean, chittening
48. Coral bean, seedling
49. Loquat leaf oak—hot water soak, Ziploc, stratification, uniform germination
50. Native fringe cold moist stratification
51. Wet newspaper oak chittening
52. Propagation flats for seeds
53. *Sabal minor* in communities
54. Pine seedling in tube trays vs. rootmaker trays
55. Sowing seed
56. Covering seed, vermiculite, sand, perlite
57. Misting seed flats
58. Hardening house
59. Pump-house red yaupon, cedar waxwing
60. Variegated Aquifolium holly, Dahoon holly rootstock, cutting grafts
61. Walter's viburnum, compact Walter's becoming very popular
62. Cutting collection—garden vs. containers
63. "Getting a feel for it"
64. Purple prairie aster, tipping cuttings
65. American beauty berry—cutting windows and plant manipulation
66. Cutting preparation, cleaning, tables, current baskets, etc
67. Soaking cuttings—Zenotol Diseases, seaweed soaks, NEEM (Triact 70)
68. Hormones and experimenting with new plants, alcohol sensitivity, K-IBA, TACS
69. Sticking depth, nodes and internodes, wet vs. dry operators, water holding capacity and porosity

70. Weather and mist frequency
71. Mixing crops under mist in specialty nurseries—crops can be table specific, gh gradients
72. Low cost potting tables
73. Guys working at a table
74. Remember plants and people need each other
75. So let's enjoy out work with plants
76. No matter what type of plants we are growing (bowling ball daisy pinwheel)…
77. Let's plant some gardens…
78. Then we will take a nap…
79. Grow some more plants (Montrose purple vitex)…
80. Have a beer and relax…
81. And play with some more plants!! (Variegated tapioca)

RARE NATIVE PLANTS OF EAST TEXAS AND BEYOND CONSERVATION AT MERCER ARBORETUM AND BOTANIC GARDENS

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In the 1940's, Charles and Thelma Mercer created their personal oasis along Cypress Creek and on this land preserved beautiful specimens of dogwood, rusty black-haw viburnum, hawthorn and other native East Texas trees. Plantings of exotic ornamental trees including *Camellia*, *Ginkgo*, *Bauhinia* and Camphor complemented the native flora on the property. In 1974, Harris County purchased the property after the Mercers proposed that their 14.5acre private garden be preserved as an education and horticultural facility for the public. Mercer Arboretum & Botanic Gardens is a nationally recognized arboretum and botanic garden and is located just minutes northeast of Houston in Humble, TX. Maintained for the public by Precinct 4, Mercer now includes nearly 300 acres and attracts over ~100, 000 visitors annually. Mercer remains free of admission charge and is open year-round (http://www.cp4.hctx.net/mercer/index.htm).

Mercer's growing conservation program is consistent with Charles and Thelma's foresight to preserve the native plants on their property and promotes a two-part mission: ***conservation education*** and ***applied conservation***. The Endangered Species Garden, a rare native plant garden, was founded at Mercer in 1994 from a donation by Star Enterprises. In 2002, River Oaks Garden Club and the Mercer Society graciously supplied the funds to enlarge and renovate this unique garden. A replica of a beaver dam and pond serve as the focal point for the woodland and wetland habitats for this teaching garden. Companion natives, selected by volunteers and staff, complement the rare species on display here. The Endangered Species Garden is featured during docent and staff led adult and children's tours. Tours are offered to ~36,000 school children annually and their teachers receive a copy of the Center for Plant Conservation's (CPC) America's Vanishing Flora.

The CPC mission is to preserve and restore America's native plants. Loss of habitat, introduction of foreign species, and over-collection are just a few of the threats to the Nation's ~20,000 native plant species, at least a ¼ of which occur in Texas. Already, more than 200 species have become extinct in the U.S. and over 730 species are federally listed as endangered or threatened. Loss of native plant species weakens the natural ecosystem, reduces the beauty and diversity around us, and depletes an irreplaceable gene pool that may hold the cures for diseases, such as certain forms of cancer as well as cures for diseases of agricultural crops. Although the extinction of flora and fauna is a natural process that has occurred throughout the history of our Earth, the activity of humans on Earth has greatly accelerated the rates of extinction. The CPC has organized a national gene bank of rare U.S. species and now ranks as one of the largest collections of rare plants in the world. Mercer is one of 33 botanic institutions in the US that maintains the National Collection of Endangered Plants for the CPC. In Texas, the CPC works in collaboration with many allies including: TX Parks & Wildlife Dept. (TPWD), the US Fish &Wildlife Service, US Forest Service, US Corps of Engineers, local flood control districts, Dept. of Transportation, the Nature Conservancy (TNC), several colleges and universities, garden clubs and other volunteer organizations and private citizens.

Many CPC plants are in restoration projects. The endangered status of rare plants is re-classified as necessary as new populations are discovered or restored. The CPC facility, New England Wildflower Society's Garden in the Woods in MA, recently restored the rare *Potentilla robbinsiana*, Robbins' Cinquefoil, to its mountain habitat and this wildflower has now been delisted. For more than 13 years, Mercer has teamed up with the CPC and is certified to care for endangered plants from throughout the upper Gulf Coast region of the U.S.A. Mercer currently is the primary lead in the care of 24 threatened or endangered species. Over 600 species in the National Collection of Endangered Plants, including those maintained and displayed by Mercer, may be viewed and studied from detailed plant profiles online at: http://www.mobot.org/CPC/. Although charitable sponsorship donations to endowments help to support CPC's payments made each year to assist Mercer in maintaining the Large-fruited Sand Verbena, White Bladderpod and Pondberry, the remaining 21species maintained at Mercer are in need of sponsorship (http://www.mobot.org/CPC/ and http://www.cp4.hctx.net/mercer/index.htm). "Restoring the population of a single plant species is a long-term commitment and a big job!" says Dr. Kathryn Kennedy, president and executive director, CPC. From collecting endangered seeds in the wild to carefully cultivating and restoring a plant's gene pool, the process is exacting and costly. Conservation projects underway at Mercer include cleaning and banking of seed, seed germination and propagation studies and public education. Seeds deposited at Mercer are backed up at Mercer's CPC sister facility, Lady Bird Johnson Wildflower Center, and at the National Center for Genetic Resources Preservation in Ft. Collins, CO. Mercer serves as a rescue center and maintains endangered plants submitted by local sources and from out-of-state. A volunteer rare plant-monitoring group for local species began in 2002 with TPWD and Harris County Flood Control. Also, as of 2003, introductory plant conservation is included in the curriculum in Mercer's Master Gardener Certification classes.

The TX species listed below are part of ~200 rare plants included in the document: January 2002 Edition of A List of Rare Plants of Texas by Jackie M. Poole, Jason R. Singhurst and Dana M. Price, Wildlife Diversity Program, Texas Parks and Wildlife Department 3000 IH 35-S, Austin, TX 78704 and William R. Carr, Texas Conservation Data Center, The Nature Conservancy of TX, P.O. Box, 1440, San Antonio, TX 78205-1721. Those plants that Mercer maintains that are not found in TX are listed as such below. Many of the National Collection plants listed below already are included in Mercer's gene bank as seed or live plants and are on display in the Endangered Species Garden. Those plants indicated with an **E** are federally endangered; the remaining plants are Threatened or Species of Concern.

E *Abronia macrocarpa* (sponsored by the Quaker Hill Foundation) Large-fruited Sand Verbena (Four O'clock Family, Nyctaginaceae) occurs in Freestone, Leon, Robertson counties in East-central TX. This long-lived, drought-tolerant perennial is found in sandy post-oak savannas. Its threats include development, oil drilling and invasive plants. *A. macrocarpa* is extremely fragrant at dusk and is pollinated by moths. Dr. Paula Williamson from SW TX Univ. in San Marcos and Gena Janssen of Janssen Biological in Austin are experts on *A. macrocarpa* and have formed conservation partnerships with private owners who take pride in having this plant on their lands.

***Agalinis navasotensis* Navasota False Foxglove** (Figwort Family, Scrophulariaceae) occurs in Grimes Co. in TX. *A. navasotensis* is found only on the Oakville geologic outcrop and primarily is under threat from road widening. This annual is partly parasitic on native grasses and thus presents a challenge for propagation. *A. navasotensis* is in tissue culture propagation by Dr. Valerie Pence at the Cincinnati (Ohio) Zoo and Botanical Gardens. Monique Reed of TX A&M

and BRIT (Botanical Research Institute of Texas) and Judith Canne-Hilliker of Ontario discovered the species. This genus is host for Buckeye butterflies.

***Aster puniceus var. scabricaulis* Rough-stemmed Aster** (Sunflower Family, Asteraceae) occurs in Anderson, Cherokee, Franklin, Henderson, Hopkins, Smith, Van Zandt, Wood in NE TX. This perennial also occurs in LA and MS and is under threat from drainage of its bogs/pond habitats. The *Aster* genus is host for butterflies including the Painted Lady.

***Bartonia texana* Texas Screwstem** (Gentian Family, Gentianaceae) occurs in Angelina, Hardin, Jasper, Nacogdoches, Newton, Polk, San Augustine, San Jacinto and Tyler counties. TX Screwstem is found most often in bog habitats along wooded streams in East TX. This species is a 2003 addition to the CPC National Collection.

