Appendix A. 2011 M&E Report for Management Indicators

Introduction

As part of the 1996 revision of the Land and Resource Management Plan for National Forests and Grasslands in Texas, management indicators were selected to help indicate the effects of management on biological resources. These indicators include major vegetation communities, habitat elements, species assemblages/ guilds, and individual species. This report documents results of monitoring and evaluating trends of these indicators. This analysis of management indicators represents a broad evaluation of biological resources and effects of management at the level of the entire NFGT administrative unit. It is designed to guide decisions about the need to change management direction at this broad level, while providing useful context for project development and effects analysis.

Selection of Management Indicators

The goal in selecting management indicators for the 1996 Land and Resource Management Plan (hereafter, the *Plan*) was to compile a set of indicators that would provide meaningful information on effects of management on major components of biological resources on the National Forests and Grasslands in Texas (NFGT). Comprehensive lists of vegetation communities, habitat elements, species assemblages/guilds, and individual species were considered. The U.S. Forest Service Ecological Classification System and Plant Community Characterization were used to identify habitats and communities for consideration. As a result of this process, 18 wildlife species, 8 fish species, 2 guilds, 9 communities, and 1 habitat element (Table 1; see also, *Plan* EIS, page 103, and *Plan*, pages 306-307) were selected as management indicators. Indicators were linked with seral stage habitats and vegetation groups to show their association with broad categories of habitat.

A subset of the selected management indicators is "management indicator species," as described in National Forest Management Act (NFMA) regulations (36 CFR 219.19). According to these regulations, management indicator species are to be selected "because their population changes are believed to indicate the effects of management activities" (36 CFR 219 (a)(1)). They are to be used during planning to help compare effects of alternatives (36 CFR 219.19(a)(2)), to set Forest *Plan* objectives for the wildlife and fish resource (36 CFR 219.12(k)(4)), and as a focus for monitoring (36 CFR 219.19(a)(6)). Where appropriate, management indicator species represent the following groups of species (36 CFR 219 (a)(1)):

Threatened and endangered species on State and Federal lists,

1. Species with special habitat needs,
2. Species commonly hunted, fished, or trapped,
3. Non-game species of special interest, and
4. Species selected to indicate effects on a group of species associated with selected biological communities or water quality.

Of the selected indicators, only the indicators that are individual species are "management indicator species" subject to requirements of NFMA regulations at 36 CFR 219.19, with one exception: the "guild" of neotropical migrants (as identified in the *Plan*, page 306). Although "guilds" are not normally considered as species for the purposes of management indicator species requirements, in this case the neotropical migrant "guild" was chosen and monitoring and evaluation occurs through looking at populations of three individual species, specifically yellow-throated vireo, wood thrush, and Acadian flycatcher. Therefore, the NFMA regulation requirements for management indicator species apply to these three species. In contrast, the stonefly guild is monitored and evaluated as a group (without considering population trends of individual species); therefore, the NFMA regulation requirements for management indicator species do not apply to the stonefly guild.

Management indicator species are but one type of indicator used to develop management strategies and monitoring programs designed to meet NFMA requirements related to diversity of plant and animal communities and management of biological resources. Other management indicators important to monitoring effects of *Plan* implementation on biological resources of NFGT include monitoring of:

- Forest-wide levels of four broad seral stages reflecting forest structure in age-classes: (1) 0-20 years, (2) 20-50 years, (3) 50-90 years, and (4) 90+ years,
- Nine key ecological communities, including maintenance of the appropriate prescribed fire regime: (1) Longleaf Pine Woodlands and Savannahs, (2) Longleaf Pine Barrens, (3) Herbaceous Wetlands, (4) Bay Shrub Wetlands, (5) Dry Xeric Oak-Pine Forests, (6) Mesic Oak-Pine Forests, (7) Mesic Hardwood Forests, (8) Tallgrass Prairie, and (9) Bottomland Streamsides,
- Two broad aquatic habitats: (1) Ponds and Reservoirs, and (2) Rivers and Streams, and
- One key habitat element: Snags.

In this report, indicator trends were evaluated in relation to *Plan* requirements and achievement of desired outcomes described in the *Plan*. Desired outcomes include availability of wildlife resources for public use and persistence of communities and species within the planning area. Where data are inconclusive or suggest communities or species are declining to a point that desired outcomes are not likely to be achieved, specific recommendations are made for modifying management or monitoring approaches.

Table 1. Management Indicators by Seral Stage Habitats and Vegetation Groups

Seral Stage Habitats and Vegetation Groups	Management Indicators
Forest/Grassland Early Succession 0 – 20 years	Eastern Wild Turkey Whitetail Deer Yellow Breasted Chat Snags
Forest/Grassland Mid Succession 20 –50 years	Eastern Wild Turkey Whitetail Deer

Seral Stage Habitats and Vegetation Groups	Management Indicators
	Yellow Breasted Chat Pileated Woodpecker Gray/Fox Squirrel Snags
Forest/Grassland Late Succession 50 –90 years	Eastern Wild Turkey Whitetail Deer Yellow Breasted Chat Pileated Woodpecker Gray/Fox Squirrel Snags
Forest/Grassland Old Growth 90+ years	Eastern Wild Turkey Whitetail Deer Pileated Woodpecker Gray/Fox Squirrel Snags
Longleaf Pine Woodlands and Savannahs	Red-cockaded Woodpecker Slender Gay Feather Incised Groovebur Scarlet Catchfly Longleaf – Bluestem Series
Longleaf Pine Barrens	Navasota Ladies'-Tresses Little Bluestem–Rayless Goldenrod Series
Herbaceous Wetlands	Yellow Fringeless Orchid Spagnum–Beakrush Series
Bay–Shrub Wetlands	Nodding Nixie Texas Bartonia Sweetbay–Magnolia Series
Dry–Xeric–Oak Pine Forests	Red-cockaded Woodpecker Louisiana Squarehead Shortleaf-Oak Forest
Mesic Oak-Pine Forest	Red-cockaded Woodpecker Loblolly-Oak Forest
Mesic Hardwood Forests	Southern Ladyslipper Beech-White Oak Series
Tallgrass Prairie	Northern Bobwhite Quail Little Bluestem-Indiangrass
Bottomlands Streamsides	Neotropical Migrants- (Yellow-throated Vireo, Wood Thrush, Acadian Flycatcher) Neches River Rosemallow Bottomland Hardwood
Aquatic – Ponds and Reservoirs	Largemouth Bass Redeared Sunfish Bluegill Sunfish

Seral Stage Habitats and Vegetation Groups	Management Indicators
	Channel Catfish
Aquatic - Rivers and Streams	Paddlefish Sabine shiner Dusky Darter Scaly Sand Darter Stonefly Guild

Trends in Seral Stage Habitats and Vegetation Groups

Methods

The NFGT is comprised of 637,621 acres in four national forests and 38,100 acres in two national grasslands. An abundance of monitoring of seral stage habitats and vegetation groups occurs over time through rotating periodic inventories of NFGT acreage.

Vegetation inventory databases track changes in vegetation age-classes and cover types over time. Changes in acreage by age-class are translated into changes in availability of seral stage habitats. Changes in cover types reflect changes in availability of major vegetation groups. These changes may occur as a result of management, such as in restoring longleaf pine forest to appropriate sites, or when lack of disturbance results in successional change to a different vegetation type. Together, these changes in acreage reflect the availability of major habitats on NFGT.

Results

Table 2 below shows the steady increase in very late succession stage since 1992. The decrease in the late succession is due primarily to stands growing into the very late stage. The decrease in acreage in the early succession stage is due to a reduction in the number of acres being regenerated.

The FSVeg age-class distribution report for the end of 2011 shows a continuing trend towards an older forest. For instance, the acres in stands over 100 years old have increased from 15,037 acres in 1992 to 79,509 acres in 2011. The acres in young stands age 0 to 10 years old were 83,612 acres in 1992 and have decreased to just 4,867 acres in 2011.

Table 2. Seral Stage Habitat Trends for NFGT

Seral	Age	1992	2004	2008	2010	2011	Trend
Early Succession	0-20 years	22 %	13 %	10%	5%	5 %	decreasing
Mid Succession	21-50 years	11 %	15 %	17 %	22 %	23 %	increasing
Late Succession	51-90 years	61 %	53 %	49 %	40 %	42%	decreasing
Very Late Succession	91+ years	6 %	18 %	24 %	34 %	31%	increasing

Major forest vegetation groups have remained fairly stable over the life of the *Plan* (Table 3).

Table 3. Major Forest Vegetation Group Trends for NFGT

Forest Type Group	*1992*	*2004*	*2008*	*2010*	*2011*	*Trend*
Longleaf Pine Woodlands	5.6%	5.7%	5.2%	4.9%	4.4%	Decreasing
Dry-XericOak PineForests	25.8%	25.1%	25.4%	25.5%	24.9%	Stable
Mesic Oak-Pine Forests	58.6%	58.4%	59.2%	60.3%	59.0%	Stable
Mesic Hardwood Forests	2.9%	3.9%	3.8%	3.8%	3.8%	Increasing
Bay-Shrub Wetlands	0.4%	0.4%	0.4%	0.4%	0.4%	Stable
Bottomland/Streamside Forest	6.7%	6.5%	6.0%	6.2%	5.9%	Stable

Evaluation

The *Plan* sets short-term and long-term objectives for a decrease of early and late succession habitats and an increase in mid-succession and old-growth habitats (page 307). Trends in seral stage acreage indicate movement toward these objectives. These trends are the expected result of moving from a predominately late-successional forest towards a forest with a more balanced age-class distribution. Continued movement toward this desired balance in age classes is dependent on regular regeneration of a

relatively small proportion of forests through natural disturbances or management action. These results do not indicate a need to change monitoring or management at this time.

Although conversion of forest types (as called for in the *Plan*) is occurring, successional change in forest types is slow. The slight shift from oak-pine to hardwood forests could be evidence of successional change due to lack of prescribed burning in these forests over the reporting period; however, it is more likely due to more precise inventory of hardwood stands over recent years. Increases in acres treated with prescribed fire in 2006 (96,684 acres), 2007 (129,618), 2008 (165,360), 2009 (139,053), 2010 (148,903), and 2011 (79,437 acres) improved the condition and sustainability of longleaf pine woodland and dry-xeric oak pine forests, which need frequent burning to promote the open canopy and grass/forb ground cover characteristics of these habitats, as well as regeneration of diagnostic tree species. These results do not indicate a need to change monitoring or management at this time.

Trends in Management Indicators

Monitoring of Management Indicator Species

Successional Species

Figure 1. Eastern Wild Turkey (*Meleagris gallopavo*)

Background

This bird historically occupied 30 million acres in eastern Texas. As a result of unregulated hunting and the loss of habitat, this species was virtually eliminated by 1900. Restocking efforts of Rio Grande, Florida, and pen-raised turkeys from 1924-1978 were unsuccessful. Restocking of Eastern wild turkeys began in 1979, but most restocking efforts have occurred since 1987. Rangewide this species is considered secure with a Global Status of G5-Secure. In the state of Texas, the wild turkey has a rank of S5-Secure (NatureServe, 2011).

Selection

Eastern wild turkey was selected as a management indicator species because it is a demand/game species of high economic importance. This species utilizes a wide range of habitat types, including grass/forb-dominated openings interspersed with mast producing hardwoods or open pine woodlands making it suitable as a management indicator species associated with early, mid and late-successional forests, as well as old growth.

Monitoring Methods

This species has been and continues to be monitored through combinations of survey techniques, including gobbler call counts and gathering harvest levels data. Surveys are conducted by both Texas Parks and Wildlife Department (TPWD) and USFS personnel and are analyzed by TPWD.

Results

Annual surveys and harvest data (Table 4) suggest that Eastern wild turkey populations are stable and that viability is not an issue on NFGT. When evaluated by individual counties, wild turkey population numbers are low in some areas (Table 5).

Table 4. Spring Turkey Harvest in Angelina, Houston, Jasper, Nacogdoches, Newton, Sabine, San Augustine, Shelby, San Jacinto, Trinity, Montgomery and Walker Counties (National Forest Counties) from 1997-2011.

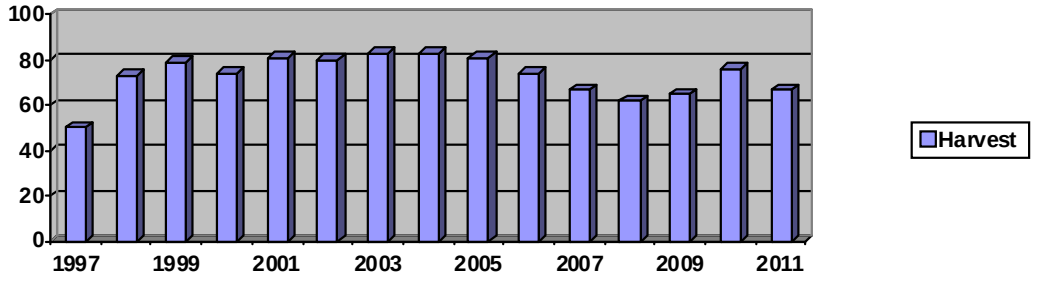


Table 5. Spring Turkey Harvest by County (National Forest Counties) 2008-2011.

	2008	2009	2010	2011
Angelina	7	9	9	3
Houston	0	0	0	0
Jasper	18	16	12	12
Nacagdoches	7	6	9	10
Newton	13	15	25	22
Sabine	11	8	14	14
San Augustine	5	8	6	3
Shelby	0	1	1	1
San Jacinto	0	0	0	1
Trinity	1	2	0	1
Montgomery	0	0	0	0
Walker	0	0	0	0
Total	62	65	76	67

Evaluation
Habitat improvements can be largely attributed o the increase in mulching and prescribed burning which promotes and improves the herbaceous plant community. Six consecutive years of near 100,000 acres or more of prescribed fire on the NFGT, has increased adequate nesting, brood and adult turkey foraging habitat. It is expected that there will be increases in turkey numbers which will follow in the next three-to-five years as a result of the increased prescribed burning and habitat improvements that occurred during 2006-2011.

Need for Change
Harvest data for several east Texas counties shows that wild turkey populations appear to be low (Table 5). The NFGT is considering removing the wild turkey as a Management Indicator because populations are too low to be a reliable indicator of Forest management.

Figure 2. Whitetail Deer (*Odocoileus virginianus)*

Background
Historically, the white-tailed deer populations have expanded and been reduced due to the influences of human intervention. Current annual harvest in this region exceeds two million animals. Historical restocking programs and state agency population management efforts, including appropriate hunting regulations, ensure that population viability for this species is no longer an issue, in east Texas or on the NFGT. Rangewide, this species is considered secure with a Global Status of G5 (NatureServe 2011).

Selection
The white-tailed deer was selected as a management indicator species in the *Plan* as a demand species associated with grass/forb and brushy habitats, interspersed hardwoods, and associated edges which covers the four forest/grassland seral stage habitats listed in the *Plan*: early, mid, and late succession and old growth.

Monitoring Methods

Deer populations are monitored using annual deer spot-light surveys and a more recent method known as distance sampling (TPWD, 2011). Both methods are actual counts of deer along established routes. In addition, harvest data are provided by the TPWD.

Results

Figure 3 shows trends of estimated white-tailed deer population size in specific ecological regions (ecoregions) and resource management units (RMUs) which sit within ecoregions. The information used is extrapolated by TPWD to develop annual harvest recommendations. Trends for all RMUs surrounding the NFGT indicate a stable to increasing population. These estimates parallel hunter use and harvest information on the NFGT units.

Figure 3. Trends in Estimated Whitetail Deer Populations in Resource Management Units Containing USFS Lands.

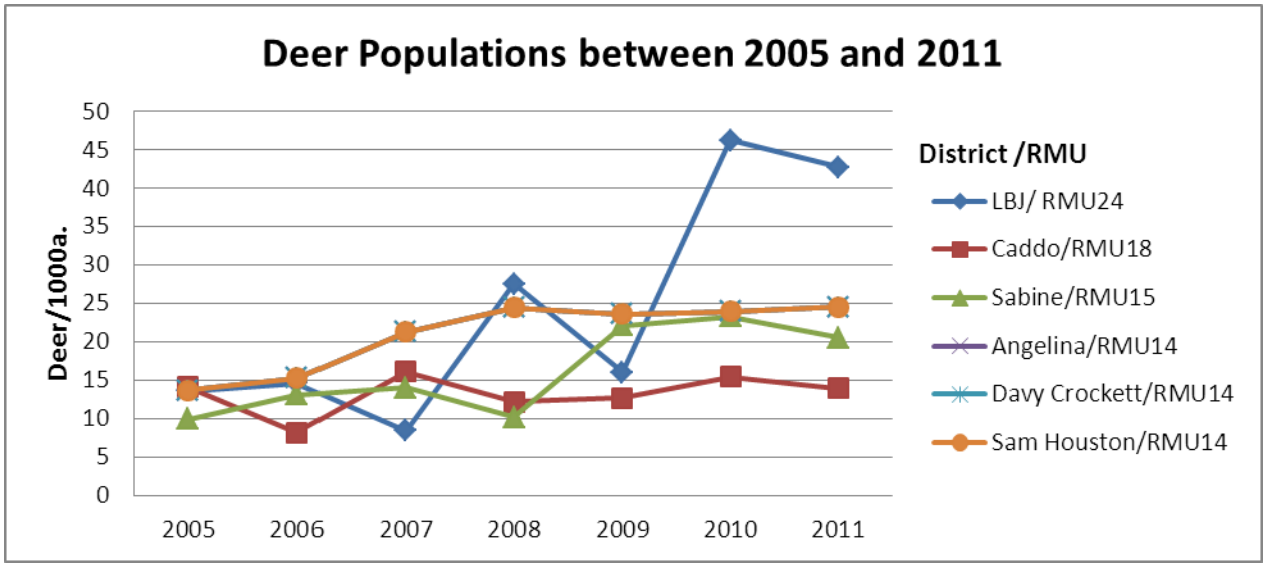


Figure 3 includes the estimated white-tailed deer population size by RMU. The method used to report trend data in the prior M&E reports was done by ecoregion trend which is based on a much larger sample size rather than the RMU which is a smaller more precise sample size. The data is extrapolated from annual surveys on approximately seven to ten lines, each 15 miles per RMU. After assessing the former reported data, reporting by RMU is more representative of populations on the NFGT. All of the NFGT Forests are within the Pineywoods ecoregion, the LBJ Grasslands falls within the Crosstimbers ecoregion, and the Caddo Grasslands falls predominately within the post Oak Savannah ecoregion. The Angelina, Davy Crockett and Sam Houston NFs are all in RMU 14; therefore, Figure 3 only shows a single line for this RMU.