***Chloris texensis* Texas Windmill-grass** (Grass Family, Poaceae) occurs in Brazoria, Brazos (historic), Chambers, Galveston, Harris, Nueces, Refugio and possibly Hildalgo counties in TX. *Chloris texensis* most often is associated with elevated prairie bare spots called mima or pimple mounds. This perennial is under threat primarily from urban development. U.S. Army Corps of Engineers Addicks & Barker Reservoirs in southwest Harris County and northeast Fort Bend County, The Katy Prairie Conservancy, Harris County and Flood Control properties may currently offer the best refuges for this plant. Mercer also works with USF&W, TPWD and Dr. Larry Brown of Houston Community College to preserve this species. Native grasses are important host plants for butterflies including the Satyr and Skipper.

***Cypripedium kentuckiense* Southern Lady's Slipper Orchid** (Orchid Family, Orchidaceae) occurs in Cass, Nacogdoches, Harrison, Newton (historic), Red River, Sabine, San Augustine counties, Shelby and Tyler counties, TX and scattered throughout AL, AR, GA, KY, LA, MS, OK, TN and VA. Inhabits shady ravines in East TX. This orchid is under threat from logging, development and collectors. Wild seed will be tested in tissue culture propagation by Dr. Valerie Pence at the Cincinnati Zoo and Botanical Gardens, OH and will be banked.

***Gaillardia aestivalis var. winkleri* White Fire-wheel** (Sunflower Family, Asteraceae) occurs in Hardin Co. in TX. Due to elimination of natural fire cycles in the Pineywoods, this perennial is under threat from competition by native woody plants and invasive plant species. Reintroduction is currently underway via a federal grant authored by the NPS for the Big Thicket National Preserve in cooperation with Dr. David Creech of Stephen F Austin Univ. and others. This perennial is potential future candidate for drought-tolerant gardening and is an important nectar source for wildlife.

Hibiscus dasycalyx. **Neches River Rose Mallow** (Rose-mallow Family, Malvaceae) occurs in Cherokee, Harrison, Houston and Trinity counties in East TX. Dr. David Creech of Stephen F. Austin University currently is reintroducing this shrub to Davy Crockett National Forest. Continued loss to herbicide runoff and loss of habitat of this wetland perennial may elevate it to Endangered Status in the future. *Hibiscus* is a host plant for butterflies including the Hairstreak.

E *Hymenoxys texana* **Prairie Dawn** (Sunflower Family, Asteraceae) occurs in Harris and Ft. Bend counties in TX and often is associated with the low areas around elevated prairie bare spots called mima or pimple mounds. Prairie Dawn is tolerant of extreme ranges in salinity and water and is under threat from development and competition from other plant species. Please refer to *Chloris texensis* above for conservation details.

E *Isoetes louisianensis* **Louisiana Quillwort (**Quillwort Family, Isoetaceae) occurs in Washington and St. Tammany Parishes in LA and in two counties in MS. This primitive, non-flowering relative of the mosses, ferns and horsetails is a living fossil. Found most often on sandbars in streams, *Isoetes louisianensis* is under threat from clear-cutting of stream bank timber and sand/gravel mining. US Forest Service, LA Nature Conservancy and LA Natural Heritage program monitor LA populations. Mercer maintains a rescued population from LA for the USFWS and LA Natural Heritage program. LA Quillwort is in trials for tissue culture propagation by Dr. Valerie Pence at the Cincinnati (Ohio) Zoo and Botanical Gardens.

Leavenworthia aurea var. texana **Texas Golden Glade Cress** (Mustard Family, Brassicaceae) inhabits the unique geological outcrop, the Weches formation, in San Augustine, Sabine and in an introduced site in Nacogdoches counties, TX. The Weches formation creates "islands" of alkaline sediments within the surrounding acidic Pineywoods. Threats to *L. aurea* var. *texana* include destruction from open pit mining of glauconite, "green rock" for road surface material. Due to elimination of natural fire cycles, this annual also is under threat from competition by both native woody plants and invasives. TNC, TPWD, USF&W, Stephen F. Austin University and the Piney Woods Native Plant Center and Mercer are establishing a conservation plan for this species. Brassicaceae are native host plants for butterflies including the Whites.

Leitneria floridana **Corkwood** (Corkwood Family, Leitneriaceae), a small tree, inhabits coastal and inland wetlands in Brazoria, Chambers(historic), Fort Bend, Galveston (introduced), Harris (introduced) and Jefferson counties, TX and in AL, AR, FL, GA and MO.

E *Lesquerella pallida* **(sponsored by Dr. and Mrs. Sellers J. Thomas, Jr.; Mr. Frank A. Liddel, Jr.; Dr. and Mrs. Charles F. Squire; US Fish & Wildlife Service) White Bladderpod** (Mustard Family, Brassicaceae) occurs on the unique geological outcrop called the Weches formation in San Augustine County, TX. Please refer to *L. aurea var. texana* for details.

Liatris tenuis **Slender Gay-feather** (Sunflower Family, Asteraceae) occurs in well-drained sites often in pine forests in Angelina, Hardin, Jasper, Newton, Orange, Sabine, San Augustine and Tyler counties, TX and in LA. *L. tenuis* and is under threat from logging and development.

E *Lindera melissifolia* (fully sponsored by 1. Mrs. Alice C. Fick of Auburn, AL in memory of Kenneth Beighley and 2. the Edward K. Love Conservation Foundation of St. Louis*)* Pondberry (Laurel Family, Lauraceae) occurs in one county each in AR, MO, MS, SC and NC and is extinct from FL, AL, LA and GA. This colonial, deciduous, aromatic shrub grows in a variety of floodplain habitats in its range. Female plants produce fruits (drupes) that are bright red at maturity. Mercer continues to store fruit and propagate seed from MO via Missouri Botanical Garden and state botanist, Rhonda Rimer. *Lindera* genus is a host plant for Spicebush Swallowtail Butterfly.

E *Phlox nivalis ssp. texensis* (partial sponsorships: 1. Carol Kobb of Conroe in memory of Millie Guadino of Houston and 2. The River Oaks Garden Club) Texas Trailing Phlox (Phlox Family, Polemoniaceae) occurs in the Pineywoods of Hardin, Polk and Tyler counties of East TX. Due to elimination of natural fire cycles, this perennial is under threat from competition by native woody plants and invasive exotics. A reintroduction is currently underway via a NPS grant for the Big Thicket National Preserve in collaboration with Dr. David Creech of Stephen F Austin Univ., Magnolia Garden Club of Beaumont and others. Mercer, USFWS, The Garden Club of Houston, The River Oaks Garden Club, Magnolia Garden Club, the TNC and others first reintroduced plants to the Big Thicket in 1995. This Phlox is a nectar source for wildlife and a possible future candidate for drought-tolerant gardening after it has been recovered.

Physostegia correllii **Correll's False Dragon-head** (Mint Family, Lamiaceae) historically occurred in Bexar and Montgomery and although reported in Galveston, Travis, Val Verde and Zapata counties, no plants recently have been recorded in TX. *Physostegia correllii* presently occurs in St. Charles and Cameron parishes in LA; and the status is unknown in Coahuila, Nuevo Leon and Sonora states in Mexico. The US Forest Service, the LA Nature Conservancy and the LA Natural Heritage program monitor LA populations. *P. correllii* historically occurred in many diverse wetland habitats in its range. Now possibly extinct from TX, this perennial is under threat from road widening, herbicide run-off and channelization of ditches.

Physostegia longisepala **Long-sepaled False Dragon-head** (Mint Family, Lamiaceae) occurs in Hardin, Jasper, Newton, Orange and Tyler counties, TX and in LA (Acadia, Beauregard, Calcasieu, possible: Allen and Bienville). This species is found on poorly drained soils along roadways, ditch banks, edges of mesic forests and moist soils of pine flatwoods. *Physostegia longisepala* is a 2003 addition to the CPC National Collection.

Rayjacksonia aurea (syn: Machaeranthera aurea) **Houston Camphor Daisy** (Sunflower family, Asteraceae) occurs in Harris and Galveston counties, TX. *R. aurea* is often associated with elevated prairie bare spots called mima or pimple mounds. This possible future candidate for drought-tolerant gardening is a nectar source for wildlife. Please refer to *Hymenoxys texana* and *Chloris texensis* for conservation details.

Rudbeckia scabrifolia **Bog Coneflower** (Sunflower Family, Asteraceae) occurs in Angelina, Jasper, Newton, Sabine and Shelby counties in TX and in Natchitoches, Sabine, Vernon and Winn parishes, LA. Bog Coneflower is found in seepage areas and bogs along hillsides and forests. This species is a 2003 addition to the CPC.

Silene subciliata **Scarlet Catchfly** (Pink Family, Caryophyllaceae) occurs in Hardin, Jasper, Jefferson (H), Liberty, Newton, Polk, Sabine, Shelby and Tyler counties, TX and in Allen, Beauregard, DeSoto, Natchitoches, Sabine, Vernon parishes, LA. This perennial is often is found in oak-farkleberry sandylands in open woodlands, sand-hills, scrub and also along disturbed sandy roadways. *Silence subciliata* is a 2003 addition to the CPC National Collection.

Thalictrum texanum **Texas Meadow-rue** (Buttercup Family, Ranunculaceae) occurs in Brazos, Fayette(H), Grimes, Harris(H) and Waller counties, TX. This species often occurs in partially shaded, damp, sandy soils in moist post-oak woodlands. *Thalictrum texanum* is a 2003 addition to the CPC National Collection.

Trillium texanum (syn.: Trillium pusillum var. *texanum*) **Texas Trillium** is in the Lily Family or some place these plants in a separate family, the Trilliaceae. *Trillium texanum* occurs in Cass, Smith, Nacogdoches, Angelina, Jasper, Cherokee, Harrison, Houston (historic), Rusk, Panola (historic) and Wood counties, TX. This species also occurs in Rusk and Caddo Parish in LA. *T. texanum* inhabits shady, acidic ravines, seeps and bogs. Mercer stores and maintains plants collected with assistance by SF Austin University from a rescue site in Nacogdoches County. *T. texanum* primarily is under threat from development. Dr. Valerie Pence at the Cincinnati Zoo and Botanical Gardens, OH is propagating this plant via tissue culture.

Yucca necopina **Glen Rose Yucca** (Agave Family, Agavaceae) occurs in Hood, Parker, Somervell and Tarrant counties. This perennial is found in sandy areas and fencerows of North Central Texas. *Yucca necopina* is a 2003 addition to the CPC National Collection.

Public informative articles about the rare plant conservation at Mercer are published in the Harris County Precinct 4 magazine, Parkscape. This free publication circulates 115,000 issues each year and also is featured in Harris County Precinct 4's website http://www.cp4.hctx.net/mercer/index.htm. Anita Tiller thanks the Mercer volunteers and the Mercer Society, Mercer and Harris County staff, CPC sponsors, conservation advisors and collaborators, universities, colleges and the staffs of the USF&W, TNC, Natural Heritage offices, Flood Control offices, Katy Prairie Conservancy, BRIT and the CPC for their dedication, guidance and support.

Butterflies and Dragonflies of the Cajun Prairie:
Landscaping for Native Insects

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Abstract

Landscaping begins with a garden! As an alternative to a lawn, a natural garden centering upon habitat for butterflies and dragonflies native to the Cajun Prairie is recommended. This gardening experience involves creating a natural garden for ten common, local butterflies. Dragonflies are bonus features. Monitoring the garden is central to our concept.

Introduction

Nothing is more relaxing than to sit and watch the butterflies and dragonflies flitter about on a warm afternoon. As habitats have been lost to urbanization and the increasing population growth, these sites are becoming less frequent. In the last half of the last century, the preservation and restoration of native areas have become the focus of environmental groups and concerned individuals. These activities are increasing feverishly, and we advocate this!

In south Louisiana there is a concerted effort to restore and preserve the Cajun Prairie Ecosystem (Allain *et al.* 2000, Vidrine *et al.* 1995). The ecosystem is no longer intact; it has been literally plowed under by the agricultural machinery of the last century. Much of it today has been reduced to lawns in suburbia. The remainder of the prairie is burdened by intensive, modern agriculture.

However, small, seemingly intact remnants exist as right-of-ways along railroads and appear to be literally all that remains of the original one million hectares of Cajun Prairie.

These remnants too have received a large amount of physical and chemical disturbance by the railroad, local highway departments, and farms. Routine applications of biocides occur. Burning, an essential element necessary to sustain the prairie ecosystem, may be sporadic and in no way mimics historical patterns.

The Cajun Prairie restoration movement began at the beginning of the last decade of the twentieth century with a city park in Eunice known as the Cajun Prairie Restoration Project. More recent projects include much larger restoration efforts by the Lacassine National Wildlife Refuge, NRCS, National Wetland Center, etc. and smaller projects by LSUE and The Cajun Prairie Gardens. The restoration effort is now linked with native landscaping initiatives nationwide, and this paper centers on the essential need for an understanding of the role of insects both in the restoration process and in the restored landscape.

How does all of this restoration and landscaping relate to insects, especially butterflies and dragonflies? The answer is simple for butterflies and much more complex for dragonflies. Understanding and implementing both of the answers solves the puzzle of maintaining insect diversity. As a general response, habitat recreation is advocated both on large- and small-scale landscapes. The process must extend to waterways and include the whole ecosystem--air, land, water, and biota.

Methods

Gardening for Butterflies

It is important to begin the process by familiarizing oneself with the species most common to the area and their preferred habitats, food plants, oviposition (egg-laying) sites, food for the caterpillars and hibernation or over-wintering sites (Fontenot 1992). Louisiana has recorded 131 species of butterflies and skippers (Ross, 1994) with 54 species of butterflies occurring in the Cajun Prairie Ecosystem (Vidrine et al., 2001). Rather than try to target this large number of species, it is more prudent to identify and garden for perhaps 10 of the most numerous species native to the habitat. However, the most common butterflies in the Cajun Prairie region reflect the local weedy flora and the absence of diverse host plants for the caterpillars rather than maximizing local potential (Opler *et al.* 1995, Allen and Vidrine 1990, and Glassberg 2002). In order to improve butterfly diversity, gardening should at minimum account for the following butterflies:

A. gulf fritillaries (*Agraulis vanillae*),
B. common buckeyes (*Junonia coenia*),
C. pearl crescents (*Phycoides tharos*),
D. variegated fritillaries (*Euptoieta claudia*),
E. the sulfurs (*Phoebis sennae*, *Eurema lisa*, *Colias eurytheme*, and *Eurema nicippe*),
F. viceroys (*Limenitis archippus*),
G. swallowtails (*Papilio* spp. *Battus* philenor, and *Eurytides marcellus.*),
H. monarchs (*Danaus plexippus*),
I. question marks (*Polygonia interrogationis*), and
J. hairstreaks (*Calycopis cecrops* and *Strymon melinus*).

This gives the gardener the widest variety of commonly expected butterflies, which we consider an essential part of the Cajun Prairie butterfly garden. Adult butterflies need host plants for nectar (Table 1). A mixture of such plants is required in order to provide nectar through the seasons, even winter in southern Louisiana. The color of the flowers, the positioning of the plants in terms of creating large masses of single color, and flower types may

Asclepias spp. (milkweeds)
Buddleia spp. (butterfly bushes)
Eupatorium spp. (Joe-pye weed)
Sedum spp. (stonecrops)
Liatris spp. (blazing stars)
Aster spp. (asters)
Lantana spp. (lantanas)
Verbena spp. (vervains)
Echinacea spp. (coneflowers)
Tithonia spp. (Mexican sunflowers)
Zinnia spp. (zinnias)
Cosmos spp. (cosmos)
Hemerocallis spp. (daylilies)

Table 1. Nectar plants for adult butterflies.

also be considerations in garden design. Many nectar-rich plants are exotic and native weeds, that are loved by all kinds of insects; thus, the plants generally are either herbicided or if they are desirable insecticided. In either case, the adult butterflies are deprived of nectar during normal maintenance. It is also beneficial to include rotting fruit, feces, rotting meat, etc. for those species that are non-nectar feeders.

Larval butterflies (caterpillars) need specific plants for food as hosts (Table 2). Thus butterfly diversity is dependent upon plant diversity. Many of the needed plants are native 'weeds' that are not often considered desirable. Thus the plants are usually weeded or herbicided as part of most management protocols.

Butterfly	**Preferred host(s) for Caterpillars**
Buckeye	Figwort, vervain, and plantago families
Crescent, pearl	Asters
Fritillary, Gulf	Maypops (*Passiflora*)
Fritillary, variegated	Maypops, viola, flax
Hairstreak, gray	Mints, legumes (beans), and mallows(*Hibiscus*)
Hairstreak, striped	Oaks
Monarch	Milkweeds
Orange, sleepy	Legumes (bean family), partridge pea (*Cassia*)
Question mark	Nettles, hackberry
Sulphur, cloudless	Legumes (bean family)
Sulphur, little	Legumes (bean family)
Sulphur, orange	Legumes (bean family)
Swallowtail, black	Carrot family
Swallowtail, giant	Citrus family, toothache tree
Swallowtail, laurel	Redbay, sassafras, sweetbay
Swallowtail, pipevine	Pipevines (*Aristilochia*)
Swallowtail, spicebush	Spicebush and sassafras
Swallowtail, tiger	Willows, cottonwood, ashes, tulippoplar
Swallowtail, zebra	Pawpaw
Viceroy	Willows, poplars, cherries, plums

Table 2. Host plants for butterfly larvae.

Besides the plants of the garden, there are other considerations when enhancing the attractability of the garden setting for species in the area. Butterflies are "cold-blooded" and therefore require the warmth of the sun to warm their bodies. A sunny area with "basking" surfaces (i.e. flat stones with reflective surfaces) is an attractive feature. Butterflies congregate to areas of wet sand or gravel and the edges of mudpuddles in an activity called "puddling". These areas provide mineral supplements in the form of salts to the butterflies (Glassberg 2002). "Puddling" areas can easily be provided in the garden setting and enhanced by the addition of salts--their favorite sources are urine and sweat.

Gardening for Dragonflies

The Cajun Prairie ecosystem is home to a diverse Odonate community with 92 species of dragonflies and damselflies (Vidrine et al., 2001, Mauffray 1997, and Dunkel 2000). Adult dragonflies have relatively brief flight seasons; some fly for only month. Diversity of habitats provides for diversity of dragonflies. Dragonflies fall prey to birds, especially purple martins. Dragonflies eat lots of mosquitoes and other insects. Thus, spraying for insects and mosquitoes can severely disrupt their ecosystem.

Dragonfly larvae (nymphs) require specific aquatic habitats for development. Obviously, a diverse community of dragonflies requires a diverse number of kinds of habitats, e.g., ponds, swamps, marshes, creeks, rivers, etc. Some of these habitats are prone to mosquitoes; however, the nymphs prey upon the mosquito larvae. Nymphs are common prey of fish and crayfish.

A pond provides a limited habitat for dragonflies. The number of species that are able to reproduce in a pond varies directly with the size of the pond and the diversity of edge in the pond. Most gardeners will not be able to achieve habitat production but for a few common species of dragonflies. Gardening interest must necessarily focus upon habitat for the adult dragonflies--usually 'neglect' is the best gardening premise for increasing the number of dragonfly species. In other words, avoid biocides of all kinds. Obviously gardening for birds will compete with gardening for dragonflies, but this is an acceptable 'modus operandi.'