All NFGT Districts have portions of the district which have been designated as a WMA; which ranges from 14,600 acres on the Davy Crockett to the entire Sam Houston NF (163,037 acres) which is all WMA.

Evaluation
White-tailed deer respond to adequate supplies of browse and escape cover throughout the majority of the year and the availability of hard mast in the fall and winter. Timber harvest techniques, which encourage the release of hard mast producers and maintenance of early succession habitats, will ensure quality deer habitat is provided. Population reductions through hunting are a vital tool in the management of deer herds on the NFGT. Providing opportunity for hunting will aid in preventing habitat destruction by deer herds that may be reaching the carrying capacity of the lands. Quality white-tailed deer habitat is dispersed across the NFGT. This availability of habitat, along with results of annual surveys and harvest levels suggest that white-tailed deer populations on NFGT are sufficient to support current levels of hunting demand.

Need for Change
The white-tailed deer is a habitat generalist not specifically reflective of any seral stage or plant community; thus its role as an ecological indicator is limited. The NFGT recommends dropping the white-tailed deer as a MI.

Yellow-breasted Chat *(Icteria virens)*

Background
The yellow-breasted chat ranges from southern Canada and British Columbia east to southern New Hampshire and south to northern Florida, the Gulf Coast and Baja, California. The species winters from southern Texas and central Mexico south through the Yucatan to western Panama. The NFGT is used by this species primarily as breeding habitat, and is seldom seen during the winter seasons.

Figure 4. Yellow-breasted Chat[1]

Selection

This species was selected in the *Plan* as a management indicator for the brushy, scrub habitat available in early, mid and late seral stage habitats. Acres of habitat in 1996 were estimated to total 174,000 acres, and the *Plan's* short-term objective is to have 140,000 acres. The *Plan* projected that habitat acreage reductions would occur in the early and late succession stages, and increases would occur in the mid succession stages, with overall reductions exceeding increases by 34,000 acres.

Monitoring Methods

The NFGT have annually conducted breeding bird point surveys since 1998. The NFGT, through neo-tropical bird point-counts, assesses population trends of yellow-breasted chats annually in various forest types and age classes. National forest trend estimates are evaluated in part by comparison with trends estimated from annual Breeding Bird Survey (BBS) data from surveys across the larger regions in which national forests in Texas occur.

Results

Figure 5 reflects a stable trend in this species with secure viability over all four national forests. Though early succession habitat is decreasing, the use of yellow breasted chats of this seral stage continues to show wide-spread occurrence on the NFGT. Table 6 shows the numbers of YBCH for each unit.

[1] Courtesy of Hilton Pond Center for Piedmont Natural History, found at www.hiltonpond.org

Figure 5. Yellow Breasted Chats Found In All Forest Stands.

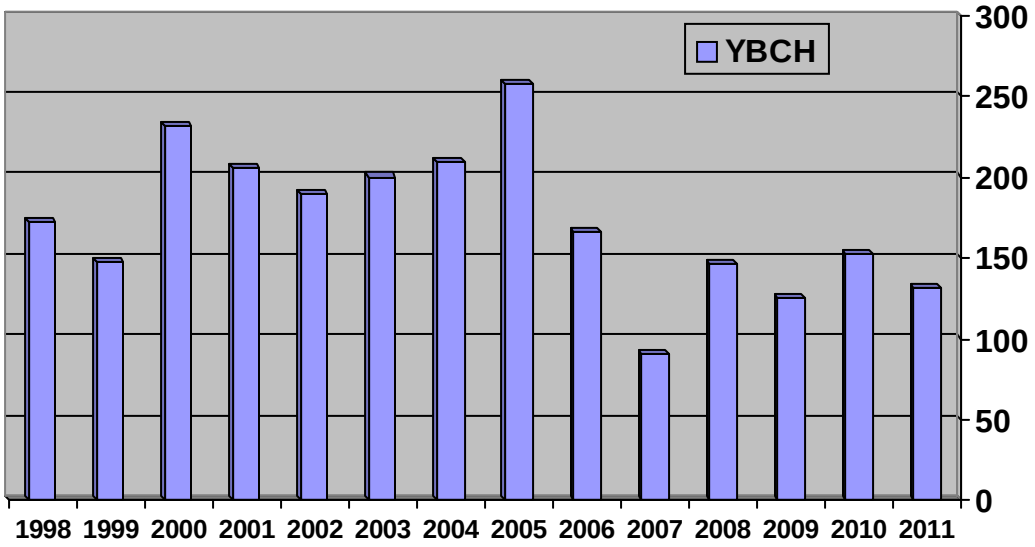


Table 6. Yellow Breasted Chat History by unit 2008-2011.				
	2008 (#)	2009 (#)	2010 (#)	2011 (#)
ANF	31	36	31	42
SNF	46	30	46	32
DCNF	42	33	40	27
SHNF	27	26	34	29
Caddo NG	None reported	None reported	1	2
LBJ NG	None reported	None reported	0	0
Total	***146***	***125***	***151***	***132***

Evaluation

Throughout the southeast, this species is considered secure with a Global Status of G5-Secure. In the state of Texas, the yellow-breasted chat has a rank of S5-Secure (NatureServe, 2011).

Need for Change

Yellow-breasted chats are birds of disturbance regimes. This lends them to be good indicators of early succession. Their numbers tend to decrease rapidly in forest stands. Prescribed burning is a tool that is used to maintain early successional habitat (NRCS, 2003). The increased prescribe burning on the NFGT should continue to improve habitat for the Yellow-breasted chat. This data should only be used as an indicator for early seral habitat.

Figure 6. Pileated Woodpecker *(Dryocopus pileatus)*

Background
Pileated woodpeckers are birds of the forest, preferring large diameter snags/trees, and needing up to 200 acres of foraging habitat per nesting pair. Pileated woodpeckers have demonstrated the ability to adapt to human habitation and are common in managed forests, as well as rural, suburban, and urban park-like settings (Conner 1978: Hamel 1992). Widely distributed in wooded areas of North America; populations have been stable or increasing in recent decades. Rangewide this species is considered secure with a Global Status of G5-Secure and S5-Secure (NatureServe 2011).

Selection
The pileated woodpecker was identified as a management indicator for the NFGT because of its specific habitat requirements needing large snags (Hamel 1992, Dickson 2001). This species was also selected in the *Plan* as an indicator for three forest or grassland seral stage habitats: mid and late succession and old growth. Acres of habitat in 1996 were estimated to total 280,000 acres, and the *Plan's* short-term objective is to have 372,000 acres. The *Plan* projected that habitat acreage reductions would occur in the late succession stage, and increases would occur in the mid-succession and old-growth stages, with overall increases exceeding reductions by 92,000 acres.

Monitoring Methods
Pileated woodpecker populations have been monitored annually through bird point counts on the NFGT since 1998. National forest trend estimates are evaluated in part by comparison with trends estimated from annual Breeding Bird Survey (BBS) data from surveys across the larger regions in which national forests in Texas occur.

Results
Data from point counts suggest a stable trend (Figure 7).

Figure 7. Pileated Woodpecker Occurrences - All Forest Stands.

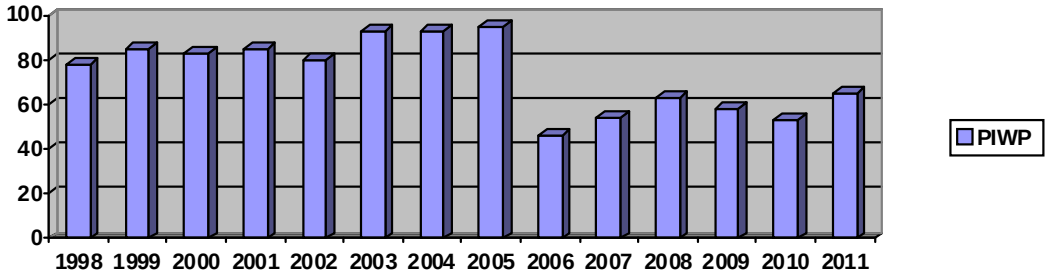


Table 7. Pileated Woodpecker History by unit 2008-2011.				
	2008 (#)	2009 (#)	2010 (#)	2011 (#)
ANF	14	10	7	20
SNF	19	12	12	14
DCNF	8	13	14	17
SHNF	22	16	17	9
Caddo NG	No data	7	3	5
Total	***63***	***58***	***53***	***65***

Evaluation
Pileated Woodpecker numbers appear to be rebounding after a slight downturn in 2006. The following data showing the increases in the number of snags on the NFGT should help to increase Pileated Woodpecker numbers.

Need for Change
Pileated woodpeckers specific 'large diameter snag' habitat requirement makes it most suitable as a management species for late seral/mature forest and old-growth habitats instead of mid seral succession. Continue to monitor Pileated Woodpeckers in the R8 Bird Point counts.

SNAGS

Background
Snags are a habitat component of virtually all seral stages, and the lack of snags can be a limiting factor in maintaining or increasing populations of some species. Numerous factors influence the creation and longevity of snags (Dickson 2001). Prescribed burns, wildfires, weather events, insects, disease, and decay are some of the factors that influence the numbers and distribution of snags across the landscape. For example, the prescribed burning program on the NFGT influences snag distribution by both creating and removing snags from the forest. Any prescribed burn will burn with varying intensity as a result of many factors including: the amount, type, and distribution of fuels, weather conditions, and topographical features. These factors combine to result in a mosaic effect in which some areas burn intensely, while other portions burn with little intensity, or fail to burn at all. The results are that some single trees or pockets of live

trees may be killed, creating new snags, while some existing snags are consumed. This creation and consumption of snags results in an uneven distribution of snags across the landscape. When combined with the other factors influencing snag creation and retention, it is obvious that snag numbers and distribution will be very dynamic across the NFGT.

Selection

Snags were selected as a management indicator because they are used by and are important to a wide variety of wildlife species for nesting, roosting, foraging, perching, and other uses in all four successional stages—early, mid, late seral and old growth. Woodpeckers are primary cavity nesters that rely heavily on snags for nest sites (Conner 1978). Snags are important habitat components throughout the forest; therefore it is used as a management indicator in early, mid, late seral, as well as old growth habitat.

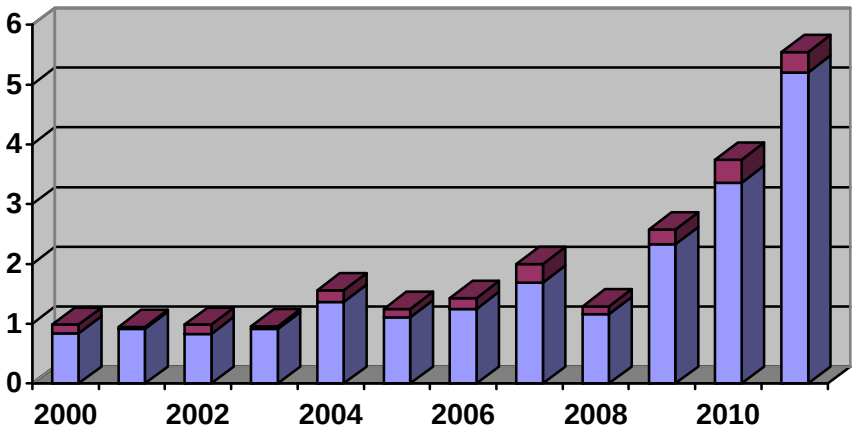
Monitoring Methods

Snag data is gathered as part of the vegetation sampling portion of the R8 Bird protocol. Data on snag numbers has been collected at approximately 700 survey points. A sample of approximately 93 survey points is surveyed annually. Snags are recorded based on their diameter, and grouped into two size categories: 1) 12” – 20” dbh, and 2) larger than 20” dbh.

Results

Figure 8 displays average number of snags per acre from the habitat data collected in the R8 bird point count effort; this combines all seral stages, indicating all areas have from 1 to 2 snags per acre.

Figure 8. Average Number of Snags at Each Sampling Point



Evaluation

As described in Chapter V of the Forest *Plan*, the objective for snags increases as forest stands mature. Management activities, such as prescribed burning, wildfires and natural tree mortality are maintaining a fair number of snags per acre; however, a standard or

guide to protect or create snags during timber harvesting activities would increase the availability of snags forestwide. Table 8 shows the available 12”-20” snags by unit. Table 9 shows the available snags > 20” by unit. It is unknown why there are more snags on the landscape in 2011. Possibly the effects of the drought which began in the latter part of 2010 and continued through 2011 could have created more snags.

Table 8. Average # of snags *12"-20"* at each sampling point by unit				
	2008	**2009**	**2010**	**2011**
ANF	1.00	2.00	1.66	1.47
SNF	0.84	1.69	2.28	2.21
DCNF	1.25	2.39	4.37	7.79
SHNF	1.54	2.83	1.76	3.33
Caddo	--	2.73	4.12	8.75
LBJ	--	--	5.96	7.66
Total	1.16	2.33	3.36	5.20
Table 9. Average # of snags *>20"* at each sampling point by unit				
	2008	**2009**	**2010**	**2011**
ANF	0.07	0.09	0.27	0.21
SNF	0.11	0.25	0.14	0.17
DCNF	0.26	0.30	0.87	1.31
SHNF	0.08	0.17	0.47	0.22
Caddo	--	0.43	0.50	0.12
LBJ	--	--	0.07	0.00
Total	0.13	0.25	0.38	0.34

Need For Change

Utilization of vegetative data collected during bird point counts has established baseline data on density of snags on the forest. Continued collection of this information will establish trends over time forestwide in all seral stages. Continue to monitor snags in the R8 bird point counts.

Figure 9. Gray and Fox Squirrels *(Sciurus carolinensis* and *Sciurus niger)*

Eastern Grey Squirrel

Eastern Fox Squirrel

Background
Gray and fox squirrels are popular small game throughout the southeastern U.S., and squirrel hunting is second only to white-tailed deer hunting in most forested areas. Together these species generate considerable revenue and sport, and serve as a noteworthy wildlife species providing the main source of mammalian wildlife viewing opportunities to many people. Optimum habitat for these species consists of mature deciduous and mixed forests with abundant supplies of mast (e.g., acorns, hickory nuts) with availability of permanent water. Streamside zones normally provide this optimum habitat. Range-wide these species are considered secure with a Global Status of G5 (NatureServe 2011).

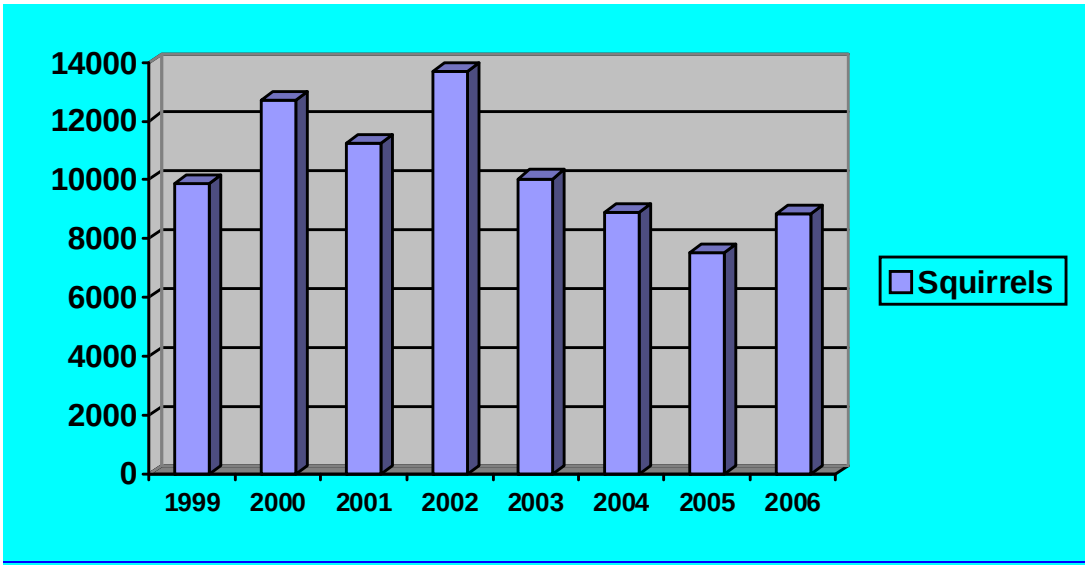
Selection
These species were also selected in the *Plan* as indicators for forests or grasslands seral stage habitats: mid and late succession and old growth. The gray and fox squirrels were chosen as management indicator species because of their significance as a popular species identified by the public for recreational game, casual observation and because of their need for dens and hardwood mast produced by mature hardwood trees.