Prairie restoration and natural gardening reduce siltation in nearby waterways by reducing runoff typical of lawns and agricultural lands. The simple action of prevention of erosion is the most beneficial thing that we can do in order to preserve aquatic biodiversity of not only dragonfly nymphs but also all aquatic life. Creating ponds in the garden landscape slows runoff and provides habitat for dragonfly nymphs.

Garden Assessment

The new wave of gardeners is not satisfied with simply growing plants, insects, birds, etc. They have to monitor the changes in the garden. Then they take it a step further: using holistic methods, they modify the garden habitat to maintain and potentially increase biodiversity. There are a number of techniques that one can use to monitor the success of the garden including:

- Count the number of insects in a marked route or a set time from a single location
- Diversity index--identify the insects (namely butterflies and dragonflies) in a locale or a specific time
- Monitor numbers of an individual insect, e.g. monarch butterfly

Results

Gardening in the Cajun Prairie has provided a beautiful, diverse setting to attract popular native insects. Ninety-two species of Odonata (dragonflies and damselflies) and 54 Lepidoptera (butterflies, excluding skippers and moths) have been recorded in the Cajun Prairie ecosystem and associated habitats (Vidrine et al., 2001).

Discussion

In order to appreciate the very delicate balance that is required to maintain plant and animal diversity, sustainability of a garden habitat must become a central theme in management. In an awkward turn of events, fertilizer, once thought to be universally beneficial, causes abnormal growth and electrolyte imbalances that ricochet through the ecosystem often neutralizing efforts to balance air, soil, water, and biota in the garden.

The Cajun Prairie Gardens were created on a rural lot in a subdivision constructed from a burnt-out rice field. Although historically disturbed, the gardens demonstrate landscaping using Cajun Prairie plants. The gardens re-establish the native plant communities, and the insects have also returned to the area. Establishing these native gardens provides a tremendous opportunity to get the whole family involved and participate in habit preservation and increase the number of butterflies and dragonflies in the area. Patience is truly a virtue in these projects. Attracting butterflies to the area takes time, but in turn these butterflies will attract other insects and animals.

Our proposition to gardeners is simple. Select a location in your yard and dedicate it to a butterfly garden. Be modest in your initial plan! Plan for ten or a dozen different butterflies! Provide everything they need in order to survive and propagate! Take our suggested list of ten major butterflies for the Cajun Prairie and:

A. plant good to modest amounts of nectar plants for the adults (see Table 1)
B. plant modest to large amounts of host plants for the larvae (see Table 2)
C. make a small pond with sand available for puddling butterflies and dragonfly nymphs
D. encourage birds and other animals to stay in other parts of the yard or neighborhood
E. provide fruit, rotting meat, etc. for non-nectar feeding adults
F. monitor the garden and add plants in order to add butterflies!

This is basically all that is necessary for the creation of a butterfly and a dragonfly habitat. The dragonflies are a bonus (a reward) for creating the butterfly garden. Dragonflies are a bit more challenging for identification, but they are usually color-coded. Males and females and tenerals are each a different color or pattern of color.

Nearly one hundred species of dragonflies and damselflies are native to the Cajun Prairie. During a year, at least half of them should be seen. A short list of some of the more common dragonflies and damselflies usually encountered can be found in Table 3. They are very seasonal in their flights, and each has a unique approach to the habitat. For example, smaller dragons and damsels stay near your feet, while larger species tend to command higher branches and the sky. Open sunny perches provide the best view of the adults.

Argia tibialis (Rambur) blue-tipped dancer
Enallagma civile (Hagen) familiar bluet
Ischnura (Anomalagrion) hastata (Say) citrine forktail
Ischnura ramburii (Selys) Rambur's forktail
Anax junius (Drury) common green darner
Coryphaeschna ingens (Rambur) regal darner
Epiaeschna heros (Fabricius) swamp darner
Aphylla angustifolia Garrison broad-striped forceptail
Arigomphus submedianus (Williamson) jade clubtail
Dromogomphus spinosus (Selys) black-shouldered spineyleg
Epicordulia princeps Hagen prince baskettail
Epitheca (Tetragoneuria) cynosura (Say) common baskettail
Brachymesia gravida (Calvert) four-spotted pennant
Celithemis eponina (Drury) Halloween pennant
Erythemis simplicicollis (Say) eastern pondhawk
Libellula auripennis Burmeister golden-winged skimmer
Orthemis ferruginea (Fabricius) roseate skimmer
Pachydiplax longipennis (Burmeister) blue dasher
Pantala flavescens (Fabricius) wandering glider
Pantala hymenaea (Say) spot-winged glider
Perithemis tenera (Say) eastern amberwing
Libellula (Plathemis) lydia (Drury) common whitetail
Sympetrum corruptum (Hagen) variegated meadowhawk
Tramea carolina (Linnaeus) Carolina saddlebags
Tramea lacerata Hagen black saddlebags

Table 3. Common dragonflies and damselflies of the garden.

Creating a starter garden based upon our simple design should be:

- ecologically sound
- inexpensive and adventurous
- educational and fun
- an opportunity to expand upon the original design

We want to emphasize the latter. The undertaking is an opportunity to design your own garden and build toward a more diverse layout that elaborates upon your own goals in the gardenscape.

The biggest problem is winterizing the garden. Using native plants is key to the garden, since they are resistant to the typical winter extremes. However, many of these plants thrive upon fire--an annual burn. Even *Hemerocallis, Buddleia* and *Lantana* withstand winter (dormancy) fires! Mowing or bushhogging are acceptable alternatives as winterizing options. Burning does however destroy insects that overwinter in the garden stems; thus the development of a large garden is necessary in order to create a mosaic sufficient to provide for all concerns.

As a final gardening suggestion: try creating a prairie (meadow) with native plants. You will be surprised each day by new flowers blooming and numerous insect visitors/residents of the natural garden. It is our hope that this millennium will bring new meaning to preservation and conservation practices, such that each garden is viewed as part of a larger whole--the ecosystem.

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Field Trip #1
East Texas Overview

Mark Bronstad
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Warren, TX

Dogwood Trails Plant List

Woody Plants:

Acer rubrum	Red Maple
Acer sacharinum	Sugar Maple
Aesculus pavia	Red Buckeye
Alnus serrulata	Hazel Alder
Arailia spinosa	Devil's Walking Stick
Aronia arbutifolia	Chokecherry
Asimina triloba	Dwarf Pawpaw
Betula nigra	River Birch
Callicarpa Americana	American Beautyberry
Carpinus caroliniana	Hornbeam
Carya cordiformis	Bitternut Hickory
Carya tomentosa	Mockernut Hickory
Cephalanthus occidentalis	Common Buttonbush
Cercis Canadensis	Eastern Redbud
Chionanthus virginicus	Fringetree
Cornus florida	Flowering Dogwood
Crataegus brachycantha	Blueberry Hawthorn
Crataegus marshalii	Parsley Hawthorn
Crataegus opaca	May Hawthorn
Cyrilla racemiflora	Leatherwood
Euonymous Americana	Strawberry Bush
Fagus grandifolia	American Beech
Fraxinis pensylvatica	Green Ash
Halesia diptera	Two-winged Silverbell
Hamamelis virginica	Witch Hazel
Ilex opaca	American Holly
Ilex vomitoria	Yaupon
Itea virginiana	Virginia Sweetspire
Juniperus virginiana	Eastern Redcedar
Liquidambar styraciflua	Sweetgum
Magnolia grandiflora	Southern Magnolia
Magnolia virginiana	Sweetbay Magnolia
Morus rubra	Red Mulberry
Myrica cerifera	Wax Myrtle
Ostrya virginiana	Hophornbeam

Persea borbonia	Red Bay
Pinus echinata	Shortleaf Pine
Pinus palustrus	Longleaf Pine
Pinus taeda	Lobloly Pine
Platanus occidentalis	Sycamore
Prunus mexicana	Mexican Plum
Prunus serrotina	Black Cherry
Quercus alba	White Oak
Quercus michauxii	Swamp Chestnut Oak
Quercus nigra	Water Oak
Quercus phellos	Willow Oak
Rhamnas caroliniana	Carolina Buckthorn
Rhododendron canescens	Piedmont Azalea
Rhododendron oblongifolia	White Azalea
Rhus copallina	Shining Sumac
Sabal minor	Palmetto
Sassafras albidum	Sasafras
Styrax Americana	American Snowbell
Symplocos tinctoria	Horse Sugar
Taxodium distichum	Bald Cypress
Ulmus alata	Winged Elm
Ulmus Americana	American Elm
Viburnum dentatum	Arrowood Viburnum
Viburnum rufidulum	Rustyblackhaw Viburnum

Herbaceous Plants

Arisaema dracontium	Green Dragon
Arisaema quinatum	Five Leaved Jack-in-the-pulpit
Tradescantia hirsutiflora	Hairy-flowered Spiderwort
Lilium michauxii	Carolina Lily
Erythronium rostratum	Trout Lily
Polygonatum biflorum	Great Solomon Seal
Hypoxis hirsute	Yellow Star-grass
Habenaria clavellata	Green Rein Orchid
Corallorhiza wisteriana	Spring Coral Root
Claytonia virginica	Spring Beauty
Podophyllum peltatum	May Apple
Cardamine bulbosa	Spring Cress
Oxalis violacea	Wood Sorrel
Viola walteri	Walter's Violet
Monotropa uniflora	Indian Pipe
Gelsemium sempervirens	Carolina jessamine
Asclepias variegata	White Flowered Milkweed

Salvia lyrata	Lyre-leaf Sage
Penstemon laxiflorus	Loose-flowered Penstemon
Bignonia capreolata	Cross-vine
Campsis radicans	Trumpet-creeper
Epifagus virginiana	Beech-drops
Ruellia nudiflora	Violet Ruellia
Mitchella repens	Partridge Berry
Lonicera sempervirens	Coral Honeysuckle
Wahlenbergia marginata	Wahlenbergia
Chasmanthium	Inland Sea Oats
Polystichum acrosticoides	Christmas Fern
Thelyteris kunthii	Wood Fern

Field Trip #2
Little Cow Creek

Matt Welch
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Nacogdoches, TX 75962-3000

Acer leucoderme
Acer rubrum
Aralia spinosa
Asimina parviflora
Callicarpa americana
Carpinus caroliniana
Carya texana
Castanea sp.
Celtis sp.
Chionanthus virginicus
Cornus florida
Crataegus brachyacantha
Crataegus marshallii
Crataegus mollis type
Crataegus pearsonii
Crataegus spathulata
Cyrilla racemiflora
Fagus grandiflora
Fraxinus pennsylvatica
Halesia diptera
Hamamelis vernalis
Hamamelis virginiana
Ilex ambigua
Ilex coriacea
Ilex longipes
Ilex opaca
Ilex vomitoria
Itea virginica
Liquidambar styraciflua
Magnolia grandiflora
Magnolia virginiana
Myrica cerifera
Myrica heterophylla
Nyssa sylvatica
Ostrya virginiana

Persea borbonia
Pinus taeda
Prunus umbellata
Quercus alba
Quercus falcata
Quercus marilandica
Quercus nigra
Quercus phellos
Rhamnus caroliniana
Rhododendron canescens
Rhus copillina
Sassafras albidum
Smilax bona-nox
Smilax laurelifolia
Stewartia malacodendron
Styrax grandifolius
Symplocos tinctoria
Tillia caroliniana
Ulnus serrulata
Vaccinium anomeum
Vaccinium arboreum
Vaccinium arkansanum
Viburnum acerifolia
Viburnum dentatum
Viburnum rufidulum
Viburnun nudum
Vitis rotundifolia

Field Trip #3
Naconiche Creek

Larry Shelton
15449 FM 1878
Nacogdoches, TX 75961

WOODY PLANTS

Scientific Name	**Common Name**
Acer rubrum	red maple
Alnus serrulata	witch alder
Betula nigra	river birch
Bartonia spp.	screw stems
Cornus florida	flowering dogwood
Euonymous americanus	spindletree
Fagus grandifolia	American beech
Itea virginica	Virginia sweetspire
Ilex glabra	gallberry holly
Ilex opaca	American holly
Liquidambar styraciflua	sweetgum
Lycopodium spp.	clubmoss
Lyonia ligustrina	huckleberry
Lyonia mariana	stagerbush
Magnolia virginiana	sweetbay magnolia
Myrica spp.	wax myrtle
Nyssa sylvatica	black gum
Pinus taeda	loblolly pine
Quercus alba	white oak
Quercus nigra	water oak
Quercus phellos	willow oak
Rhus toxicodendron	poison ivy
Rhus vernix	poison sumac
Sambucus canadensis	elderberry
Rubus spp.	dewberry
Smilax spp.	greenbriar
Vacciniun corymbosum	elliott's blueberry
Viburnum nitidum	shiny viburnum
Viburnum nudum	possumhaw viburnum
Vitis spp.	grape

HERBACEOUS PLANTS

Scientific Name	**Common Name**
Apteria aphylla	nodding nixie
Ariseama triphyllum	jack-in-the-pulpit

Bartonia texana	Texas screwstem
Boehmeria cylindrica	small-spike false nettle
Burmannia biflora	two flower burmannia
Burmannia capitata	cap burmannia
Carex spp.	sedge
Commelina spp.	day flower
Eupatorium fistulosum	joe pye weed
Hydrocotyle spp.	penny wort
Hypericum walteri	Walter's St. John's wort
Hypericum spp.	St. John's worts
Listera australis	tway blade orchid
Mayaca aublettii	bog moss
Melanthium virginicum	bunch flower
Osmunda cinnomomea	cimmamon fern
Osmunda regalis	royal fern
Onoclea sensibilis	sensitive fern
Parnassia assarifolia	grass of parnassas
Plantanthera ciliaris	yellow fringe orchid
Plantanthera clavellata	small wood orchid
Habenaria repens	Nuttall habenaria
Pogonia ophioglossoides	rose pogonia
Saururus cernuus	common lizard tail
Solidago spp.	goldenrod
Viola spp.	violets
Woodwardia areolata	chain fern

Field Trip #4
Mill Creek Gardens and Local Stops

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Preliminary Checklist of the Vascular Plants of The Pineywoods Native Plant Center, Nacogdoches County, Texas

Spring Flora March 27 & 28 1999

Singhurst J.R., M. Norman, and H. Gaylord

Singhurst, Norman, and Gaylord (1999) base this checklist of the vascular plants Tucker Estate on reports and excursions on the property. Nomenclature follows Correll and Johnston (1970) and Johnston's update (1990). Common names follow Correll and Johnston or Hatch et al. (1990). The list is intended to document the species present immediately prior to PNPC development. Additions to this checklist are anticipated and in the absence of voucher specimens, this list should not be considered authoritative.

CONIFERS

CUPRESSACEAE	**CYPRESS FAMILY**
Juniperus virginiana	eastern red cedar
PINACEAE	**PINE FAMILY**
Pinus taeda	loblolly pine
Pinus echinata	shortleaf pine
TAXODIACEAE	**TAXODIUM FAMILY**
Taxodium distichum	bald cypress

FERNS AND FERN-ALLIES

ASPLENIACEAE	**SPLEENWORT FAMILY**
Asplenium platyneuron	ebony spleenwort
DENNSTAEDTIACEAE	**BRACKEN FERN FAMILY**
Pteridium aquilinum	tailed bracken fern
OPHIOGLOSSACEA	**ADDER'S TONGUE FERN FAMILY**
Botrychium dissectum	lace frond grape fern
Botrychium virginianum	rattlesnake fern

POLYPODIACEAE	**POLYPODY FERN FAMILY**
Anthrinum felix-femina	downy maiden fern
Polypodium plypodioides	resurrection fern
SCHIZAEACEAE	**CLIMBING FERN FAMILY**
Lygodium japonicum	Japanese climbing fern
WOODSIACEAE	**CLIFF FERN FAMILY**
Onoclea sensibilis	sensitive fern
Woodsia obtusa	blunt lobed cliff fern

FLOWERING PLANTS

ACANTHACEAE	**ACANTHUS FAMILY**
Ruellia humilis	low ruellia
ACERACEAE	**MAPLE FAMILY**
Acer negundo	boxelder
Acer saccharum	sugar maple
Acer rubrum	red maple
AIZOACEAE	**CARPETWEED FAMILY**
Mullugo verticillata	Indian chickweed
AMARANTHACEAE	**AMARANTH FAMILY**
Amaranthus sp.	amaranth
ANACARDIACEAE	**SUMAC FAMILY**
Rhus aromatica	fragrant sumac
Rhus glabra	smooth sumac
Rhus toxicodendron	poison ivy
ANNONACEAE	**CUSTARD APPLE FAMILY**
Asimina triloba	pawpaw
APIACEAE	**CARROT FAMILY**
Cicuta maculata	water hemlock
Hydrocotyle verticillata	whorled pennywort
Sanicula canadensis	Canada sanicle
AQUIFOLIACEAE	**HOLLY FAMILY**
Ilex opaca	American holly
Ilex decidua	deciduous holly
Ilex vomitoria	yaupon holly

ARACEAE	**ARUM FAMILY**
Arisaema dracontium	green dragon
Arisaema triphyllum	jack-in-the-pulpit
ARALIACEAE	**GINSENG FAMILY**
Aralia spinosa	Devil's walking stick
Hedra helix	English ivy (introduced)
AREACEAE	**PALM FAMILY**
Sabal minor	dwarf palmetto
ARISTILOCHIACEAE	**BIRTHWORT FAMILY**
Aristolochia seperentaria	Virginia dutchman's pipe
ASCLEPIADACEAE	**MILKWEED FAMILY**
Matelea gonocarpa	milkweed vine
ASTERACEAE	**SUNFLOWER FAMILY**
Achillea millifolium	common yarrow (intoduced)
Antennaria parlinii	pussytoes
Aster patens	skydrop aster
Bidens sp.	beggarticks
Chaetopappa asteroides	common least daisy
Cirsium sp.	thistle
Conyza canadensis	horse weed conyza
Elephantopus tomentosus	hairy elephant foot
Erigeron strigosus	prairie fleabane
Eupatorium capillifolium	dog fennel
Eupatorium coelistinum	blue mist flower
Eupatorium sp.	eupatorium
Gamochaeta purpureum	greenleaf cudweed
Gnaphilium obtusifolium	fragrant cudweed
Helenium amarum	bitter sneezeweed
Helianthus sp.	sunflower
Krigia caespitosa	weedy dwarf dandelion
Krigia dandelion	tuber dwarf dandelion
Lactuca ludoviciana	wild lettuce
Lactuca sp.	wild lettuce
Senecio obovatus	golden groundsel
Solidago auriculata	clasping leaf goldenrod
Solidago sp.	solidago
Soliva pterosperma	lawn burweed
Sonchus asper	spiny leaved sawthistle
Taraxacum officinale	common dandelion
Verbesina virginica	frostweed
Vernonia sp.	ironweed