Monitoring Methods
Between 1999 and 2002, the NFGT attempted to develop point-counts for squirrels, similar to the point-counts used to assess numbers of breeding birds. The data collected for these four years was evaluated and it was determined these counts be dropped in favor of more traditional harvest and habitat evaluation techniques. Currently, hunter harvest data and habitat trends are the primary means to assess squirrel populations on the NFGT. To monitor actual trends in squirrel populations, hunter harvest and harvest per unit effort (hunter success rate) are recorded on NFGT Wildlife Management Areas (WMA), some 249,000 acres. These WMAs include all of the Sam Houston National Forest and portions of all other Forests and Grasslands. This area covers approximately 40% of all habitat managed on NFGT.

Starting in 2007, TPWD discontinued the way that it has extrapolated squirrel harvest data. Since that time, harvest data information has come directly from survey forms filled out by hunters on a voluntary basis. The numbers reported have been and will be considerably different from the past data. This is no indication that squirrel populations or their habitat has declined in any way. The NFGT is confident that both squirrel populations and habitat are acceptable.

Results
Acres of habitat in 1996 were estimated to total 200,000 acres, and the *Plan's* short-term objective is to have 264,000 acres. The *Plan* projected that habitat acreage reductions would occur in the mid and late succession stages, and increases would occur in the mid succession and old-growth stages, with overall increases exceeding reductions by 64,000 acres. Current trends verify an increase in mid and old-growth stages of suitable habitat for gray and fox squirrels.

Figure 10. Squirrel Harvest Data on NFGT WMAs



Evaluation
The State of Texas (through TPWD) has opted to evaluate squirrel numbers and establish harvest recommendations based on available habitat, recent harvest trends, and hunter demand. One variable of habitat is that squirrel populations closely parallel the previous season's mast crop; with populations rising when food is abundant. This factor varies due to weather and is generally not under management control. Therefore, population trends must be viewed over long periods to discern effects of management. Trends in acres of mature mast-producing forest are a more meaningful indicator of effects of management on squirrels and other mast-dependent wildlife.

Need For Change
The NFGT recommends dropping squirrels as MIS because their population changes cannot be tied to NFGT management.

Longleaf Pine Woodlands and Savannahs Habitat

The *Plan* selected the Red-cockaded Woodpecker, and plants including the Slender Gay Feather, Incised Groovebur and the Scarlet Catchfly, as well as the longleaf – bluestem series plant community as management indicators for the longleaf pine woodland and savannahs habitat. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Red-cockaded Woodpecker *(Picoides borealis)*

Background
The Red-cockaded woodpecker (RCW) was listed as a federally endangered species under the Endangered Species Act in 1970, historically occupying a fairly large range in the pine woodland prevalent in southeastern U.S. (Dickson 2001). Both quantity and quality of suitable habitat are much reduced as historical pine woodland habitat and subsequently RCW populations have declined up to 97 percent. Short-term rotation timber management has eliminated mature diseased pines required for roosting, nesting, and foraging, and fire suppression has perpetuated a dense under and mid-story vegetation layer that excludes RCW use. However, recent habitat (pine thinning and prescribed fire treatments) restoration efforts have reclaimed some of the historic pine woodland habitat, and population augmentation efforts have resulted in population increases in some areas. The Global Status of the RCW is classified as G3-Vulnerable, and S2-Imperiled for the State of Texas (NatureServe 2011).

Figure 11. Red-cockaded Woodpecker[2]

Selection
The RCW was selected as a management indicator species because it meets several of the criteria required of a management indicator species. It represents a federal and state listed endangered species. It has special habitat needs (large pine trees with red-heart disease). It is a non-game (bird) species of special interest. And it is associated on the NFGT with pine communities particularly in open woods condition with large pine trees including 'Longleaf Pine Woodlands and Savannahs Habitat', 'Dry–Xeric–Oak Pine Forests Habitat', and 'Mesic Oak-Pine Forest Habitat' that have been treated with a frequent fire regime.

Monitoring Methods
Red-cockaded woodpecker clusters have been comprehensively inventoried and tabulated in a consistent manner since 1990 and all current monitoring techniques (RCW Recovery Plan 2003) allow personnel to report data consistently. In addition, each year unoccupied habitat is inventoried (10% or more of existing unoccupied habitat) and new RCW

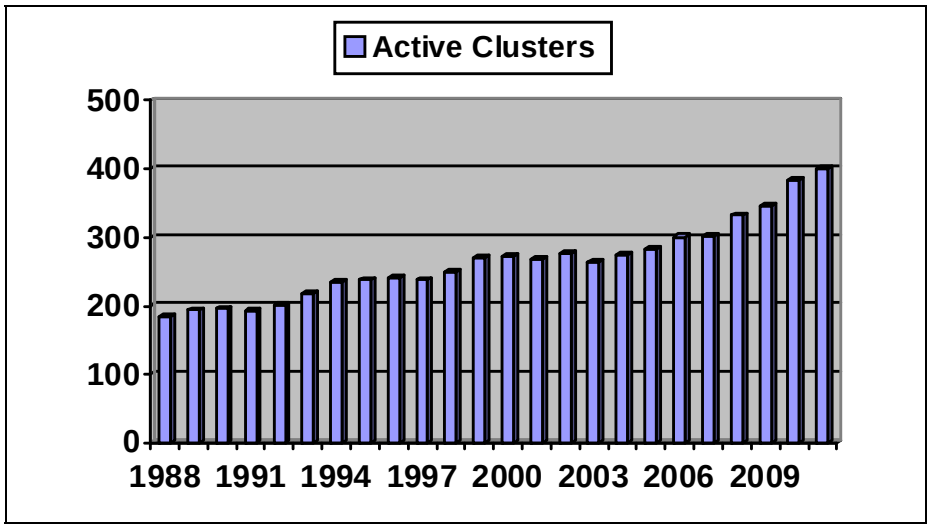
[2] Courtesty of USFS. Photograph by Unknown Photographer found at http://www.fws.gov/species/graphics/woodpkr.gif

clusters are identified. Active cluster monitoring consists of pre-nesting, nesting & post-nesting monitoring; each active cluster is monitored between February and April to determine the group size (as described as potential breeding group). Between April and July, nesting success is determined by banding nestlings, monitoring fledging and later morning and evening roost checks. Additional data is obtained during later capture and translocation efforts between October and January.

Results

The results depicted in the following figure indicate a steady increase (Figure 12) in the number of RCW active clusters known to occur on the NFGT. The increase from 194 groups in 1989 to 401 groups in 2011 represents a 106% increase in the number of active clusters known to occur on the NFGT. Annual monitoring data suggest that RCW populations are increasing and the viability is fairly secure across the NFGT.

Figure 12. Number of RCW Clusters from 1988 thru 2011



Augmentation (introducing another RCW to an unpaired RCW within an active cluster) and translocation (introducing pairs of juvenile RCW to unoccupied clusters) are proven techniques for improving RCW populations. Translocations are an important technique used to increase populations in suitable habitat where numbers of birds are low. Red-cockaded woodpeckers are moved both internally and externally (Table 11) to augment single birds and to establish new groups by moving two juveniles into a recruitment cluster. Both techniques have been used with good success when needed to bolster clusters and sub-populations.

Table 10. Number of Active RCW Clusters by Forest 2004 - 2011								
	2004	2005	2006	2007	2008	2009	2010	2011
ANF	28	31	35	37	42	46	59	61
SNF	26	27	30	31	35	35	36	39
DCNF	53	61	62	65	69	69	74	76
SHNF	155	156	161	169	186	196	214	225
Total	262	275	288	302	332	346	383	401

Table 11. Number of RCW Augmented or Translocated 1996 – 2011 (by Forest)

National Forest	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11
Angelina	0	13	24	3	1	1	0	0	0	0	0	0	0	6	10	0
Sabine	2	1	4	21	1	1	0	0	8	8	4	0	0	0	0	13
Sam Houston	4	8	13	15	2	2	25	24	8	0	0	0	0	10	20	0
Davy Crockett	1	11	15	6	2	2	5	3	1	0	0	3	0	0	0	0
Total	**7**	**33**	**56**	**45**	**6**	**6**	**30**	**27**	**17**	**8**	**4**	**3**	**0**	**16**	**30**	**13**

The fire treatment is critical to mature pine stands in keeping the open woodland condition with little to no mid story vegetation that would hamper fly-way access to nesting cavities. A forest-wide effort to improve RCW habitat through prescribed fire was initiated, with great success (Table 12). RCW habitat is being burned at a much higher frequency of three-to-four year return intervals than in previous history.

Table 12. RCW Habitat Management Area Prescribed Fire Effort 2005 - 2011.

Forest	*HMA Acres*	*Acres Burned 05*	*Acres Burned 06*	*Acres Burned 07*	*Acres Burned 08*	*Acres Burned 09*	*Acres Burned 10*	*Acres Burned 11*
Sabine	52,578	17,990 (34%)	15,571 (30%)	25,603 (49%)	29,981 (57%)	13,833 (26%)	24,137 (46%)	20,431 (39%)
Angelina	50,611	11,680 (23%)	12,997 (26%)	33,816 (67%)	43,850 (87%)	23,641 (47%)	27,190 (54%)	18,933 (37%)
D.Crockett	66,248	11, 110 (17%)	18,211 (27%)	31,000 (47%)	40,500 (61%)	17,529 (26%)	24,591 (37%)	19,545 (30%)
S. Houston	108,412	26,230 (24%)	24,785 (23%)	31,275 (29%)	41,877 (39%)	28,956 (27%)	42,551 (39%)	18,460 (17%)

Evaluation
Continued habitat improvement is expected to have positive impacts on all upland pine habitats and species using those habitats. RCW numbers are showing a consistent improvement on all four National Forests. The increased burning effort is attributed to this increase, with a number of natural expansions in RCW groups. Continued inventory of unoccupied habitat should continue as the RCW population thrives.

Need for Change
Maintaining the *Plan*'s direction for an increased prescribed fire program on the NFGT, and increases in the pine thinning program in targeted areas appears to be providing for more secure viability in the enhanced habitat for the RCW population.

Plant species:

Slender Gay Feather (*Liatris tenuis* Shinners)
Background
The 1990 TPWD Texas Natural Heritage Program (TNHP) Report and Donavan et al. (1979) noted that this species is endemic to Texas and known to occur in only eight southeast Texas counties. It occurs most frequently in fire-maintained, dry upland longleaf pine savannas associated with the Catahoula formation (Donavan et al. 1979). The Global Status of the Slender Gay Feather is classified as G3-Vulnerable, and S3-Vulnerable for the State of Texas (NatureServe 2011).

Selection
The slender gay feather was selected as a management indicator species because it meets several of the criteria required of a management indicator species. It has special habitat needs (open pine woodland). It is also associated on the NFGT with pine communities particularly in open woods and savannah conditions that have been treated with a frequent fire regime. This plant species is associated with the open, longleaf woodlands preferred by other unusual (rare or endangered) Texas species such as the RCW.

Monitoring Methods
This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results
Angelina NF. Slender gay feather is most abundant on the Angelina NF, with forty-eight known occurrences. Eight locations of slender gay feather were documented in the 1990 TNHP report. Singhurst (1996) reported relocating the eight locations and also finding seventeen new locations of this species. Surveys conducted by the MacRoberts in 1995 resulted in finding two new occurrences. Surveys in 1998-1999 by Rob Evans, NFGT Forest Botanist, and other botanists resulted in resulted in finding four new populations of slender gay feather and relocating another population. Mize found a new population in 2001. A hillside seepage slope bog floristic survey conducted between 8/8/06-8/11/06 resulted in the documentation/association of *Liatris tenuis* in three locations in Boykin Springs on the Angelina NF.

Additional surveys done on the Angelina in 2006 and 2007 resulted in the discovery of six more populations. Also, another hillside seepage slope bog floristic survey completed in July 2007 resulted in the documentation/association of this species occurring at the lower edges of these communities in another three locations within the Boykin Springs area of the Angelina NF. In 2009, Walker documented this species on the Angelina NF scattered across Compartments 91 and 92. In addition, Loos documented this species on the north end of the Angelina NF in Compartment 1 and a new location in Compartment 14, all within areas of sandy soils. Surveys by Loos in 2010 within Compartments 81, 82, and 94 did not result in finding any specimens.

2011 surveys by Elliott, Philipps, and Loos found new individuals in C-85 while surveying the Sandy Creek area. This species was also found by Philipps in Compartments 64, 73, and along a right of way within the Turkey Hill Wilderness Area while conducting project surveys. Later surveys by Philipps and Loos in Upland Island Wilderness revealed several more occurrences. It appears that this species can be found in those areas exhibiting sandy soil and are either maintained regularly by prescribed fire or found within open rights of ways that are free of competing brush and can be locally abundant in those areas.

Sabine NF. Slender gay feather has been found on the Sabine NF, with over six known occurrences. One occurrence was documented in the 1990 TNHP report. Singhurst relocated this occurrence in 1994, as did Walker in 1995. Another new occurrence was reported in 2004. Surveys done by botanists in 2006 resulted in finding two additional occurrences of slender gay feather on the Sabine NF. In addition, a project survey conducted in C-139 on the Sabine NF following a prescribed burn revealed literally thousands of *Liatris tenuis* in flower across the landscape.

In 2009, Loos surveyed areas on the south Sabine NF and recorded the occurrence of this species in Foxhunter's Hill and the Stark Tract. Meanwhile, surveys conducted by the MacRoberts documented this species scattered in the area known as North Moore Plantation. According to the MacRoberts, the species was "never abundant but healthy when found" Elliott looked at some additional locations within the North Moore Plantation in 2010 but did not find the species. The species was once again found in C-139 during the 2011 field season and along a right of way within the Indian Mounds Wilderness area. It appears that this species can be found in those areas exhibiting sandy soil and are either maintained regularly by prescribed fire or found within open rights of ways that are free of competing brush.

Evaluation

It appears that *Liatris tenuis* is not strictly restricted to dry upland longleaf pine savanna. This species has also been documented in relation to hillside seepage slope bogs (spaghnum-beakrush series) and Catahoula pine barrens (rayless goldenrod-little bluestem series). With this expansion of suitable habitat and continued use of frequent fire as a management tool, it is expected that populations for this species will continue to increase.

Need for Change

Slender gay feather commonly occurs in frequently burned longleaf pine habitat or may be found in areas frequently mowed such as right-of-ways. Simply counting all locations gives very limited information about the quantity or quality of the habitat. A two-tiered method of assessing populations may be appropriate for assessing slender gay feather: tracking quality longleaf habitat through prescribed burn history of longleaf communities and determining actual populations through inventories. Only populations that are present within the last five years should be counted towards forest objectives. It is suggested to add a monitoring task to track the number of acres of longleaf habitat burned on a two-to-three year cycle.

Figure 13. Slender Gay Feather.

Photo by Tom Philipps, USFS.

Incised Agrimony (*Agrimonia incisa* Torr. & Gray)

Background

This species occurs in the coastal plain from southern South Carolina south to north-central Florida and west to Mississippi. In southeast Texas, it grows in fire-maintained dry upland longleaf pine savannas on well-drained sandy soils and can occur with *Liatris tenuis*. However, *Agrimonia* is much more narrowly distributed on NF land, and is found only within the Longleaf Ridge area.

Selection

The incised groovebur was selected as a management indicator species because it meets several of the criteria required of a management indicator species. It has special habitat needs (open pine woodland) very much similar to the slender gayfeather. It is a (plant) species of special interest. And it is associated on the NFGT with pine communities particularly in open woods and savannah condition that have been treated with a frequent fire regime.

Monitoring Methods

This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results

Angelina NF. The 1996 baseline is four populations in the Longleaf Ridge area of the Angelina NF. 5 locations -occurrences are known for this species on the NFGT, which meets the short-term objective and approaches the long-term objective in the Plan. These additional sites need a more detailed field survey that must be conducted in late summer – during September specifically. The Global Status of the Incised Groovebur is classified as G3-Vulnerable, and S2-Imperiled for the state of Texas (NatureServe 2011).

The majority of incised agrimony occurrences have been reported from the Angelina NF. The TNHP Report, completed in May 1990, noted two locations for this species (all in the Trout Creek area of the Angelina NF). Singhurst (1996) relocated these occurrences and found six more new populations. The MacRoberts surveyed the Angelina from 1995-1996, finding eighteen new occurrences and also relocating four populations reported previously. A hillside seepage slope bog floristic survey conducted between 8/8/06-8/11/06 resulted in the inadvertent documentation of one additional population of *Agrimonia incisa* in C-77 of the Angelina NF. Another survey specifically designed to relocate known populations of this species was conducted between 9/21/2006 and 9/24/2006. A total of 15 historical populations were visited resulting in the relocation of 5 extant populations.

Additional surveys conducted in 2007 have resulted in the documentation of this species in three more areas on the Angelina NF, all within the Trout Creek area. Surveys for this

plant conducted in 2007 resulted in finding three additional occurrences. In 2010, Philipps and Elliott documented this species once again in C-77.

In 2011, Philipps and Elliott discovered two new occurrences for this species in Compartments 78 and 85 while surveying the Sandy Creek area. Agrimonia incisa is a localized species restricted to a small area on the District. It does appear under favorable habitat and management conditions (longleaf pine savanna with a frequent fire return interval). It is unknown why this species has not been documented in other areas of the District that share those same attributes.

Sabine NF. Incised agrimony was reported at two locations on the Sabine NF by Singhurst in 1996. These occurrences have not been relocated, and no new occurrences of this plant have been found. An attempt to relocate the Singhurst occurrences of this species on the Sabine NF was attempted by the MacRoberts in 2009. They looked at the known locations and searched for this species in areas of suitable habitat near North Moore Plantation, Foxhunter's Hill, and the Stark Tract but did not document any occurrences. Surveys in 2011 in the Foxhunter Hill Area (C-139) failed to relocate a previously documented location.

Agrimonia incisa is a localized species restricted to a small area on the Angelina NF. It does appear under favorable habitat and management conditions (longleaf pine savanna with a frequent fire return interval). It is unknown why this species has not been found in areas of the Sabine NF that share those same attributes, although historical records do exist.

Evaluation
Agrimonia incisa, like *Liatris tenuis*, responds very favorably to the effects of prescribed burning. Its numbers seem to be most numerous the season after burning and tends to drop off every year until the next scheduled fire event. The compartments surveyed have not been recently prescribed burned, but most are scheduled to be burned in the next year or two. It is predicted that the numbers of extant *Agrimonia incisa* populations will rebound when post burn surveys are conducted.

Need for Change
As with *Liatris tenius*, simply counting sites gives very limited information on population sizes, so occasional population counts to determine density and vigor may be desired. Where both species occur, perhaps only counting one species would suffice as a measure of habitat quality. The most comprehensive method for monitoring incised groovebur is to survey particular longleaf sites that are burned on a two-to-three year cycle.

Scarlet Catchfly (*Silene subciliata* B.L. Robins)
Background
Scarlet catchfly grows within the ecotone between upland longleaf pine savannas and forested ravines, and is maintained by low-intensity ground fires. The 1990 TNHP Report noted the occurrence of this endemic species only in southwest Louisiana and southeast Texas, including five Texas counties. NatureServe (2011) has locations known in eight

Texas counties. The Global Status of the scarlet catchfly is classified as G3-Vulnerable, and S3-Vulnerable for the State of Texas (NatureServe 2011).

Selection
The scarlet catchfly was selected as a management indicator species because it has special habitat needs (open pine woodland). It is a non-game (plant) species of special interest. It differs from the slender gayfeather and incised groovebur in that it is associated on the NFGT within the ecotone between frequently burned upland longleaf pine savannas and forested ravines that have been treated with a low-intensity fire regime.

Figure 14. Scarlet Catchfly.

Photo by Tom Philipps, USFS.

Monitoring Methods
This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results
Angelina NF. No occurrences of scarlet catchfly have been reported from the Angelina NF, although suitable habitat is present for this species. Surveys specifically searching for this plant were done in 2006 and again 2007, but no populations were discovered. Surveys conducted by Loos in 2009 did not result in locating this species on the Angelina NF. Additional surveys by Loos in 2010 in Compartments 75 and 85 followed by surveys in Compartment 78 in 2011 did not result in finding this species. This species does

respond well to prescribed fire, after which an increase of flowering stems will be seen followed by a gradual reduction of individuals until the next fire event. Suitable habitat does exist on the District, but so far no occurrences have been documented. Most occurrences of this species are within the extreme southeast portion of the Sabine NF and south from there into Jasper and Newton Counties. It appears that the Angelina NF may be outside the known range for this species.

Sabine NF. The known occurrences of scarlet catchfly were all found on the Sabine NF. The 1990 TNHP report documented one occurrence located within the Stark Tract. Surveys done by Carr in 1990 failed to relocated this occurrence. However, the 1991 surveys by Carr and Evans resulted in finding two new occurrences—one at Fox Hunters Hill and a new occurrence at the Stark Tract. Ferguson relocated the Fox Hunters Hill occurrence in a 2000 survey. In 2005, Philipps relocated both of the occurrences found by Carr and Evans. A new occurrence was found in 2006 by Loos in the Stark Tract area. One of the occurrences found by Carr and Evans was relocated in 2007. Surveys on the Sabine NF in 2009 by Loos and the MacRoberts did not result in locating this species. Surveys by Loos and Philipps in 2010 have resulted in the successful relocation of an occurrence reported by Ferguson in 2000 and a new occurrence in Compartment 140. 2011 surveys by Loos revealed no further new locations. Currently there are four known occurrences on the Sabine NF.

This species does respond well to prescribed fire, after which an increase of flowering stems will be seen followed by a gradual reduction of individuals until the next fire event. This species is more common in Jasper and Newton counties which are further south of the District. The fact that scarlet catchfly has only been found in the far southeast corner of the District may be an indicator that it has reached the edge of its range.

Davy Crockett NF. No occurrences of scarlet catchfly have been reported from the Davy Crockett NF. Extensive searches for this species at sites with favorable habitat were conducted in 2006, but no new occurrences were found. There appears to be no suitable habitat for this species on the Davy Crockett NF and the District is outside its known range.

Evaluation

Silene subciliata, like *Agrimonia incisa* and *Liatris tenuis,* responds very favorably to the effects of prescribed burning. Its numbers seem to be most numerous the season after burning and tends to drop off every year until the next scheduled fire event. The new occurrence record on the Stark Tract was documented the growing season right after the application of a prescribed fire. Also, the failure to find any new populations on the Angelina and Davy Crockett NFs suggests that this species is indeed restricted to a narrow geographical area in the southeastern Sabine NF.

Need for Change

Monitoring scarlet catchfly gives limited information about the quantity or quality of longleaf habitat since it is narrowly distributed on NFGT lands and is generally found on the ecotone on the edge of longleaf habitat, not within it. An easier method of tracking

quality longleaf habitat is through prescribed burn history of longleaf communities. Add a monitoring task to track the number of acres of longleaf habitat burned on a two-to-three year cycle. Recommend dropping scarlet catchfly as a management indicator species in the next Forest Plan Revision.

Longleaf Pine – Little Bluestem Series
Background
Longleaf pine woodlands are fire-dependent communities, requiring frequent low intensity fires to reduce woody midstory growth and encourage a diverse understory that supports a variety of plants and animals. Burning frequency rather than burning season is the single most important factor necessary to restore and maintain longleaf pine-dominated habitats (Glistzenstein and Streng 1995, Waldrop et al. 1992).

This community type is characterized by mainly evergreen woodlands on loamy or sandy acidic soils in southeast Texas. Longleaf pine is the dominant evergreen species, but loblolly and shortleaf pines may also be present. Common deciduous associates are blackjack, bluejack, and southern red oaks, and sweetgum. A shrub layer containing flowering dogwood, beautyberry, redbay, wax myrtle and vaccinium is common, along with a well-developed herbaceous layer of little bluestem, panicum, switchgrass, sedges and other species.

Selection
The longleaf pine – little bluestem series vegetation community was chosen as a management indicator because of its requirement of a frequent fire regime to maintain the viability. Also, because of the requirement of open woodlands that is need to sustain the little bluestem ground cover.

Monitoring Methods
Two criteria are used to monitor and evaluate the extent and quality of longleaf pine – little bluestem communities. One is more quantitative, the other more qualitative.

The acres of longleaf pine in FSVeg, the Field Sampled Vegetation national database. The annual change in this database describes changes in acreage identified as longleaf pine forest (stands dominated by longleaf pine). Since restoration of longleaf pine is a Forest Plan objective, acreage changes for this community reflect (1) stands regenerated from another species to longleaf pine and (2) those that have been treated to favor longleaf pine through thinning or other cultural efforts.

Disturbance through fire is the other criteria used to evaluate longleaf pine – little bluestem community. This effort is gauged strictly on frequency of fire and its impact on the little bluestem component of the longleaf pine stand. FSVeg allows greater quantification of understory vegetation, and this database may be developed to monitor this aspect of this community.

Results

At the end of 2011, a total of **25,403** acres were shown in the FSVeg database. The *Plan's* baseline is 21,000 acres with a short-term objective of 40,000 acres. Prescribed burning accomplishments were again substantial.

Evaluation
Most of the planned increase in acreage of this series is expected from the restoration of areas currently occupied by slash and loblolly pine and an aggressive prescribed fire management program where some longleaf overstory currently exists. Prescribed burning, during both the dormant and growing seasons, has maintained or improved the quality of most existing stands, but exactly how many and which ones have herbaceous dominated understories is unknown.

Need for Change
Continue to monitor the acres of Longleaf Pine- Little Bluestem.

Longleaf Pine-Barrens Habitat

Navasota ladies'-tresses and the little bluestem–rayless goldenrod series plant community were selected as management indicators for longleaf pine barrens habitat. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Navasota Ladies'-Tresses (*Spiranthes parksii* Correll)
Background
This plant species is a Texas endemic, primarily known from two river drainages in east-central Texas and a separate disjunct location in east Texas on the Angelina National Forest. Although approximately 100 populations with a total of about 10,000 plants are known, many of the sites are threatened by strip mining and rapid urban encroachment on suitable habitat. This Federal and State Listed Endangered Species is endemic to the Post Oak Region of East Central Texas. Navasota ladies'-tresses were federally listed as endangered on May 6, 1982. The Global Status of the Navasota ladies'-tresses is classified as G3-Vulnerable, and S3-Vulnerable for the State of Texas (NatureServe 2011).

Selection
The 1990 TNHP Report noted populations in nine counties, including a disjunct population (one specimen recorded) on the Angelina NF in Jasper County. Though not noted as a pineywoods plant species, the few hundred acres of barrens habitat and suitable soil conditions on the southern Angelina National Forest indicated more occurrences were possible. This possible site situation and the single known occurrence served as the baseline for the *Plan* and the potential to improve habitat conditions for more occurrences in barrens habitat is possible in future years.

Monitoring Methods
This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These

surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results

Angelina NF. Suitable habitat for the Navasota Ladies'-tresses is limited to areas of Catahoula pine barrens in Compartments 84, 76 and 86 on the Angelina NF. Surveys performed in Compartments 76 in the past have not detected the species. Orzell (1990) reported that the species was found in Compartment 84 on Catahoula formation barrens. This occurrence was not relocated in the MacRoberts 1996 survey, although they reported finding a new population. Surveys were conducted for Spiranthes parksii in suitable habitat on the Angelina NF on October 24-25, 29, and November 7, 2005. No new occurrences for this species were found. Surveys conducted by Philipps in 2006 again failed to locate any representatives of this species. A survey conducted by Philipps, Singhurst, Walker, Loos, and Rudolph in the fall of 2007 again failed to relocate the species. There have been two element occurrence records for this species recorded, in 1986 and 1996. Both occurrences were located on the Angelina NF in Black Branch Barrens; however, all recent attempts to relocate this species have failed. Personal communications with several biologists indicate the species has been found on a barren(s) on Campbell Group forest properties between Compartments 84 and 86.

Various botanists searched for Navasota ladies'-tresses in surveys of suitable habitat in 2005, 2006, 2007, 2009, and 2010. The two known occurrences were not relocated during these surveys, nor were any new populations discovered. Currently there are no known extant populations of this plant on the Angelina NF.

Evaluation

The two occurrences of Navasota ladies'-tresses on the Angelina NF are in an inclusional community surrounded by fire-maintained communities. This supports the belief that Navasota ladies'-tresses populations need fire as a management tool (MacRoberts et. al. 1997).

In addition to the preceding theory, it must be realized that orchids can remain dormant for many years until the particular conditions that trigger growth occur. Both past sightings of this species, in 1990 and 2000, were characterized by specific climatic conditions, specifically wet and cooler springs followed by temperate summers. Those conditions have never exactly been replicated since the last reported sighting, and may be a prerequisite for future occurrences.

Figure 15. Navasota Ladies'-Tresses.

Photo © Paul Montgomery.
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Need for Change

Only two occurrences of Navasota ladies'-tresses, consisting of a few individuals on the NFGT, is not a good management indicator for longleaf pine barrens. The species is difficult to identify, difficult to monitor on a yearly basis, and population fluctuations may tell little if anything about quality of the Catahoula barrens habitat (Rob Evans personal communication.) In addition, even though species occurrences were reported in 1990 and 2000, no voucher specimens exist in any established herbarium that could confirm the identification of the species. Recent literature disputes the validity of the 1990 record and the 2000 record is also lacking paperwork documenting positive identification. Continued monitoring of this population is necessary since it is an endangered species, but the recommendation is to remove it as a management indicator for longleaf pine barrens.

Little Bluestem – Rayless Goldenrod Series

Background

This community type is characterized by open grasslands or forb-dominated barrens, and is restricted to flat, shallow soil areas of the Catahoula formation in the southern portion of the East Texas Pineywoods and Post Oak Savanna. These barrens are often interspersed within deciduous woodlands of post oak and black hickory or within dry longleaf pine savannas. This habitat is uncommon, found only on the southern portion of the Angelina NF.

Selection

The little bluestem – rayless goldenrod plant community was chosen to gauge the trend (size and quality) in this component of the longleaf pine woodland community. Changes reflect the degree of success of the fire management program.

Monitoring methods
Acreage of this community is monitored through GIS and GPS data. Quality is monitored through site visits to known glades.

Results
The *Plan's* baseline of 440 acres identified from the TNHP Report, documents three sites of 437 acres on the southern Angelina NF. An additional site, less than one acre, was found on the northern Angelina NF since the *Plan* was written. These barrens habitats are normally restricted from mechanical disturbance, with fire being the primary management tool used to enhance this community.

Evaluation
Several small isolated areas of little bluestem-rayless goldenrod communities were found since the *Plan* was written. In FY 05, a plan to map and inventory these sites was developed and implementation began. All Catahoula pine barrens in Compartments 84 and 86 were located, documented using GPS, and entered into the Forest GIS database.

Need for Change
Fire history for all sites should be monitored with a minimum goal of burning them once every four-year period.

Herbaceous Wetlands (Seepage Bogs) Habitat

The yellow fringeless orchid and the spagnum–beakrush series plant community were selected during *Plan* development as management indicators for the herbaceous wetlands (seepage bogs) habitat. As a wetland, this habitat is protected from much disturbance and falls within the MA-4 direction. In contrast to much of MA-4, fire is a required element of these wetlands to enhance the conditions most suitable to promote the vigor of the many species considered unusual. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Yellow Fringeless Orchid (*Platanthera integra* (Nutt.) Gray ex. Beck)
Background
This orchid can be found in low, wet pine savannas, sphagnum seeps and bogs in the southeastern United States from New Jersey, south to north-central Florida, and west to Tennessee and southeast Texas. The 1990 TNHP Report documented two small populations, both in bogs on the southern Angelina NF. These two sites were examined in 1998 and both were still extant. The 1996 baseline is one population.

Selection

This species was selected as a management indicator species for this plant community as a way to measure the effects of prescribed fire in this habitat. The lack of frequent prescribed burning is the greatest threat to the yellow fringeless orchid. Seasonal flooding and periodic burning are the key components to the communities where this orchid is found. The Global Status of the yellow fringeless orchid is classified as G3-Vulnerable, and S1-Critically Imperiled for the State of Texas (NatureServe 2011).

Monitoring Methods

This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results

Angelina NF. Yellow fringeless orchid has only been reported from the Angelina NF of the NFGT. Orzell found two locations of this plant in 1988. A later survey in 1998 relocated these two populations (personal communication). Surveys conducted in 2005 and 2006 did not result in relocating the two populations. However, one occurrence was relocated by Loos in 2007, after the site had been prescribed burned. Philipps' 2008 surveys of a number of Angelina bogs, the suitable habitat for this plant, did not result in finding any new populations of yellow fringeless orchid. In surveys conducted in 2009 by Loos and subsequently Walker on the Angelina NF did not relocate a single specimen of this species in any of the previously documented locations. No new locations were found.

* Due to the extremely hot and dry conditions that prevailed over the region from July into early fall and a subsequent inspection of current conditions in habitats where Platanthera integra, occurs, it was decided that environmental conditions were not favorable to conduct surveys for this species in FY10. Currently, only one extant occurrence of this plant is known to occur on the Angelina NF. The continuing drought in 2011 made conditions for this species in its habitat very unfavorable. Many bogs were very dry and even the pitcher plants were going dormant. Nevertheless, Loos and Philipps surveyed several areas for this species, including the site of the last visible occurrence and several sites in Upland Island Wilderness. No individuals were seen and it is possible that drought conditions may be impacting occurrences, although that is difficult to determine due to the sporadic past appearances of this species. This species is more common in the low wet pine savannas found in Jasper and Newton Counties to the south of the forest. It may be that the NFGT locations are rarer due to them being near the edge of its range.

Evaluation

This fire-dependent species becomes dormant or is shaded out by invading woody competition in the absence of fire. More frequent, higher intensity fire in and around the seepage bog areas will improve habitat conditions for this orchid.

Need for Change

The only two populations of yellow fringeless orchids are found on the Angelina NF. Most seepage bogs on the NFGT do not contain this orchid. Therefore, it provides little information as a management indicator for herbaceous wetlands. Recommend dropping it as an indicator species.

Sphagnum – Beakrush Series

Background

This is an herb-dominated community type which includes various types of seepage bogs. Occurrences are usually small and isolated within a matrix of upland pine or pine-oak forest. Small trees and shrubs such as sweetbay, magnolia and evergreen bayberry invade many bogs in the absence of fire. These mesic sites occur mostly on the Angelina and Sabine National Forests. These mesic habitats host a variety of plant species that are unique to this series.

Selection

The *Plan's* status of 150 acres came primarily from the TNHP Report, which listed 148 acres on 37 sites in the southern portions of the Angelina and Sabine NFs. These sites, as a unique plant community, were selected to gauge the impact of various management actions through time.