BERBERIDACEAE	**BARBERRY FAMILY**
Nandina domestica	nandina
Podophyllum peltatum	may apple
BETULACEAE	**BIRCH FAMILY**
Carpinus caroliniana	blue beech
Ostrya virginiana	eastern hophornbeam
Betula nigra	river birch
BORAGINACEAE	**BORAGE FAMILY**
Myosotis macropsperma	spring forget me not
BRASSICACEAE	**MUSTARD FAMILY**
Capsella bursa-patoris	shepard's purse
Cardamine bulbosa	spring cress
Lepedium virginicum	poor man's peppergrass
CACTACEAE	**CACTUS FAMILY**
Opuntia stricta	southern spineless cactus
CAMPANULACEAE	**BLUEBELL FAMILY**
Lobelia cardinalis	cardinal flower
Triodanis perfoliata	clasping Venus lookingglass
CAPRIFOLIACEAE	**HONEYSUCKLE FAMILY**
Lonicera japonica	Japanese honeysuckle
Sambucus candensis	common elderberry
Viburnum rufidulum	blackhaw viburnum
CARYOPHYLLACEAE	**PINK FAMILY**
Cerastium brachypodum	shortstalk chickweed
Cerastium glomeratum	clustered flowered chickweed
Sagina decumbens	pearlwort
Spergula arvensis	corn spury
Stellaria media	common chickweed
CISTACEAE	**ROCKROSE FAMILY**
Lechea mucronata	hairy pinweed
Lechea tenuifolia	narrowleaf pinweed
CLUSSIACEAE	**ST. JOHN'S WORT FAMILY**
Hypericum hypericoides	St. Andrew's cross
Hypericum stans	St. Peterswort
Hypericum walteri	Walter's St. John's wort

COMMELINACEAE	**SPIDERWORT FAMILY**
Commelina erecta	erect dayflower
Commelina virginica	Virginia dayflower
Tradescantia hirsutiflora	hairy spiderwort
CONVOLVULACEAE	**MORNING GLORY FAMILY**
Dichondra carolinensis	ponyfoot
CORNACEAE	**DOGWOOD FAMILY**
Cornus florida	flowering dogwood
Nyssa sylvatica	black gum
CYPERACEAE	**SEDGE FAMILY**
Carex amphiloba	amphibious sedge
Carex caroliniana	Carolina sedge
Carex crus-corvi	crowfoot sedge
Carex sp.	sedge
Carex sp.	sedge
Cyperus esculentus	yellow nutsedge
Cyperus retroflexus	oneflower flatsedge
Eleocharis sp.	spikerush
Fimbristylis sp.	fimbry
Scirpus koilolepis	small bullrush
Scirpus sp.	bullrush
EBENACEAE	**PERSIMMON FAMILY**
Diospyrus virginiana	common persimmon
ERICACEAE	**HEATH FAMILY**
Vaccinium arboreum	farkleberry
EUPHORBACAE	**SPURGE FAMILY**
Acalypha gracilens	slender three seeded mercury
Acalypha ostrayefolia	three seeded mercury
Cnidosculus texanus	bull nettle
Croton capitatus	wooly croton
Sapium sebiferum	Chinese tallow tree
Tragia sp.	noseburn
FABACEAE	**LEGUME FAMILY**
Albizia julibrissin	mimosa tree
Cercis canadensis	red bud
Chamaecrista fasiculata	partridge pea
Desmodium sp.	beggar's ticks
Desmodium sp.	beggar's ticks
Galactia glabella	downy milkpea

Lespedeza sp.	bush clover
Trifolium campestre	low hop clover
Trifolium incarnatum	crimson clover
Trifolium repens	white clover
Viccia caroliniana	Carolina vetch
Viccia ludoviciana	deer vetch
FAGACEAE	**BEECH FAMILY**
Quercus alba	white oak
Quercus falcata	southern red oak
Quercus lyrata	overcup oak
Quercus marilandica	blackjack oak
Quercus michauxii	swamp chestnut oak
Qurcus nigra	water oak
Quercus nuttallii	Nuttall oak
Quercus phellos	willow oak
Quercus shumardii	shumard oak
Quercus similis	bottomland post oak
Quercus stellata	post oak
Quercus velutina	black oak
GERANIACEAE	**GERANIUM FAMILY**
Geranium carolinianum	Carolina geranium
HAMAMELIDACEAE	**WITCH HAZEL FAMILY**
Liquidambar styraciflua	sweetgum
HIPPOCASTANACEAE	**BUCKEYE FAMILY**
Aesculus pavia	red buckeye
IRIDACEAE	**IRIS FAMILY**
Sisyrinchium exile	blue-eyed grass
JUGLANDACEAE	**WALNUT FAMILY**
Carya cordiformis	bitternut hickory
Carya ovata	shagbark hickory
Carya texana	black hickory
Carya tomentosa	mockernut hickory
Juglans nigra	black walnut
LAMIACEAE	**MINT FAMILY**
Lamium amplexicaule	henbit
Prunella vulgaris	common selfheal
Scutellaria cardiophylla	heartleaf skullcap

LAURACEAE	**LAUREL FAMILY**
Sassafras albidum	sassafras
LILIACEAE	**LILY FAMILY**
Allium canadense	Canada garlic
Allium drummondii	Drummond's onion
Camassia scilloides	wild hyacinth
Erythronium albidum	white trout lily
Hypoxis hirsuta	common goldenstar
Lilium michauxii	Carolina lily
Nothoscordum bivalve	false garlic
Polygonatum biflorum	Solomon's seal
Smilax bona-nox	saw greenbriar
Smilax glauca	cat greenbriar
Smilax hispida	bristly greenbriar
Smilax laurifolia	laurel greenbrar
Smilax rotundifolia	common greenbriar
Yucca louisianensis	Louisiana yucca
LOGANIACEAE	**LOGONIA FAMILY**
Gelsemium sempervirens	Carolina jessamine
Polypremum procumbens	juniper leaf
MAGNOLIACEAE	**MAGNOLIA FAMILY**
Magnolia grandiflora	southern magnolia
MALVACEAE	**MALLOW FAMILY**
Modiola caroliniana	modiola
Sida rhombifolia	diamondleaf mallow
MENISPERMACEAE	**MOONSEED FAMILY**
Cocculus carolinus	Carolina snailseed
MORACEAE	**MULBERRY FAMILY**
Morus rubra	red mulberry
Maclura pomifera	Bois d'arc
MYRICACEAE	**WAXMYRTLE FAMILY**
Myrica heterophylla	waxmyrtle
OLEACEAE	**OLIVE FAMILY**
Fraxinus americana	white ash
Fraxinus pennsylvanica	green ash
Ligustrum sinense	Chinese privet

ONAGRACEAE	**EVENING PRIMROSE FAMILY**
Ludwegia sp.	seedbox
Oenothera laciniata	cutleaf evening primrose
Oenothera speciosa	showy evening primrose
OXALIDACEAE	**WOOD SORREL FAMILY**
Oxalis dillenii	yellow wood sorrel
Oxalis violacea	violet wood sorrel
PAPAVERACEAE	**POPPY FAMILY**
Corydalis micrantha	scrambled eggs
Sanguinaria canadensis	bloodroot
PASIFLORACEAE	**PASSION FLOWER FAMILY**
Passiflora lutea	yellow passion flower
PHRYMACEAE	**LOPSEED FAMILY**
Phryma leptostachya	lopseed
PHYTOLACACCEAE	**POKEWEED FAMILY**
Phytolacca americana	pokeweed
PLANTAGINACEAE	**PLANTAIN FAMILY**
Plantago lanceolata	English plantain
POACEAE	**GRASS FAMILY**
Andropogon glomeratus	bushy bluestem
Andropogon virginicus	broomsedge bluestem
Arundinaria gigantea	switch cane
Briza minor	little quaking grass
Chasmanthium latifolium	broadleaf chasmanthium
Chasmanthium sessiliflorum	sessile flowered chasmanthium
Cynodon dactylon	Bermuda grass
Digitaria ciliaris	southern crabgrass
Elymus virginicus	Virginia wildrye
Melica mutica	twoflower melic
Oplismenus hirtellus	basketgrass
Panicum sp.	panicum
Panicum sp.	panicum
Paspalum urvillei	vaseygrass
Poa annua	annual bluegrass
Stenotaphrum secundatum	St. Augustine grass
Stipa leucotricha	Texas wintergrass
Tridens flavus	purple top

PLANTANACEAE	**PLANE TREE FAMILY**
Plantanus occidentalis	sycamore
POLEMONIACEAE	**PHLOX FAMILY**
Phlox pilosa	downy phlox
POLYGONACEAE	**KNOTWEED FAMILY**
Polygonum sp.	Smartweed
Rumex hastatulus	heartwing dock
PORTULACACEAE	**PURSLANE FAMILY**
Claytonia virginica	spring beauty
RANUNCULACEAE	**BUTTERCUP FAMILY**
Ranunculus sp.	buttercup
RHAMNACEAE	**BUCKTHORN FAMILY**
Berchemia scandens	Albama supplejack
Rhamnus caroliniana	Carolina buckthorn
ROSEACEAE	**ROSE FAMILY**
Agrimonia microcarpa	slender agrimony
Crataegus marshallii	parsley hawthorn
Crataegus spathulata	pasture haw
Duchesni indica	Indian strawberry
Geum canadense	white avens
Prunus caroliniana	Carolina cherry laurel
Prunus mexicana	Mexican plum
Prunus serotina	black cherry
Rosa multiflora	Japanese rose
Rubus trivalis	southern dewberry
RUBIACEAE	**MADDER FAMILY**
Diodia teres	rough buttonweed
Diodia virginiana	Virginia buttonweed
Galium aparine	catcweed bedstraw
Hedyotis crassifolia	small bluets
Mitchella repens	partridge pea
RUTACEAE	**CITRUS FAMILY**
Zanthoxylum clava-herculis	prickly ash
SALICACEAE	**WILLOW FAMILY**
Salix nigra	black willow
Populus deltoides	eastern cottonwood