Monitoring Methods

Known areas of this community are routinely checked by USFS and cooperators; many have recently been located using GPS equipment. These mid-site coordinates are entered into the Forest GIS database as a center-point, but with acreages only approximated.

Results

Seasonally wet bogs as part of MA-4 are typically protected from timber harvest and road building. These communities are allowed to develop with no or very little human disturbance, but they do depend on prescribed fire on a regular basis (every one-to-three years). The major concern for these habitats is the lack of fire and the development of heavy overstory conditions shading out the herbaceous community. Recent increases in prescribed fire have had positive effects on many of these sites.

Evaluation

In FY 05, a plan to map and inventory these sites was developed in FY 05 and implementation began. In FY06, all hillside seepage slope bogs and low wet pine savannas on the Angelina and Sabine NFs were located, documented using GPS, and entered into the Forest GIS database, although some smaller areas may remain undiscovered. These additional mapping and inventory efforts are needed to locate and protect these herbaceous wetland communities. Many additional sites have been found since the baseline was established in 1990. The quality of many of these new sites is generally undetermined, but they do depend on fire for greater species richness and diversity. Periodic monitoring after initial inventorying efforts are completed will be needed to ensure that the characteristic structure and composition of the community is being maintained. Fire history should be the basic indicator of quality of habitat, along

with freedom from mechanical disturbance that alters the hydrological flow. Many sites may need midstory control to restore quality herbaceous conditions.

Need For Change
This is a good indicator of a critical and important habitat and monitoring efforts should continue. Monitoring tasks should be added to monitor the frequency at which the sites are burned. The quality of new sites is generally undetermined and periodic monitoring after initial inventory efforts is needed. Fire history and any mechanical disturbance should be recorded.

Bay-Shrub Wetlands Habitat

Nodding nixie, Texas screwstem, and the sweetbay–magnolia series plant community were selected as management indicators for the bay-shrub wetlands habitat during development of the *Plan*. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Nodding Nixie (*Apteria aphylla* (Nutt.) Barnh. ex Small)
Background
According to the TNHP Report, nodding nixie occurs in damp, deeply shaded, seepage saturated forests (baygalls), often in association with mosses (*Sphagnum spp.)* and is generally restricted to eight counties in southeast Texas. The Global Status of nodding nixie is classified as G4-Apparently Secure, and S2-Imperiled for the State of Texas (NatureServe 2010). These areas are typically protected during harvest treatments. Occasionally in drier years, prescribed fire may creep into these sites.

Selection
This species was selected as a management indicator for bay-shrub wetland habitat due to it having a preferred habitat within MA-4. MA-4 is classified in the 1996 LRMP as streamside habitat and is generally excluded from project planning by the establishment of an SMZ. This species does not respond well to disturbance and was chosen to determine the effectiveness of MA-4 exclusion from project plans as well as to determine the quality of undisturbed and well developed sweetbay-magnolia plant communities.

Figure 16. Nodding Nixie.

Photo by Tom Philipps, USFS.

Monitoring Methods

This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results

Angelina NF. The 1990 TNHP report documented three locations of nodding nixie on the Angelina NF. The MacRoberts found an additional 12 locations there 1995. In 1998, Evans collected plants from one of the locations found by the MacRoberts. One of the original TNHP occurrences was relocated in 2005 by Philipps. During a floristic survey of a hillside seepage bog in 2006, four new populations of nodding nixie were discovered incidentally. Two more populations were discovered incidentally that year by Griffith during his relocation search for Texas Bartonia. Specific searches for this species in 2006 resulted in relocating one population and the discovery of two new locations. Philipps found a new population of nodding nixie while surveying a baygall in 2007. Loos documented three populations of this species on the Angelina NF during surveys in 2009. All were in the Trout Creek area within baygall habitat. Also, Loos did find a new population within C-16 on the north end of the Angelina NF, again within a baygall. There are currently 28 sites on the southern Angelina NF, with an estimated several thousand plants.

Sabine NF. The 1990 TNHP report documented two locations of nodding nixie on the Sabine NF. The MacRoberts found an additional occurrence in 1995. Evans collected this plant from a new site on the Sabine in 1998. Philipps relocated one of the occurrences reported by TNHP in 2006. Loos searched suitable habitat for this species in 2009 within the southern Sabine NF but did not document any occurrences.

* Due to the extremely hot and dry conditions that prevailed over the region from July into early fall and a subsequent inspection of current conditions in habitats where *Apteria*

aphylla occurs, it was decided that environmental conditions were not favorable to conduct surveys for this species in FY10. The continuing drought made conditions for this species in its habitat very unfavorable. Nevertheless, in 2011 Loos conducted surveys for this species in Compartment 71 and in suitable habitat within Upland Island Wilderness without success. However, surveys conducted in a small tract of land adjacent to Upland Island Wilderness that is currently part of a proposed land exchange did result in a new occurrence. Likewise, a survey by Philipps and Marr in Compartment 76 did find a scattering of individuals. The numbers of individuals seen were few in all cases and it appears that drought conditions may be impacting occurrences. However, this species is usually quite common under normal conditions in relatively undisturbed baygall habitat.

Sam Houston NF. Volunteers from the Houston Sierra Club located nodding nixie on six sites on the east side of the Sam Houston NF in 1997. Four of those occurrences were relocated by Philipps in 2006. In 2007, Keith surveyed potential areas of suitable habitat and documented this species in four compartments. He reported that "*Apteria aphylla* is common if baygall habitat is present".

*Due to the extremely hot and dry conditions that prevailed over the region from July into early fall and a subsequent inspection of current conditions in habitats where Apteria aphylla occurs, it was decided that environmental conditions were not favorable to conduct surveys for this species in FY10. The drought intensified in 2011. Based on the very limited success in finding individuals of this species elsewhere on the forest it was decided to suspend surveys for this species until conditions improve. Currently, the occurrences of this plant on the Sam Houston NF are all within the area surrounding Nebletts Creek and Henry Lake Branch.

Evaluation
Populations, when found, number in the hundreds to millions of plants. The fact that the known extant populations continue to increase also suggests that current management practices for this species and the community type where it is found is successful.

Need for Change
Continue to use this species as management indicator.

Texas screwstem (*Bartonia texana* Correll) (formerly Texas bartonia)
Background
Texas screwstem is found to occur in and around acid seeps in pine-oak forests on gentle slopes and in bay-gall (*Ilex coriacea*) thickets, often on elevated clumps of sphagnum moss or other organic matter. These areas are in MA-4 and are typically protected during timber harvest and road building operations. There are about 15 scattered occurrences, all in southeastern Texas, containing a total of fewer than 1,000 individuals. The Global Status of Texas screwstem is classified as G2-Imperiled, and S2-Imperiled for the State of Texas (NatureServe 2011).

Selection

This species was selected as a management indicator for bay-shrub wetland habitat due to it having a preferred habitat within MA-4. MA-4 is classified in the 1996 LRMP as streamside habitat and is generally excluded from project planning by the establishment of an SMZ. This species does not respond well to disturbance and was chosen to determine the effectiveness of MA-4 exclusion from project plans as well as to determine the quality of undisturbed and well developed sweetbay-magnolia plant communities.

Monitoring Methods

This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results

Angelina NF. Although three populations of Texas screwstem have been reported on the Angelina NF, recent surveys to relocate these occurrences have not been successful. Angelina NF records described a population of Texas screwstem in the Steven F. Austin Experimental Forest. Evans and Petersen collected this plant from a new location in 1994. The MacRoberts discovered an additional population in 1995 and relocated the population found by Evans. Recent attempts to relocate these populations have not been successful. Philipps did not find the population at the SFA Experimental Forest when he searched for it in 2005. In 2006, Griffith did not relocate the two populations found by Evans and the MacRoberts. Loos reported a suspected, but not confirmed, occurrence for this species within a baygall in C-75 of the Angelina NF. The specimen was not in good condition and could not be differentiated between *B. texana* and *B. paniculata*, which occur in similar habitats. *Bartonia texana* appears to be truly rare.

* Due to the extremely hot and dry conditions that prevailed over the region from July into early fall and a subsequent inspection of current conditions in habitats where Bartonia texana occurs, it was decided that environmental conditions were not favorable to conduct surveys for this species in FY10. The continuing drought in 2011 made conditions for this species in its habitat very unfavorable. Nevertheless, Loos conducted surveys for this species in Compartment 71 and in suitable habitat within Upland Island Wilderness without success. Likewise, a survey by Philipps and Marr in Compartment 76 in a previously documented location returned negative results. This species remains very elusive and it appears possible that drought conditions may be impacting occurrences, although that is difficult to determine due to the rarity of this species.

Sam Houston NF. A search conducted in 1994 in Compartment 95 of the Sam Houston NF failed to find any occurrences of Texas screwstem. Three new locations of this plant were found in Compartment 98 in surveys done in 2006. In 2007, Keith relocated a single occurrence along Nebletts Creek in C-98. This species appears to be truly rare.

*Due to the extremely hot and dry conditions that prevailed over the region from July into early fall and a subsequent inspection of current conditions in habitats where Texas

screwstem occurs, it was decided that environmental conditions were not favorable to conduct surveys for this species in FY10. The drought intensified in 2011. Based on the lack of success in finding individuals of this species elsewhere on the forest it was decided to suspend surveys for this species until conditions improve. Currently, the occurrences of this plant on the Sam Houston NF are all within the area surrounding Nebletts Creek.

Evaluation
No prescribed management is directed at this species, as protection through MA-4 direction would allow the habitat for this species to develop over time. However, this is an elusive species, difficult to identify and has a unpredictable flowering period, anywhere between early September to late October depending on conditions. The fact that another management indicator species for this community, *Apteria aphylla*, was located in all of the reported *Bartonia texana* sites while *Bartonia* was only found once should be evidence that the condition of the bay-shrub wetlands habitats are capable of supporting populations of species which require undisturbed conditions. *Bartonia texana* appears to be truly rare.

Need for Change
This species is difficult to locate and identify and due to its infrequency this species may not be a good indicator of the quality of the bay shrub community (Rob Evans personal communication). Recommend dropping this species as a management indicator.

Sweetbay-Magnolia Series
Background
This community type is a mainly deciduous to evergreen low forest occurring over seeps, in wet creek bottoms, and in other permanently moist soils in East Texas. It is often associated with the sphagnum-beakrush series, and may be successional to bogs in the absence of fire. These areas are typically protected from logging operations. Periodic fire may maintain some grassy vegetation in these habitats.

Selection
As a valuable component of the mesic plant community associated many times with MA-4, the selection of this community was to evaluate the quality of streamside zones and the associated plants within those communities.

Monitoring Methods
Acreage of this community is monitored through GIS and GPS data. Quality is monitored through site visits to known glades.

Results
The 1990 TNHP Report noted 15 locations on 325 acres of the Angelina and Sabine NFs, and another location of 29 acres on the Sam Houston NF. The *Plan's* status is 250 acres, which was determined from 1991 CISC records. For several years we have monitored this community by using forest type code 68 (sweet bay - swamp tupelo - red maple). CISC data from 1992 showed 502 acres in forest type 68. FSVeg data at the end of 2011

shows there were 461 acres in forest type 68. Some of these sweetbay – magnolia acres coincide with the 354 acres mapped by TNHP. In recent streamside zone protection efforts, better documentation of sites meeting these criteria was realized. The new acreage for these communities will be added to the existing GIS data.

Evaluation
These areas are in MA-4 and are typically protected during timber harvest and other mechanical operations. As new sites are added to FSVeg, TNHP areas need to be checked against FSVeg records to be sure they are correctly identified in the database.

Need for Change
Continued improvement of community identification should be valuable in assessing the extent and quality of this management indicator. Forest Service personnel should be made aware of this habitat type and record it as such in FSVeg, providing a more accurate assessment of extent and quality of this habitat.

Dry-Xeric Oak-Pine Forests Habitat

This habitat is found over much of the northern Sabine, Angelina and most of the Davy Crockett and western Sam Houston National Forests. Chapter V of the *Plan* identified the Red-cockaded woodpecker as a management indicator (discussed previously in Longleaf pine woodlands and Savannahs) and the plant, the Louisiana squarehead, and the shortleaf-oak forest series plant community as management indicators for the dry-xeric oak-pine forest habitat. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Louisiana Squarehead (*Tetragonetheca ludoviciana* (Torr. & Gray) Gray)
Background
Known also as the sawtooth nerveray, this species has been recorded in 19 east Texas counties as well as in western Louisiana and extreme southwest Arkansas (according to the TNHP report). Known populations are small in number of individuals (Rob Evans personal communication), and are known to occur on Davy Crockett and Angelina NFs. Infrequent fires should help maintain this species. The Global Status of the Louisiana squarehead is classified as G4-Apparently Secure, and S3-Vulnerable for the State of Texas (NatureServe 2011).

A population of Louisiana squarehead was discovered on the Sabine NF in 1998 during surveys following windstorm damage. This population was relocated by Ferguson in 2000.

Figure 17. Louisiana Squarehead.

Photo by Tom Philipps, USFS.

Selection
Louisiana squarehead is restricted to sandy soils in sandhill woods and xeric sandhills in longleaf pine savannas. It was selected in order to monitor management effects on these habitats by analyzing the population trends and number of extant occurrences of this species. Management practices that would disturb the deep sandy soil would be detrimental. Periodic prescribed burning would retard woody invasion, thereby maintaining open sandy areas with little competition.

Monitoring Methods
This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results
Angelina NF. Most of the populations of Louisiana squarehead have been found on the Angelina NF. The 1990 TNHP report documented two locations. The MacRoberts found five additional populations in 1995. Pike collected a specimen in 1997. Evans found another population in 1998. In 2005, Philipps found an additional location of this plant and relocated a population found by the MacRoberts. Another occurrence was found incidentally during a survey of a hillside bog in 2006. Vegetative surveys of the Upland Island Wilderness area in 2007 resulted in finding a new population and relocating another. Philipps and Walker surveyed for this species in 2009 resulting in the documentation of two new populations, both occurring on the top of xeric bluejack oak sandhills. Philipps and Loos documented a very large population in Compartment 1 in 2010. In 2011, Loos documented a new occurrence within the Upland Island Wilderness. The baseline in the Plan was five populations, which included two locations that were

reported by TNHP, both occurring on the Angelina NF. The current known populations are estimated at 15 on the Angelina NF.

This species is uncommon across the District. It prefers open deep sandy soils with little competition. The initiation of growing season burns would improve habitat for this species as seen in the Compartment 76 wildfire which impacted a number of individuals. Monitoring after the fire revealed that the plants were flourishing but have steadily declined back to pre-wildfire numbers. The current drought may also be a factor in this trend.

Sabine NF. An occurrence of Louisiana squarehead was discovered on the Sabine NF in 1998 during surveys following windstorm damage. This occurrence was relocated by Ferguson in 2000. Surveys in 2011 in the Foxhunter Hill Area (C-139) failed to relocate a previously documented location.

This species has not been recently found on the District. It prefers open deep sandy soils with little competition. The initiation of growing season burns would improve habitat for this species as seen in the Compartment 76 wildfire on the Angelina NF which impacted a number of individuals. Monitoring after the fire revealed that the plants were flourishing but have steadily declined back to pre-wildfire numbers. The current drought may also be a factor in this trend.

Davy Crockett NF. Philipps conducted surveys for Louisiana squarehead in 2005 and rediscovered four occurrences. In 2010, Loos surveyed areas in and around the Northwest corner of the forest and did relocate one known occurrence but failed to discover any new locations.

This species has been documented on the District. It prefers open deep sandy soils with little competition. The initiation of growing season burns would improve habitat for this species as seen in the Compartment 76 wildfire on the Angelina NF which impacted a number of individuals. Monitoring after the fire revealed that the plants were flourishing but have steadily declined back to pre-wildfire numbers. The current drought may also be a factor in this trend.

Sam Houston NF. Louisiana squarehead has not been previously documented on the Sam Houston NF and was known from only a historical record collected by Turner in Montgomery County 5 miles east of Willis, Texas. In 2011, Elliott documented this species in a right of way in C- 37 on the Sam Houston NF, again within Montgomery County. It is the only known site for this species on the forest.

This species prefers open deep sandy soils with little competition. The initiation of growing season burns would improve habitat for this species as seen in the Compartment 76 wildfire on the Angelina NF which impacted a number of individuals. Monitoring after the fire revealed that the plants were flourishing but have steadily declined back to pre-wildfire numbers. The current drought may also be a factor in this trend.

Evaluation
Louisiana squarehead is found in deep sandy soils of longleaf pine sandhills and bluejack oak sandhills, as well as within road ROWs. It is a fire-adapted species and appears to respond well to any fire intensity, as has been documented following the wildfire in C-77 of the Angelina NF where this species was seen to flourish as the result of that very intense fire. Also, the numbers of individuals found within road ROWs suggests that this species does well when there is a lack of woody competition. Forest-wide populations seem to be stable, and new populations are being discovered as additional surveys are completed within suitable habitat.

Need for Change
All populations have been mapped and entered into GIS coverage. Sites have been revisited to determine if they are still extant. Continue to use this species as management indicator in the next Forest Plan Revision.

Shortleaf – Oak Forest
Background
This community type occurs primarily in northeast Texas and is characterized by mainly deciduous upland woodlands on shallow to deep, usually sandy soils. Shortleaf pine is the dominant evergreen species, but loblolly pine may also be present. The common oak species are southern red, white, black, post, and blackjack, and hickories are often present as well. Periodic prescribed fire is the most effective management tool of this community. Frequency and intensity of fires will determine the structure of these communities. More frequent fires will favor shortleaf and infrequent fires will favor hardwoods. The *Plan's* baseline for this community is 150,000 acres with a short-term objective to increase acreage to 160,000. Current acreage in shortleaf pine is 147,332.

Selection
This community was chosen as a management indicator due to its importance to many other species such as red-cockaded woodpecker and certain plant species. Quantifying acreage of this community was thought to provide a gauge to the extent of this community and those species of interest.

Monitoring Methods
Two criteria are used to monitor and evaluate the extent and quality of shortleaf pine – oak forest. One is more quantitative, the other more qualitative.

The Continuous Inventory of Stand Condition (CISC) was the database used to tract forest cover types and was recently replaced by a new system called FSVeg. The annual change in this database describes changes in acreage identified as shortleaf pine forest (stands dominated by shortleaf pine). Since restoration of shortleaf pine is a Forest Plan objective, acreage changes for this community reflect: (1) stands regenerated from another species to shortleaf pine; and (2) those that have been treated to favor shortleaf pine through thinning or other cultural efforts.

Disturbance through fire is the other criteria used to evaluate the shortleaf - oak community. This effort is gauged strictly on frequency of fire and its impact on the shortleaf pine stand. FSVeg allows greater quantification of under-story vegetation, and this database may be developed to monitor this aspect of this community.

Evaluation
Better evaluation of this community and habitat type is needed. As new and more detailed information is entered into the FSVeg database, better assessment of both the extent and quality of this habitat may be improved.

Need for Change
Analysis of fire history using GIS is needed to plan and direct future burning operations in these communities. These communities should persist in the future on the NFGT.

Mesic Oak-Pine Forests Habitat

The *Plan* selected the Red-cockaded woodpecker which is discussed previously in 'longleaf pine woodlands and savannahs' and the loblolly-oak forest plant community as management indicators for the mesic oak-pine forest habitat. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Loblolly – Oak Forest
Background
This community type occurs on loamy or sandy acidic soils in East Texas, and is characterized by mainly deciduous upland forest. Loblolly pine is the dominant evergreen species, but shortleaf pine may also be present. The common oak species are southern red, white, post, and water, and hickories are often present as well. Timber harvest, planting and prescribed fire will convert some stands, where suitable, to more desirable species composition consisting of longleaf and shortleaf.

Selection
This community was chosen as a management indicator due to its large expanse over the NFGT. Quantifying acreage of this community was to provide a gauge to this large forest community and the change through time as areas were converted to longleaf and shortleaf pine.

Monitoring Methods
One quantitative criteria is used to monitor and evaluate the extent and quality of the loblolly pine – oak forest.

The Continuous Inventory of Stand Condition (CISC) was the database used to tract forest cover types and was recently replaced by the system called FSVeg. The annual change in this database describes changes in acreage identified as loblolly pine forest. Since restoration of longleaf and shortleaf pine are *Plan* objectives, tracking the change in acreage of loblolly pine forests was important.

Results
The *Plan's* baseline is 300,000 acres, although the 1992 CISC records show there were 357,297 acres in this community. The *Plan's* short-term objective is a reduction to 270,000 acres in this type being replaced by other types on suitable sites (longleaf, shortleaf, bottomland hardwoods, etc.) either by natural succession or management treatment. Current FS VEG acreage identifies 339,739 acres in mesic oak-pine forests.

Evaluation
The number of acres of loblolly – oak forest has been stable for several years.

Need for Change
Soil layers in GIS will help managers make better decisions on where stands should be converted.

Mesic Hardwood Forests Habitat

The southern ladyslipper and the beech-white oak series plant community were selected during *Plan* development as management indicators for the mesic hardwood forest habitat. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Kentucky Lady's Slipper (*Cypripedium kentuckiense* C.L. Reed)
Background
This species occurs on mesic beech-white oak forested slopes in East Texas. These slopes are generally only impacted by prescribed fire on a rare basis. This species is distributed from the Ouachita Mountains in Arkansas east to the Cumberland Plateau in Kentucky and Tennessee, south to the East Gulf Coastal Plain in Alabama and Mississippi, and west to Louisiana, southeastern Oklahoma and eastern Texas. The TNHP Report noted populations in seven counties in East Texas, including three populations on the Sabine NF and one on the Angelina NF. The Global Status of the southern ladyslipper is classified as G3-Vulnerable, and S1-Critically Imperiled for the State of Texas (NatureServe 2011).

Selection
This species is quite showy and considered a key element in the mesic hardwood habitats in the southeast. It was chosen to represent the quality understory condition of the beech-white oak community.

Figure 18. Southern Ladies'Slipper.

Photo by Tom Philipps, USFS.

Monitoring Methods
This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results
This species occurs on mesic beech-white oak forested slopes in east Texas. These slopes are generally only impacted by prescribed fire on a rare basis. It is distributed from the Ouachita Mountains in Arkansas east to the Cumberland Plateau in Kentucky and Tennessee, south to the east gulf coastal plain in Alabama and Mississippi, and west to Louisiana, southeastern Oklahoma and eastern Texas. The TNHP Report noted populations in seven counties in east Texas, including three populations on the Sabine NF and one on the Angelina NF. The Global Status of the Southern Lady' Slipper is classified as G3-Vulnerable, and S1-Critically Imperiled for the state of Texas (NatureServe 2011).

Angelina NF. One population of southern ladies slipper has been documented on the Angelina NF, but it has not been relocated in the most recent survey for this species on the district. The 1990 TNHP report documented one population of the orchid on the Angelina. This population was relocated by Singhurst (1996). Philipps found the Angelina lady's slipper population in 2005, but did not relocate it in his 2007 survey with Loos. In 2009, Loos did relocate this species within its original location. Philipps and Loos once again located and monitored this location in 2010 and 2011. This site remains stable with an average of 2-3 flowering specimens per year.

Occurrences of this species have been stable for more than 15 years. They are not declining but neither are they expanding. It has been suggested that the Texas individuals are part of a relict population, outliers of a much more numerically abundant group. Habitat is limited in Texas; however, individuals do not seem to have been negatively impacted from hurricanes, poaching, and feral hogs. A dedicated reintroduction program should be initiated.

Sabine NF. Nine extant occurrences of Kentucky ladies slipper are currently known to be present on the Sabine NF. The 1990 TNHP report documented three occurrences of this orchid on the Sabine. Walker relocated one of these occurrences in 1990. Singhurst found three more occurrences and relocated three (1996). The MacRoberts found a new occurrence of the orchid in 1996. Evans and other biologists found two new occurrences in 1998. Ferguson relocated these occurrences in 2000 and 2001. Philipps relocated five occurrences in 2005. Surveys in 2006 by the Forest Service, TPWD, Azimuth Forestry, and the Pineywoods Chapter of the Texas Native Plant Society resulted in relocating several occurrences and one new occurrence. Philipps and Loos relocated five occurrences in 2007. Philipps surveyed for new occurrences in 2008. He did not find any new occurrences, but relocated two known occurrences. In 2009, Philipps and Loos again surveyed for this species. No new occurrences were discovered but all known locations were revisited and are extant. Surveys by Philipps and Loos in 2010 resulted in the relocation and of many of the known locations and the inadvertent discovery of a new occurrence totaling four plants on lands managed by the Campbell Group in the Matlock Hills area of the Sabine NF.

2011 surveys by Singhurst and Loos in and around Compartments 2-4 failed to find this species, although suitable habitat was present. Other known sites in Matlock Hills, Height Hill, Indian Mounds Wilderness, Cypress Creek, Boat Ramp, and Bourghs Creek were revisited by Loos and appeared to be stable but exhibited very few flowering specimens as compared to past years.

Evaluation

Populations of this species within the NFGT seem to be stable. The scattered distribution and few individuals within each population seems to suggest that this species is indeed at the edge of its range and may even be considered “relict” populations; remaining individuals of a historically much more numerically widespread distribution. A previous threat to this species has been poaching from orchid enthusiasts. The latest and much more serious threat to this species continued existence in the NFGT is the exponential expansion of the feral hog population. Serious feral hog damage from rooting was observed in proximity to most of the known sites. Another question surrounding this species will be its response to the effects of Hurricane Rita, which had serious impacts on the beech-white oak forest type. The Hurricane felled many of the large beech and white oaks where populations of this orchid occurred, opening up the canopy and exposing much more of these mostly shaded areas to sunlight. The response of this species to this environmental change will be monitored.

Need for Change
A cooperative agreement between the Forest Service and TPWD has been initiated for further surveys for this species and associated species found in the same communities. Continued inventory of four to six compartments a year should survey all suitable habitats within a three-year period. Prescribed fire should be allowed to slowly creep down the slopes and extinguish naturally.

Beech-White Oak Series
Background
The *Plan's* baseline of 2,532 acres results from consolidation of the American beech-white oak series and the American beech-southern magnolia series acres reported by TNHP and as recorded in the CISC database during development of the LRMP. Additional area of this type is known and may be typed in FS VEG as forest type 53 (white oak-Northern red oak-hickory) and others. The Nature Conservancy examined the status and extent of many forest communities in which American beech is present in the overstory during 1997. Many stands of beech were significantly impacted during the blowdown on the Sabine and Angelina National Forest in 1998, Hurricane Rita in 2006 and Hurricane Ike in 2008.

Selection
This community type occupies mesic ravines and ridges within creek bottoms. This community is found almost exclusively on the Sabine National Forest and to a limited extent on the northern Angelina National Forest. It is considered as habitat for a number of other less common forest plants.

Monitoring Methods
Identification of this forest series is a primary requirement in order to manage for this habitat. The Ecological Classification System landscape model, the GIS database, and CISC were utilized to select 38 sites on the northern Sabine NF for field survey between 1998 and 2000. Of these sites, 21 were ranked as high-quality examples of natural lower slope mesic forests. Community maps and element occurrence data forms for each site are on file and will be utilized to incorporate this information into the GIS and FS VEG databases for the Sabine NF. Once recorded as such, regular monitoring of quality and condition can continue as sites are entered during various project planning efforts.

Results
Most mesic hardwood areas are protected from mechanical disturbance; additional sites are contained in TNHP sites and Scenic Areas such as Beech Ravines and Colorow Creek. No real change in acreage from the 2,500 baseline has occurred; beech and all other mature hardwood stands were significantly impacted by Hurricanes Rita and Ike.

Evaluation
Many of the known areas for this community type remain unmapped. A consistent means of identifying stands is needed to determine the baseline number of populations. Recent work on the NFGT (by Nature Serve under agreement with USFS Region 8) has helped to clarify the range of variability in this type.

Need for Change
At the western margin of occurrence on the Sam Houston NF, this community may transition into one dominated by laurel oak. Laurel oak stand acreage should be included in future reports as part of this community type. The NFGT does not currently have a forest type code for just laurel oak; however, there is a laurel oak-willow oak, code 64. FSVeg currently has 1,118 acres in forest type 64.

Tallgrass Prairie Habitat

The *Plan* selected the Northern bobwhite quail and the little bluestem-Indiangrass plant community series as management indicators for the tallgrass prairie habitat. This habitat occurs on the Caddo and LBJ National Grasslands. A discussion of the most current information regarding the effects of management to these species/communities and their habitat follows.

Northern Bobwhite Quail *(Colinus virginianus)*
Background
Tallgrass prairie habitat for the Northern bobwhite is distributed across all units of the LBJ and Caddo National Grasslands of Texas. The LBJ Grasslands has considerably more tallgrass prairie habitat. As a general rule in Texas rangelands, quail prefer areas containing the significant bare ground, with low to moderate grass cover, and some tall forbs. The North American Breeding Bird Survey indicates that from 1966-1998, Northern bobwhite populations underwent a significant range-wide decline of -2.7% every year in nearly every state within their geographic range, and has been nearly extirpated from Ontario, Canada. The Global Status of the Northern bobwhite is classified as G5-Secure, and S4B-Apparently Secure for the State of Texas (NatureServe 2011).

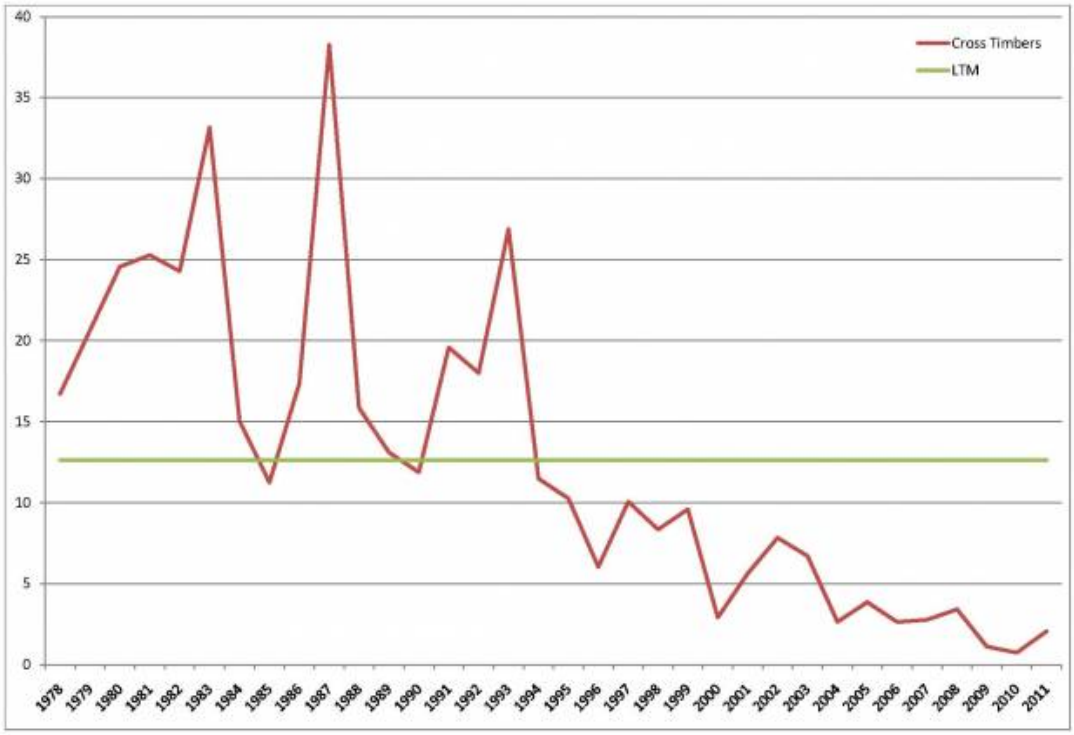
Selection
Northern bobwhite was chosen as a management indicator species for Tallgrass Prairie habitat because of its small home range and habitat diversity requirements. This bird species responds to frequent burning and other disturbance activities that scarify the soil creating grass/herbaceous ground cover in close association with shrubs, vines, and young trees. As an important game bird, selection of this species was an attempt to blend demand with the quality of grassland habitat. The habitat requirements include brushy areas for cover, grass seeds and greenery in the spring, woody plant fruit in the summer, and forb seeds, berries, and oak mast during the fall and winter.

Monitoring Methods
Monitoring of the species, according to the *Plan*, is accomplished through annual census methods. Quail route data collected annually on the grasslands has been utilized to meet forest-monitoring guidelines. In addition, Texas Parks and Wildlife Department obtains statewide data through survey routes established in 1976 and repeated annually to determine quail population trends.

Results

Northern bobwhite throughout the Cross timbers region of north Texas have experienced declines and are currently in very low numbers over the last 20 years (Figure 19).

Figure 19. Mean Number of Bobwhite Quail Observed/Route in the Cross Timbers Ecological Region of Texas.



Although inventory data specifically for the grasslands is only available for the past seven years, it appears the Northern bobwhite quail on the Caddo National Grasslands have been slightly decreasing and are in very low numbers particularly on the Caddo National Grasslands (Figure 19). Some years the weather conditions on the grasslands have hindered the burn program; however, in recent years the staff on the grasslands has increased the burning acres and frequency and is committed to improving quantity and quality of the desired grassland habitat (Table 13).

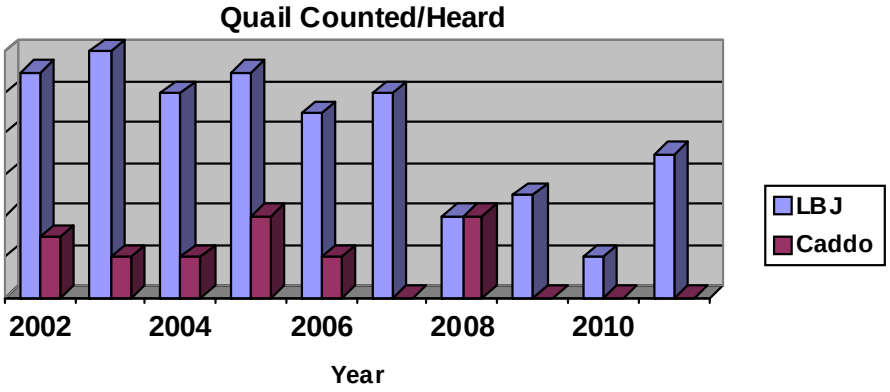
Table 13. Caddo/LBJ National Grasslands Burns 2007-2011.

Year	LBJ	Caddo	***Total Acres***
2011*	0	0	*0*
2010	5,043	0	*5,043*
2009	0.00	8,227.02	*8,227.02*
2008	3,282.53	0.00	*3,282.53*
2007	325.20	4,218.31	*4,543.50*

*No acres accomplished because of the 2011 drought.