SAPOTACEAE	**SAPODILLA FAMILY**
Bumelia lanuginosa	woolybucket bumelia
SAXIFRAGACEAE	**SAXIFRAGE FAMILY**
Lepuropetalon spathulatum	lepuropetalon
SCROPHORULACEAE	**FIGWORT FAMILY**
Castilleja indivisa	Texas Indian paintbrush
Veronica peregrina	purslane spedwell
SOLANACEAE	**NIGHTSHADE FAMILY**
Physalis sp.	ground cherry
Solanum carolinense	Carolina horse nettle
TILIACEAE	**LINDEN FAMILY**
Tilia americana	American basswood
ULMACEAE	**ELM FAMILY**
Celtis laevigata	Texas sugarberry
Ulmus americana	American elm
Ulmus crassifolia	cedar elm
Ulmus rubra	slippery elm
URTICACEAE	**NETTLE FAMILY**
Boehmeria cylindrica	false nettle
Urtica chamaedryoides	heartleaf nettle
VALERIANACEAE	**VALERIAN FAMILY**
Valerianella radiata	beaked cornsalad
VERBENACEAE	**VERVAIN FAMILY**
Callicarpa americana	American beautyberry
Phyla lanceolata	northern frog fruit
Verbena officinale	Texas verbena
VIOLACEAE	**VIOLET FAMILY**
Viola rafinesquii	field pansy
Viola walteri	Walter's violet
Viola sp.	violet
VITACEAE	**GRAPE FAMILY**
Ampelopsis arborea	peppervine
Parthenocissus quinquefolia	Virginia creeper
Vitis aestivalis	summer grape
Vitis mustangensis	mustang grape
Vitis rotundifolia	muscadine grape

Field Trip #5
Weches Outcrop

Peter Loos
P.O. Box 520
Chireno, TX 75937

Plant List for Weches Outcrop/ Stewart Ranch

Weches Outcrop

1. Water Oak, *Quercus nigra*
2. Chinkapin Oak, *Quercus muhlenbergia*
3. Lanceleaf Buckthorn, *Rhamnus lanceolata*
4. Wild Privet, *Foresteria ligustrina*
5. Rusty Blackhaw, *Viburnum rufidulum*
6. Eve's Necklace, *Sophora affinis*
7. Roughleaf Dogwood, *Cornus drummondii*
8. Red Buckeye, *Aesculus pavia*
9. Eastern Red Cedar, *Juniperus virginiana*
10. Possumhaw Holly, *Ilex decidua*
11. Youpon, *Ilex vomitoria*
12. Hercules Club, *Zanthoxylum clava-herculis*
13. Green Haw, *Crataegus virdis*
14. Sweetgum, *Liquidambar styraciflua*
15. Locust, *gledistia triacanthos*
16. Wild Onion, *Allium canadense*
17. Windflower, *Anemone sp.*
18. Whorled Milkweed, *Asclepias verticillata*
19. Sundrops, *Calylophus drummondianus*
20. White Bladderpod, *Lesquerella pallida*
21. Gayfeather, *Liatris mucronata*
22. Beebalm, *monarda citridora*
23. Crow Posion, *Nothoscordum bivalve*
24. Showy Evening Primrose, *Oenothera speciosa*
25. Palafoxia, *Palafoxia rosea*
26. Lyreleaf Sage, *Salvia lyrata*
27. Prairie Clover, *Petelostemon pulcherrimum*
28. Meadow Pink, *Sabatia campestris*
29. Sedum, *Sedum pulchellum*
30. False Aloe, *Agave virginica*
31. Blue-eyed Grass, *Sisyrinchium spp.*
32. Butterfly Weed, *Asclepias tuberosa*
33. Prairie Phlox, ***Phlox pilosa***
34. Larkspur, *Delphinium sp.*
35. Wild Petunia, *Ruellia humilis*
36. Wild Petunia, *Ruellia pedunculata*

37. Aster, *Aster texanus*
38. Aster, *Aster subulatus*
39. Lady's Tress, *Spiranthes cernua*
40. Heal All, *Prunella vulgaris*
41. Violet, *Viola rafinesquii*
42. Violet, *Viola pratincola*
43. Dock, *Rumex pulcher*
44. Senna, *Cassia obtusifolia*
45. Hedeoma, *Hedeoma hispidum*
46. Arkansas Savory, *Satureja arkansana*
47. Side Oats Grama, *Bouteloua curtipendula*
48. Quaking Grass, *Briza minor*
49. Beaked Panicum, *Panicum anceps*
50. Panicum, *Panicum hallii*
51. Sedge, *Carex muhlenbergii*
52. Dropseed, *Sporobulus asper*
53. Purpletop Grass, *Tridens flavus*
54. Peppergrass, *Lepidium virginicum*
55. Leavenworthia, *Leavenworthia texana*
56. Poa Grass, *poa annua*
57. Love Grass, *Eragrostis hirsuta*
58. 3 Awn Grass, *Aristida spp.*

Stewart Ranch

1. Loblolly Pine, *Pinus Taeda*
2. Georgia Holly, *Ilex longipes*
3. Rusty Blackhaw, *Viburnum rufidulum*
4. Possunhaw Viburnum, *Viburnum nudum*
5. Arrowwood Viburnum, *Viburnum dentatum*
6. Willow Oak, *Quercus phellos*
7. White Oak, *Quercus alba*
8. Overcup Oak, *Quercus lyrata*
9. Water Oak, *Quercus nigra*
10. Blueberry, *Vaccinium anomeum*
11. Deerberry, *Vaccinium staninium*
12. Farkleberry, *Vaccinium arboreum*
13. Mapleleaf Viburnum, *Viburnum acerifolia*
14. Witch Hazel, *Hamamelis virginiana*
15. Sassafras, *Sassafras albidium*
16. Black Hickory, *Carya texana*
17. Mockernut Hickory, *Carya tomentosa*
18. Red Maple, *Acer rubrum*
19. Florida Sugar Maple, *Acer barbatum*

20. Paw Paw, *Asimina triloba*
21. Muscadine Grape, *Vitis rotundifolia*
22. American Holly, *Ilex opaca*
23. Hop Tree/ Wafer Ash, *Ptelea trifoliata*
24. Green Ash, *Fraxinus pennsylvatica*
25. Youpon, *Ilex vomitoria*
26. Hoary Azalea, *Rhododendron canescens*
27. Hazel Alder, *Alnus serrulata*
28. Southern Magnolia, *Magnolia grandiflora*
29. Sweetbay Magnolia, *Magnolia virginiana*
30. Beech, *Fagus grandiflora*
31. Blackgum, *Nyssa sylvatica*
32. Strawberry Bush, *Euonymous americana*
33. Virginia Sweetspire, *Itea virginica*
34. Mayhaw, *Crataegus opaca*
35. Hawthorn, *Crataegus sp.*
36. Parsley Hawthorn, *Crataegus marshallii*
37. Sweetleaf, *Symplocos tinctoria*
38. Devil's walking Stick, *Aralia spinosa*
39. Palmetto, *Sabal minor*
40. Cat Briar, *Smilax bona-nox*
41. Cat Briar, *Smilax laurelifolia*
42. Cat Briar, *Smilax pumila*
43. Dogwood, *Cornus florida*
44. Swamp Privet, *Foresteria acuminata*
45. Royal Fern, *Osmunda regalis*
46. Cinnamon Fern, *Osmunda cinnamonea*
47. Elderberry, *Sambucus canadensis*
48. Crossvine, *Bignonia capreolata*
49. Red Buckeye, *Aesculus pavia*
50. Silverbell, *Halesia diptera*
51. Fringe Tree, *Chionanthus virginiana*
52. Ironwood, *Carpinus caroliniana*
53. Hop Hornbeam, *Ostyra virginiana*
54. Sweetgum, *Liquidambar styraciflua*
55. Sumac, *Rhus copallina*
56. Aromatic Sumac, *Rhus aromatica*
57. Indian Cherry, *Rhamnus caroliniana*
58. New Jersey Tea, *Ceanothus americanus*
59. Red Bay, *Persea borbonia*
60. Netted Chain Fern, *Woodwardia areolata*
61. Violet, *Viola sp.*
62. Walter's Violet, *Viola walterii*
63. Partridge Berry, *Mitchella repens*
64. Cardinal Flower, *Lobelia cardinalis*

65. Dewberry, *Rubus sp.*
66. Lady Fern, *Athyrium felix-femina*
67. Bracken Fern, *Pteridium aquilinum*
68. Jack-in-the-pulpit, *Arisaema triphyllum*
69. Solomon's Seal, *Polygonatum biflorum*
70. Wake Robin, *Trillium gracile*
71. Mayapple, *Podophyllum peltatum*
72. Southern Twayblade, *Listera australis*
73. Spring Coralroot, *Corallorhiza wisteriana*
74. Indian Pipe, *Monotropa uniflora*
75. Carolina Jessamine, *Gelsemium sempervirens*
76. White-flowered Milkweed, *Asclepias variegata*
77. Mountain Mint, *Pycnanthemum albescens*
78. Beech Drops, *Epifagus virginiana*
79. Catchfly, *Silene subcillata*
80. Cabbageleaf Coneflower, *Rudeckia maxima*
81. Pink Scale Gayfeather, *Liatris elegans*
82. Asters (numerous), *Aster spp.*
83. Goldenrods (several) *Solidago spp.*
84. Camphor Weed, *Pluchea camphorata*
85. Eastern Gamma Grass,*Tripsacum dactyloides*
86. Switch Grass, *Panicum virgatum*
87. Panicum Grass (several), *Dichanthelium spp.*