Evaluation
The long-range viability of Northern bobwhite seems fairly secure on the LBJ, but may be at risk on the Caddo (Table 14). Grazing continues to decline on both Grassland Units; however, prescribed fire has increased. As habitat changes occur, impacts from recreational use and populations of quail will be evaluated.

Table 14. Number of Quail Heard During Point Counts for Quail on the LBJ and Caddo National Grasslands



Need For Change
In the past, limited habitat management actions have occurred on the grasslands. Until significant prescribed fire improves more area, quail populations will be impacted mostly by weather. As fire and other management actions occur, a database is needed (similar to FS VEG) to track grassland habitats and conditions. Quail are a good management indicator; however, tracking habitat along with population information is needed. Recently the burn history has been mapped and calculated and will continue to be monitored.

Little Bluestem – Indiangrass Series
Background
Little bluestem and Indiangrass series represents a unique tallgrass prairie ecosystem on approximately 15,000 acres of the Caddo and LBJ NGs. No other NFGT unit has this plant community series.

Selection
The little bluestem - Indiangrass grass series was selected as a management indicator to capture the unique prairie vegetation, which is of concern throughout North America. Ongoing management activities are designed to maintain or improve tallgrass prairie habitat on both grassland units.

Monitoring Methods
This vegetation type is monitored qualitatively through range analysis. There is no current database to quantify changes through time, but quality is established through habitat management aspects such as prescribed fire.

Results
Prescribed fire and grazing are the management treatments that maintain and restore little bluestem-Indiangrass habitats on NFGT Grasslands.

Evaluation
It is possible in the future some tallgrass prairie could be restored on the Sam Houston National Forest. Through restoration efforts, some sites could exist on the Sam Houston as small remnant blackland inclusions; but, these small patches are disturbed and are not currently representative of tallgrass prairie. Efforts are underway to restore these sites and monitoring through time will evaluate the success or failure of these actions.

Need For Change
While prescribed burning on the grasslands has improved the condition of this community series, there is no known significant increase in acreage. Development of a management tool (similar to FSVeg) to track grassland habitats and conditions is needed.

Bottomland Streamsides Habitat

The *Plan* selected a bird guild – described as the Neotropical Migrants- (yellow-throated vireo, wood thrush, Acadian flycatcher), the Neches river rose mallow (a federal candidate plant species), and the bottomland hardwood forest community series as management indicators for the bottomland streamsides habitat. By the *Plan's* direction in MA-4, these habitats are typically protected from timber and road construction projects. Other impact to this habitat is limited to low intensity prescribed fire, weather and/or other natural events. A discussion of the most current information regarding the effects of management to these species/guild/communities and their habitat follows.

Neotropical Migrant Bird Guild
Background
The group of birds specifically listed in the *Plan* as the guild of neo-tropical birds is described as Acadian flycatcher, yellow-throated vireo, and wood thrush. These three birds are typical of hardwood bottoms in East Texas. Key habitat requirements are moist deciduous forests with a moderate understory, generally near a stream (Hamel et al. 1982). The Global Status of all three bird species is classified as G5-Secure, and S5-Secure for the State of Texas (NatureServe 2011).

Selection
This bird guild was selected as a management indicator because of its sensitivity to habitat loss or degradation and habitat fragmentation (and therefore indirectly, cowbird parasitism and nest predation). Stable or increasing populations would indicate preservation of the appropriate habitat without impacts from fragmentation. The NFGT have annually conducted breeding bird point surveys since 1998.

Monitoring Methods

A standard point-count migratory bird monitoring system was developed by the U. S. Forest Service to establish a long-term standard; the methodology emphasized migratory and resident landbirds. In 1998, the NFGT implemented this strategy and has continuously performed the annual monitoring effort on the four national forests. Standardized bird monitoring procedures were developed for measuring the success in achieving population and habitat objectives at the Forest and Regional levels. The goal of these programs was to contribute information to our understanding of the trends and status of the species occurring in the region.

Results

Figure 20. Netropical Migratory Bird Counts (All Units).

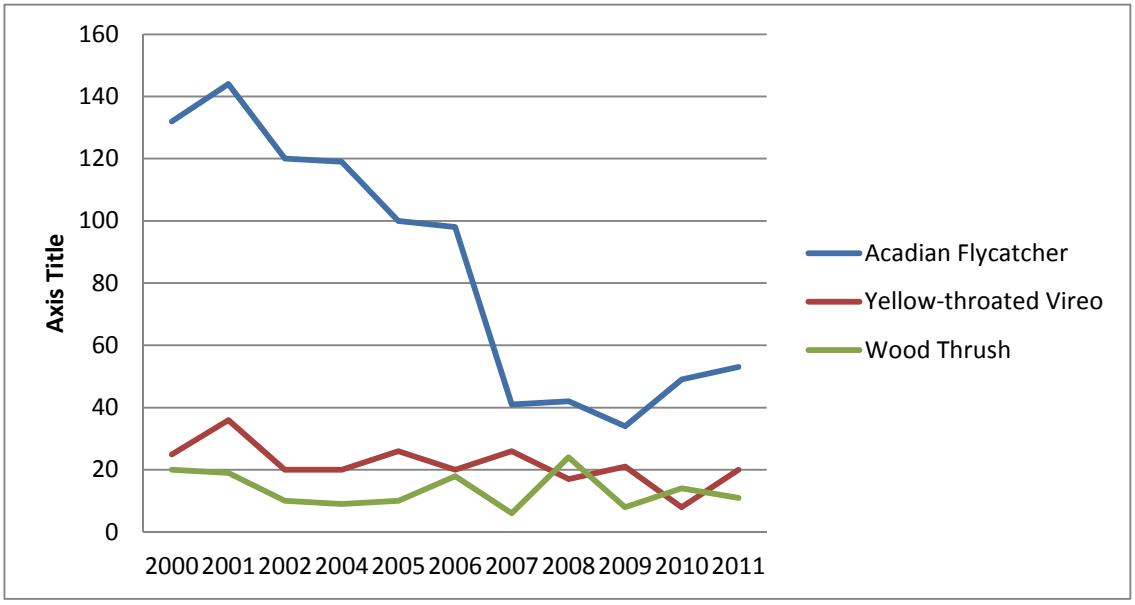


Table 15. Neotropical Migratory Bird Counts by Unit 2008-2011.

Acadian Flycatcher				
	2008 (#)	2009 (#)	2010 (#)	2011 (#)
ANF	6	5	4	11
SNF	14	4	15	13
DCNF	8	13	11	9
SHNF	14	5	7	11
CNG	--	7	12	9
	42	34	49	53

Yellow-throated Vireo				
	2008 (#)	2009 (#)	2010 (#)	2011 (#)
ANF	4	3	2	0
SNF	3	3	2	0
DCNF	5	5	1	10
SHNF	5	7	3	6
CNG	--	3	0	1
	17	21	8	20

Wood Thrush				
	2008 (#)	2009 (#)	2010 (#)	2011 (#)
ANF	3	1	0	1
SNF	5	1	2	2
DCNF	13	5	7	1
SHNF	3	1	5	9
CNG	--	0	0	0
	24	8	14	11

Evaluation

Acadian Flycatcher populations appear to be stable over the last few years. Populations of the Yellow- throated Vireo and Wood Thrush have a declining population trend on the NFGT and throughout their entire range (The Birds of North America, 2009).

Neotropical Migrant species spend part of the year in North America and the winter in Central and South America. They are susceptible to forest fragmentation (especially in Central and South America) and cowbird parasitism (The Birds of North America, 2009). The Forest Service provides protection for Neotropical Migrants within Management Area 4 – Streamside Management Zones.

Need for Change

The NFGT recommends keeping the bird guild as a management indicator for Bottomland Hardwood habitats.

Neches River Rose Mallow (*Hibiscus dasycalyx* Blake & Shiller)
Background
Neches river rose mallow is a Texas endemic that was federally declared a candidate species on May 4, 2004. The known range of this species is limited to the Davy Crockett NF on the NFGT, but suitable habitat may occur elsewhere. It is generally found to occur within openings in shrub swamps or along the margins of riparian woodlands in seasonally wet soils (often found near standing water). Sites are typically flooded during late winter and early spring, but the surface soils are often quite dry by late summer. In 2004, it was known from only six sites in three East Texas counties. All of the occurrences are subject to genetic swamping by more common hibiscus species that are perhaps better adapted to human-disturbed conditions. The Global Status of this species is classified as G1-Critically Imperiled, and S1-Critically Imperiled for the State of Texas (NatureServe 2011). The viability of this species is considered to be at high risk of failing.

Figure 21. Neches River Rose Mallow.

Photo by Tom Philipps, USFS.

Selection
This species was selected as a management indicator due to its preference for the bottomland streamsides habitat, as well as its sensitivity to management activities

Monitoring Methods
This species is monitored through ground surveys. Annual surveys are conducted for new populations of this species by Forest Service personnel, partners, and contractors. These surveys may be specific to this species or may be conducted as part of a broader survey effort in support of Forest planning. Information on new populations is recorded via GPS and entered into the Forest GIS database.

Results

Davy Crockett NF. All known occurrences of Neches River Rose Mallow on the NFGT are located on the Davy Crockett NF. Records of surveys are somewhat spotty, but four occurrences had been documented by the early 2000's. These four occurrences were relocated by Philipps in 2005, and have been subsequently monitored in 2006 and 2007. An expedition by Loos down the Neches River from Neches Bluff past the Big Slough Wilderness area in 2010 resulted in the documentation of three locations for this species, however two of the occurrences appeared to be hybrids and the one seemingly genetically pure occurrence occurred within a private inholding.

All four known sites were visited in 2011 by a group including Singhurst, Poole, Philipps, Loos, and several representatives from U.S. Fish and Wildlife Service as part of an evaluation process for possible listing of this species under the Endangered Species Act. Viable plants were found at all four sites. Occurrences seemed healthy despite being somewhat stunted due to the drought and visible predation from animals and insects. Past flowering with seed production was observed in all sites. Chinese tallow was observed in all locations. Philipps and Loos also surveyed several other areas of suitable habitat within Compartments 54 and 49 without success. Later, Loos surveyed areas around Slay Creek and Barton Branch within Compartments 118, 120, and 121 again without success.

This species does not generally occur in bottomland streamside habitat but rather on or near the edges of small lakes, sloughs, and seasonally wet buttonbush swamps. It does tend to hybridize with other members of this genus, thereby making identification sometimes difficult. It has limited distribution on the NFGT. Past re-stocking efforts have proven to have mixed results. A re-introduction program should be initiated to supplement past efforts. The Chinese tallow needs to be eradicated from all known sites.

Evaluation

The viability of this species is currently stable. By the *Plan's* direction, these bottomland streamside habitats are typically protected from timber and road construction projects; therefore, habitat degradation and detrimental impacts to the known and unknown populations would be limited.

Need for Change

Inventories are needed bi-annually to monitor progress of restoration efforts. Damage occurred in one area where restoration efforts were implemented. A water-control structure needs to be installed at this site. The three unconfirmed populations need to be verified.

Bottomland Hardwood Series

Background

The Bottomland Hardwood Forest community is of great interest throughout the south as well as in Texas. This community series consists of a mix of the following species: swamp chestnut oak, cherrybark oak, sweetgum, Nuttall oak, willow, sugarberry, American elm, green ash, laurel oak, willow oak, overcup oak, water hickory, sycamore and pecan, in bottomland areas.

Selection
This community was chosen as a management indicator due to its important coverage connecting upland communities over the NFGT. Quantifying acreage of this community was to provide a gauge to this important forest community and to understand both the quantity and quality of this habitat to many important species.

Monitoring Methods
Quantity of bottomland hardwood areas would be determined through stand examinations stored in the previously used CISC database and presently in the new FSVeg database. These designations of stand areas are performed with the use of both GPS and GIS technology.

Results

The *Plan's* baseline was 25,000 acres. Acreage was retrieved annually using the CISC records; this broad group includes CISC forest types 46, 61, 62, 63, 64, 65, 67, 75 and 98. According to 1992 CISC data, there were 40,691 acres in these forest types, but the latest FSVeg data shows 34,107 acres.

Evaluation
These areas are protected during timber harvest and road building projects; therefore, direct impacts to this community are minimal. Changes in the community allocation are primarily the improvement of the Forest Land Evaluation and Tracking Database (FSVeg). The old CISC database has been converted to the new FSVeg system; this new system and more refined data capability may improve evaluation of this plant community series across the NFGT.

Need for Change
Acreage of this forest type should persist on the NFGT with minimal or no change in the future.

M&E SURVEYS FOR MIS PLANTS BY DISTRICT

The following section describes surveys and monitoring of MIS plants by individual districts. No naturally occurring MIS plant occurrences are known to occur on the grasslands of the NFGT.

Table 16. Angelina NF MIS Plant Surveys

Slender Gay Feather	1986, 1987, 1988, 1989, 1994, 1995, 1998, 1999, 2001, 2006, 2007, 2009, 2010, 2011
Incised Agrimony	1988, 1989, 1994, 1995, 1996, 2006, 2007, 2010, 2011
Scarlet Catchfly	2006, 2007, 2009, 2010, 2011
Navasota Ladies'-tresses	1986, 1996, 2005, 2006, 2007, 2009, 2010, 2011
Yellow Fringeless Orchid	1988, 1998, 2005, 2006, 2007, 2008, 2009, 2010*, 2011
Nodding Nixie	1988, 1995, 1998, 2005, 2006, 2007, 2009, 2010*, 2011
Texas Bartonia	1994, 1995, 2005, 2006, 2009, 2010*, 2011
Louisiana Squarehead	1990, 1995, 1997, 1998, 2005, 2006, 2007, 2009, 2010, 2011
Kentucky Lady's Slipper	1990, 1996, 2005, 2007, 2009, 2010, 2011

Table 17. Sabine NF MIS Plant Surveys

Slender Gay Feather	1987, 1994, 1995, 2004, 2005, 2006, 2009, 2010, 2011
Incised Agrimony	1994, 2009, 2011
Scarlet Catchfly	1990, 1991, 2005, 2006, 2007, 2009, 2010, 2011
Nodding Nixie	1988, 1995, 1998, 2006, 2009, 2010*, 2011
Louisiana Squarehead	1998, 2000, 2011
Kentucky Lady's Slipper	1993, 1996, 1998, 2001, 2005, 2006, 2007, 2008, 2009, 2010, 2011
Texas Bartonia	2009, 2010*2011

Table 18. Davy Crockett NF MIS Plant Surveys

Scarlet Catchfly	2006
Louisiana Squarehead	2005, 2010
Neches River Rose Mallow	2005, 2006, 2007, 2010, 2011

Table 19. Sam Houston NF MIS Plant Surveys

Nodding Nixie	1997, 2006, 2007, 2010* 2011*
Texas Bartonia	1994, 2006, 2007, 2010* 2011*
Louisiana Squarehead	2011

Aquatic Systems

Fisheries and aquatic monitoring responsibilities are linked to select management indicators in the 1996 Forest *Plan*. As such, Appendix G of the 1996 *Plan* assigns monitoring tasks and timetables relative to these management indicators.

Aquatic Inventory, Survey & Monitoring History

Limited fish inventory had been done on the NFGT prior to 1990. Some scattered samples from academia and two TPWD pre-reservoir studies existed, but most of the information was greater than 20 years old and much derived from streams outside USFS holdings. This historic information was searched out and compiled in an Access database. The oldest record was from 1948. The NFGT began sampling streams in 1991 and contracted baseline surveys on each forest for fish and benthic macroinvertebrates primarily through SFASU and Texas A&M cost-share projects. These surveys included a minimum of 10 streams sampled quarterly per district. The final baseline fish survey on the Angelina NF was completed in 2001. Some data gaps in crayfish and mussel surveys exist on all Forests. Crayfish are sampled in one watershed annually based on impending projects. Beyond baseline sampling, forest fisheries personnel sample numerous creeks, especially those tied to projects. Over 400 locations were sampled and logged into the database along with contracted baseline data.

Almost all sampling was done via 100 meter segment electro-shocking, in combination with seining and occasional dip-netting. When possible, pH, conductivity, alkalinity and dissolved oxygen samples were taken. Concurrent with some fish samples, benthos were also taken by one-minute kick-net or search methods and rated with an abbreviated Environmental Protection Agency (EPA) score-sheet ("stonefly guild" as per LRMP).

Lake and pond sampling also began in earnest around 1992, where there had been almost no prior sampling, except for some one-time events in Ratcliff, Red Hills and Double Lake Recreation Area Lakes. Texas Parks and Wildlife Department has routinely sampled Coffee Mill and Davy Crockett Lakes on the Caddo NG.

Ponds and Reservoir Aquatic Species

Largemouth Bass (*Micropterus salmoides)*
Background
The largemouth bass is the focal freshwater species in Texas and as the result of intensive TPWD stocking efforts, most native strains have been hybridized with the preferred Florida largemouth. This effort was strictly focused on growing larger game-fish and may have the counter-effect of eliminating the native "northern" strain from most watersheds/water bodies.

Selection
This species was selected for aquatic pond and reservoir habitats because of its focal status as a demand species.

Monitoring Methods
The primary method for collecting is by electrofishing from a special boat that stuns the fish so they can be collected, measured, weighed, aged and released. Other collection methods include frame-netting and gill-netting. Gill-netting, however, induces mortality in all captured fish, but is a better means of collecting and assessing "rough fish" populations than shocking.

All data and analyses are from NFGT electro-fishing reports, except for Coffeemill and Davy Crockett Lakes, which are monitored by TPWD out of the Texoma Fisheries Office. These sources also apply to sunfish and channel catfish summaries for these reservoirs.