BIOS OF SPEAKERS AND TOUR LEADERS

Charles Allen is a Professor of Biology at the University of Louisiana at Monroe and a charter member of the Louisiana Native Plant Society. He served as President of LNPS from 1995-1997 and has organized and led many field trips throughout Louisiana. He is the author of "Grasses of Louisiana" and is currently preparing "Wildflowers of Louisiana" that is scheduled for release from LSU Press in 2002. He has presented "Edible and Useful Plants" to many groups including Cajun Prairie Society (May 2000) and Louisiana Archaeological Society in Feb 1999. For more info on Charles Allen, check out his web page at www.ulm.edu/~callen/ or Email: biallen@alpha.nlu.edu

Mark Bronstad, tour leader, received a BS in Horticulture from SFA in 1989 and has been with Doremus Nursery, Warren, Texas, ever since. The nursery specializes in native plants of the Southeast, bamboo, as well as general nursery stock. Email: EDoremus3@aol.com

Paul Cox received his BS in 1975 and his MS in 1983 in from Stephen F. Austin State University. He studied and worked under Dr. Elray Nixon, Biology Department, SFA before joining the San Antonio Botanical Garden as Horticulturist, where he has been ever since. Paul is currently the head Horticulturist. He is popular on the lecture circuit and has published widely, with an award-winning Texas Trees currently in its 7th reprint. He is senior editor of McMillen's Texas Gardening Wildflowers. Email: pcox@ci.sat.tx.us

Dave Creech is a Professor of Horticulture at Stephen F. Austin State University, Nacogdoches, Texas. He has been at the institution since 1978. He received the BS in Horticulture from Texas A & M University in 1970, MS in Horticulture from Colorado State University in 1972, and the PhD in Horticulture from Texas A & M University in 1978. He served as the President of the Native Plant Society of Texas in 1992 and is affiliated with numerous conservation and horticultural organizations. He is the Director of the SFA Mast Arboretum, a twenty-acre on campus garden resource, and is co-director (with Dr. James C. Kroll, College of Forestry) of a brand new resource, the 40-acre Pineywoods Native Plant Center. If you have any favorable comments to make about this conference you can direct them via Email: dcreech@sfasu.edu

John C. Ferguson has over 27 years of business experience. In November 1994 he started Nature's Way Resources, Inc. at a Houston location. The company had grown to over $6 million in annual revenues when the land was sold to a developer and the business relocated. The new location near Conroe, Texas was opened in December 1998 and focused on producing high quality compost and mulch based on biological methods for use in horticulture. Mr. Ferguson serves on the Houston©Galveston Area Council for Solid Waste (HGAC) representing the composting industry. He works with many universities, professional societies, garden clubs, and charitable organizations teaching seminars or horticulture and environmental issues. In 1998 he won the Sarah H. Emmott Environment Award for the leading environmental educator in Houston. He has also served on the Houston Environmental Foresight Project through the Houston Advanced

David Lewis is from the Vidor-Beaumont area. He received his Bachelor and Master of Science degrees from Lamar University. David has been studying Gulf Coast mushrooms for over 25 years and has co-authored several scientific papers dealing with their identification. He is a Research Associate with the Field Museum of Natural History in Chicago, Illinois, and has over 5000 specimens of fungi deposited in its' herbarium. David is a member of several mycological associations, and is President of the Gulf States Mycological Society. David is employed as a chemist at MeadWestvaco in Evadale. He and his wife Patricia live in Newton County. Email: plewis@jas.net

Barney L. Lipscomb is the Assistant Director: Administration, Head of Library, Head of Press at the Botanical Research Institute of Texas. In addition to Barney's responsibility in administration, the publications program and as director of the library, Barney is one of the three authors of *Shinners and Mahler's Illustrated Flora of North Central Texas*, and the *Illustrated Flora of East Texas*. Barney serves on the Board of Consultants for the North Texas Poison Center in Dallas, and has research interests in the application of botany to forensic science. As Editor of *Sida, Contributions to Botany* as well as *Sida, Botanical Miscellany*, Barney plays an integral role in disseminating some of the results of the BRIT research staff in our internationally distributed, peer-refereed journals. Barney's personal taxonomic specialty is the family Cyperaceae. Barney has carried out fieldwork in various parts of the U.S., Mexico and Central America. Barney is also representative to the Council of Botanical and Horticultural Libraries (CBHL). Email: barney@brit.org

Peter Loos is a botanist by love, a horticulturist by trade, and a plant taxonomist in his spare time. His professional experiences in various fields of the horticulture industry as well as his Masters degree from SFASU have greatly contributed to his extensive knowledge of Texas Native Plants and related ecological issues. Peter is currently the NPSOT Coastal Crossroads Chapter President and he was State President of the Native Plant Society of Texas during his continued long standing work on the state board. He also owns and operates Ecovirons, offering propagation, consultation, ecological evaluation, wetland mitigation and landscaping services out of his nursery in Conroe, TX. Mr. Loos is author of several papers and many publication articles regarding Texas Native Plants. He is the member of numerous organizations to include Louisiana Native Plant Society, SFASU Mast Arboretum Advisory Board and the Houston Area Urban Forestry Council. He is presently serving on the Boards of The Seeds of Texas Seed Exchange and as V.P. of the Cajun Prairie Preservation Society. He has continued to maintain his love of sharing native plants with others through various speaking engagements, the leading of horticulture workshops, and assisting schools with the implementing of various habitat/outdoor classroom projects to include creating a Prairie/Bog Garden at the East Texas Pineywoods Native Plant Center. Email: cyrilla@flex.net

John Mayronne is a founding partner and president of Natives Landscape Corporation in Covington, Louisiana, a landscape architectural and contracting company. Mr. Mayronne was the lead design professional for the 100 acre Mobile Botanical Garden in Mobile, Alabama, as well as the Highland Road Corridor at Hilltop Arboretum in Baton Rouge, Louisiana. Mr. Mayronne has served as: president of the Louisiana Native Plant Society, awards Chairman of the Cullowhee Native Plant Conferences, director for the satellite conference "Conservation and Use of Native Plants in the Gulf Coastal Region", board member of the Eastern Native Plant Alliance (ENPA) board member Louisiana Society for Horticultural Research (LSHR), and state Representative of Louisiana Project Wildflower. His work has been featured in numerous publications and periodicals. natives@fastband.com

Jan Midgley is the owner of Wildflower, a nursery selling native herbaceous perennials and ferns. She is the author of *Nursery Sources of Native Plants of the Southeastern United States* published in 1993 and *Southeastern Wildflowers* published in 1999 (also available in 7 state versions). She is a Past Director of the Cullowhee Native Plant Conference held in Cullowhee, North Carolina each July. She lectures and writes about the cultivation and propagation of native plants. Jan has been gardening with native plants for thirty years, challenged by soils and weather in Missouri, Michigan, Maryland and Alabama. She holds a BSN from the University of Missouri and a MSN from the University of Michigan. Jan has 2 children, Frank (32) and Elizabeth (30). Email: JWildflwr@aol.com

Mark Norman received a B.S. in Agriculture from Stephen F. Austin State University in 1984, and for many years was one of the largest commercial Christmas tree growers in the state of Texas. He served as the transportation and quality control director for the Texas Blueberry Marketing Association for three years, and returned to Stephen F. Austin to complete an MS in Horticulture in 1999. He is a licensed Irrigator and landscape designer, and is currently an instructor in Horticulture at Stephen F. Austin State University. mnorman@sfasu.edu

Scott Ogden is a garden consultant, writer, and lecturer based in Austin, Texas. He grew up in Dallas and studied geology before pursuing a career in horticulture and garden design. His books are *Gardening Success with Difficult Soils, Garden Bulbs for the South, and The Moonlit Garden,* all from Taylor Publishing Co., Dallas, Texas. Other recent written contributions have appeared in *Horticulture* magazine, *Fine Gardening,* and *Southern Living*. Scott also serves as the Southern Regional editor for the gardening information website, www. gardening123.com. Bulbs, heat loving perennials, and night flowering plants are special interests. Email: scot1111@flash.net

Dawn Parish, Research Associate of the SFA Mast Arboretum, received a BS degree in Biology from West Texas A & M University in 1996 and the MS degree from Stephen F. Austin State University in Horticulture in 1999. Dawn is responsible for the management of the horticulture facilities and the grounds of the 20-acre SFA Mast Arboretum. Email: dparish@sfasu.edu.

Marc Pastorek grew up in Gretna, LA (across the Mississippi from New Orleans). He has been a landscape contractor since 1985 providing design, installation and maintenance of mostly residential gardens. He formed Meadowmakers Inc. in 2001 to

Matt Welch, tour leader, received a B.S. from Stephen F. Austin State University in 1997 and is currently pursuing a M.S. in biology from SFA. He was the first Research Associate of the Pineywoods Native Plant Center and is currently employed as the technician in the Ruby M. Mize Azalea Garden at the SFA Mast Arboretum. Email: mwelch@sfasu.edu