Results

In the *Plan*, the short-term objective was to have 40-90 bass per hour catch rate in all managed reservoirs. By 1998, this had been achieved in all but Ratcliff, Cottonwood and Clear Lakes (all of which developed weed problems, curtailing fertilizing and other management efforts). In 2001, Red Hills Lake yielded a 13.2 pound Florida hybrid female that was stocked as a fry in 1992. Black Creek Lake produced two fish over 10 pounds in 1999. Combined with the loss of federal fish and prevalent weed problems, management was curtailed on all but Crockett and Coffeemill Lakes. We still do some intermittent habitat work in Boykin Springs Lake, Fannin, Red Hill Lake and Double Lake. See evaluation section for details of 2011 results.

Table 20. Largemouth Bass Survey Results From Specified Lakes. (Numbers indicate fish catch rate per hour via electro-fishing.)

Lake	2004	2005	2006	2007	2008	2009	2010	2011
Black Creek	0	0	0	0	0	0	0	
Bouton			12					1.07*
Boykin			13					
Coffeemill	0	100	0	0	0	210	0	
Cottonwood	0	0	0	0	0	0	0	
Clear	0	0	0	0	0	0	0	
Crockett	0	82	118	0	0	99	0	
Double								1.10*
Fannin	0	0	0	30	0	0	0	
Neiderhofer								1.05*
Ratcliff	0	0	0	0	0	.84*	40	
Red Hills	0	0	0	0	0	0	0	

* Catch rate unavailable. See substitute weight analysis in the evaluation section below.

Evaluation

All of our smaller lakes generally have good population balance up to the 14 inch legal minimum, above which they fall off to few or none. It is difficult to break this trend in small lakes where fishing pressure is high. Brush structures and vegetation can be used to protect some age classes from predation and make fishing take more difficult, but still cannot buffer the effects of heavy fishing pressure on population structure. Some brush structures are designed to be fish attractors, concentrating fish in areas targeted by

anglers. We prefer to employ complex structures with internal refugia that are more beneficial in protecting fry and young-of-the-year.

In FY 11 our lake sampling consisted solely of a cooperative effort with Texas Parks and Wildlife Department to monitor methyl mercury uptake in top food-chain species. Although we electrofished each lake for a specified time, only the largest individuals were collected, so a total count was not possible for catch-rate reporting. However we gained very detailed information on these larger individuals, including age and sex. We can use age coupled with length and weight to compare fish condition with the statewide standards (Childress, 1989) for that species using the relative weight index. Fish that factor out below 1.00 are in poorer condition than the average fish of that length in the state dataset. Anything above 1.00 would indicate a fish in better condition than the statewide average. Surprisingly, bass in Bouton, Double, and Niederhofer lakes all scored well above the state average. Given the relatively sterile conditions in these lakes and the lack of supplemental fertilizing, these healthy averages may correlate with large stockings of relatively small catfish (see Table 8). Conversely, Ratcliff in FY09 showed below average bass condition in an environment that had historically been favorable bass growth. Much more sparse catfish stocking prior may have been a factor, but the fish would still be expected to meet the state average without supplemental forage.

Need for Change

With a public demand species, the need for change would be based on public input. We have been able to provide great opportunities for a fortunate few in the bass fishing realm with two 13+ lb. bass taken from Ratcliff Lake in 2007. In Texas, fish of this size can be turned in under a state trophy program for angler prizes and recognition. These successes are likely based on past intensive management efforts in Ratcliff, which have been reduced in recent years in order to control aquatic weeds. We are able to still provide fishing success with other species, but bass emphasis is totally dictated by public demand. Also, the "need" for the Forest Service to provide trophy bass fishing on lakes that are too small to sustain such performance while in the proximity of huge state-managed trophy bass reservoirs is of questionable necessity. This becomes especially apparent when the intensive labor and cost is considered. We have logically evolved into providing recreation-area campers with a quality fishing experience, but not necessarily trophy bass angling.

The NFGT recommends dropping largemouth bass as a MI.

Sunfish (*Lepomis species)*

Background

This MI includes many common species such as bluegill, redear, green sunfish, warmouth and longear. Bluegills predominate most of the samples. Serving as a forage base or prey species for the largemouth bass, this group will not always exhibit concurrent trends.

Monitoring Methods

Sunfish sampling is generally done with electrofishing or frame netting.

Results
The goal from the *Plan* was to maintain sunfish in the 40-250 per hour catch rate range in the short term. As evident below, that was achieved on all lakes that didn't have aquatic weed problems.

Table 21. Sunfish Survey Results From Specified Lakes During Fiscal Year. (Numbers indicate fish catch rate per hour via electro-fishing.)

Lake	2004	2005	2006	2007	2008	2009	2010	2011
Black Creek	0	0	0	0	0	0	0	0
Coffeemill	0	705	0	0	0	283	0	0
Cottonwood	0	0	0	0	0	0	0	0
Clear	0	0	0	0	0	0	0	0
Crockett	0	696	0	0	0	244	0	0
Fannin	0	0	80	0	0	0	0	0
Ratcliff	0	0	0	0	0	0	0	0
Red Hills	0	0	0	0	0	0	0	0

Evaluation
Stunted bass populations often yield large sunfish that are too large for them to consume. This situation is good for sunfish anglers, but only in the short-term because once the larger fish are caught, there are no reproductive progeny to take their place and all the smaller fish have been consumed by malnourished bass.

Need for Change
As noted for the largemouth, all recreation area lakes that have a demand for fishing will drive management by public input coupled with the response of District managers. Attempts are made in these situations to protect sunfish fry with concentric brush structures and to increase reproductive opportunities with spawning beds.
The NFGT recommends dropping sunfish as a MI.

Channel Catfish (*Ictalurus punctatus)*
Selection
This species was chosen as another sport fishing MI for aquatic ponds and reservoirs. It is a demand species that is highly sought by fisherman on public waters. As in many man-made reservoirs, natural reproduction of channel catfish is low in NFGT lakes and ponds so this species is augmented periodically with stocking.

Monitoring Methods
Catfish monitoring is more difficult due to a slower electrical pulse required for electrofishing and their bottom-dwelling nature. Gill-net sampling leads to complete mortality. If body condition can be observed by looking at a smaller sample, then fairly good assumptions can be made about population health. Typically we use indications of public fishing success as a meter of abundance. On the NFGT we monitor the

"population inputs" through maintaining records on stocking (dates, times per year and rate) within individual water bodies.

Results
In 2011 1,760 fingerlings were stocked in recreation area lakes and ponds (Table 18). All prior stocks in Double Lake were lost as the lake dried up completely during the summer/fall drought.

Evaluation
With the availability of federal surplus fish in the last few years, we have succeeded in bolstering catfish age classes every year in order to provide a continuum of legal-sized fish. This species needs to be restocked in order to relieve the fishing pressure on the bass and sunfish populations.

Need for Change
Construction of spawning structures would help some lakes sustain their own reproducing populations. Such structures were placed in Stubblefield Lake during FY11. Because catfish populations are being supplemented by restocking, the channel catfish is not a particularly good indicator of management. Therefore, the NFGT recommends dropping channel catfish as a MI.

Table 22. Channel Catfish Stockings

Water-body	2005	2006	2007	2008	2009	2010	2011
Boykin	0	*830/8+"*	0	0	10,800/ *350/8+*	4,884/3-6	
Bouton Lake	0	*1120/8+"*	0	1,000/10		4,048/3-6	*1120/9*
Little Bouton	0	*0*	0	0			
Sexton Pond	0	*0*	0	0	350/8+	350/8+	*640/9*
Double	2140/4	5255/3.2-5.8	0	~1,500/10			
Camp Letcher	0	0	0	0			
Niederhofer	200/4	1375/3.2-5.8	1000/7.5	300/10		1,210/3-6	
Office Pond C52	0	30,000 fry	0	0			
Peden Tr. Ponds	0	390/3.2	0	0		1,210/3-6	
Plantation Pond C76	0	30,000 fry	0	0			

Water-body	2005	2006	2007	2008	2009	2010	2011
FS234B Pond C42	0	30,000 fry	0	0			
SHNF Ponds	0	0	0	0			
Ratcliff	0	4000/4.8	2500/7.5	1,500/10	12,800	1,221	
DCNF Ponds	0	375/4.8	500/7.5	0		1,221/3-6	
Red Hill	0	750/4.8	0	0	6,400		*850/9*
Lake Crockett						*4000/9*	
Lake Fannin	0	*1,100/6-8"*	0	*1120/9.0*			
Windmill Lake	0	*1,080/9"*	0	0			

All entries in italics were stocked by Texas Parks and Wildlife Department
Fish totals are followed by size in inches (number stocked/size)
~ = approximation

Rivers and Stream Aquatic Species

Paddlefish (*Polydon spathula)*
MI Selection Rationale
This species, endemic to the Angelina, Neches and Sabine River systems, was extirpated years ago when reservoirs were constructed and gravel was dredged from the rivers. Native adults were still reported in the lower Neches around the Big Thicket during the 1980s. All natural reproduction has ceased. TPWD, in cooperation with the NFGT, made a concerted effort to restock the river systems with fingerlings. Paddlefish were stocked into the Neches from 1989 to 1998, the Angelina from 1989 to 1999 and in the upper Sabine River during the same time period. Subsequent habitat surveys (1996 - 1999) revealed that the preferred backwater spawning habitat with gravel substrates was completely gone from the Neches River. Without the habitat necessary to sustain reproduction, paddlefish stocking was discontinued.

During Plan development, specialists identified paddlefish as a MI for larger river systems because it was felt there was a potential to regain a sustainable (reproducing) populations in NFGT rivers. Since 1996 it has become apparent that this species is likely only a "put & take" member of the riverine systems, so its value as a management indicator has been re-evaluated.

Effects of Management
It is difficult to assess any induced effects given that the species is no longer present in any holdings under NFGTs control, except for a small reach of the Red River bordering the Fannin Unit. This area is inaccessible and therefore insulated from perturbations.

Unless TPWD determines conditions have changed and re-evaluate the restoration of paddlefish, the utility of this species as an MI is very low.

Need for Change
Although the paddlefish is a protected species, one criterion for MI designation, it does not aptly fit the other criteria. It is not easy to monitor and is not a good indicator of river habitats due to its rare and nomadic nature. An Index of Biotic Integrity (IBI) guild system would be much more useful in riverine systems.

Results
TPWD Heart-of-the-Hills research station revealed that they had caught several paddlefish below Lake Livingston dam as "by-catch" to alligator gar they were seeking. They did not keep an accurate count, but estimated it was no more than three fish. They also were not concerned with scanning for bar code tags, which were installed in all hatchery raised fish. They indicated that the fish were not large, but could not distinguish whether they were native or stocked. It was implied that there still could be some limited natural recruitment in the Trinity system as there are still some fish above the dam.

Dusky Darter (*Percina sciera)*
Background
This small species of the perch dwells almost entirely on the bottom of streams with a diet specific to larval insects (stonefly guild). It is a species best adapted to lowland rivers and "occurs abundantly in much of its range (Kuehne and Barbour 1983)."

Selection
This species was selected as an indicator for low gradient streams due to perceived prevalence in these habitats based on preliminary sampling. However, this species does not prefer highly turbid streams. Many NFGT streams become turbid during storm events.

Monitoring Methods
This species is surveyed by backpack electrofishing or seining.

Results

Table 23. Dusky/Scaly Sand Darter Occurrence in Stream Samples - 2011

Stream/Surveyor	Summer	Winter	Spring
Angelina National Forest			
Turkey Creek/ Peterson, Jackson, Bataineh		x	
Clear Branch Site 4/Carveth, Simpson	(2 redspot)	**2** (1 redspot)	**1** (4 bluntnose,3 goldstripe)
Harvey Creek Site 9/Carveth, Simpson	x	(2 redspot)	(8 bluntnose,2 goldstripe)

Stream/Surveyor	Summer	Winter	Spring
Johnson Cr Site 24/Carveth, Simpson	x	(5 bluntnose)	x
Johnson Cr Site T/Carveth, Simpson	x	x	x
Prairie Cr Site 12/Carveth, Simpson	(1 goldstripe)	(2 bluntnose)	x
Prairie Cr Site 14/Carveth, Simpson	(1 bluntnose)	x	x
Running Br. Site 11/Carveth, Simpson	(1 redspot)	x	(2 bluntnose)
Sandy Creek Site 3/Carveth, Simpson	(15 bluntnose)	x	x
Sandy Creek Site 7/Carveth, Simpson	**1** (5 bluntnose)	x	x
Scott Creek Site 10/Carveth Simpson	(2 bluntnose)	x	x
Turkey Creek Site 8/Carveth Simpson	(4 bluntnose)	(1 bluntnose)	x
Turkey Creek Site 21/Carveth Simpson	(1 bluntnose)	x	x
Turkey Creek Site 16/Carveth Simpson	(1 redspot)	x	(1 goldstripe)
Unnamed Site 1/Carveth, Simpson	(1 redspot,1 slough)	(1 redspot)	x

X- Surveys conducted but no darters present.
( ) Darter species within parentheses are not NFGT Management Indicators, but since they are intolerant species as a group, their presence implies that other non-quality factors may be limiting the occurrence of dusky or scaly sand darters.
Goldstripe darter is an indicator of spring-fed streams, which typically are the highest quality habitats due to water clarity and flows during droughts.

Evaluation

Forest personnel found the dusky darter in Trout Creek on the *Angelina NF* in 1995 (Cowan and Mize), yet it was absent in 1995-96 (Moye 1998) and 1997 (Berhorst and Gilpin), as it was when we sampled in December of 2009. Sample season was different, which could account for absence, but it was also missing in the three consecutive July samples following its first presence in 1995.

Moye found this darter in Camp Creek on the *Davy Crockett NF* in 1995, yet Jess Kelly did not find it in 1994-95. Kelly also found it in Cochino Bayou, but it was not found there by Kirby in 1998 or Forest Service personnel in 1998 or 1999. Both Kelly and Forest Service personnel found the species in Piney Creek in 1994 and 1999, respectively. Kirby found the dusky in two tributaries of Austin Branch in 1998. 2009 sampling (Peterson, Simpson) in Walnut/Hickory Creek did not reveal this species, but did yield a redfin darter, which implies that the sampling technique was effective for

collecting darters. To further confound conclusions, Kelly found the dusky in all four seasonal samples in Hickory Creek, but never found the redfin (1995).

The dusky was documented on the *Sabine NF* in 1994 by both Espey-Huston and Rogers at different locations on Big Sandy Creek. Forest Service personnel did not find it there in 1998, but the rare harlequin darter was present. Only one individual appeared in Bull Creek during an intensive 1996-97 survey of three creeks in the Indian Mounds Wilderness done by Claudia Ebeler. The dusky appeared in all three 1996-97 samples taken by LaMont, in a reference stream adjacent to the forest. This darter was absent in all 20 samples taken by Forest Service personnel throughout the Sabine NF, even though other darter species were present. In two years of comparing Johnson and McKim Creeks, we see individuals increase in 2006, but total darter diversity was down by one species.

Extensive Sabine sampling in 2010 and 2011 by Golder Inc. (Table 9.) revealed four dusky darters in two streams on the Angelina National Forest. This was quite notable in the presence of a 100 year drought, particularly since Clear Branch contained the dusky, as well as the spring-dependent goldstripe darter and redspot which is also has a preference for clear, flowing streams. Given the condtions, these combined indicators confirm the exceptional quality of Clear Branch and a need for honoring BMP standards at all costs in present and future management. A dusky darter was also found in Sandy Creek (Site 7) during the summer. Sampling was curtailed for the summer quarter due to a lack of flowing water in many streams.

Need for Change

The species has been absent from quality habitats for no apparent reason. It has also been present and then missing in back-to-back intensive studies. There almost appears to be a geographic trend, with the occurrence fading as you go north and west on the NFGT. If stream gradient is a factor, this should only apply to the North Sabine, where streams have higher gradients. Dusky darters are rare on the Angelina, but then occur immediately north around Nacogdoches. The recommendation is to drop the dusky darter as an exclusive “low gradient” indicator during the next Forest Plan Revision process and add a cadre consisting of the bluntnose darter/slough darter/redspot darter/and dusky darter or another more endemic species like the blackspot shiner. Bluntnose and slough darters also seem to appear interchangeably in low-gradient habitats and redspot darters may be more transitional between low and high gradients. These indicators would really be more effective as guild indicators, like the macroinvertebrates. The Index of Biotic Integrity (IBI) is widely accepted and gives any species of darter the same score for being present. This helps eliminate the bias of habitat nuances, migration and other factors that contribute to anomalous results.

We still have scheduled the replacement of a badly perched (migration barrier) on Mill Creek (ANF-below) with a bottomless arch for 2011, which will open up at least one mile of redspot darter habitat.

Figure 22. Dusky darter collected in Carveth et al. sample (photo by Cori Carveth).

Scaly Sand Darter (*Ammocrypta vivax*)

Background
Although an inhabitant of creeks and rivers of various sizes with sandy, silt, gravel or hard clay substrates (Kuehne and Barbour 1983), the NFGT has found it to be more typical of higher flow/gradient streams with clear water.

MI Selection Rationale
The scaly sand darter was selected as our gradient stream indicator. However, according to Kuehne and Barbour, "it is unlikely to be thriving…and serious depletions may be occurring at the margins of the range," of which the NFGT would qualify.

Results
No scaly sand darters were found in 2011.

Evaluation
As with the dusky darter, the same logic applies to the scaly sand darter, although it is further complicated by its limited range and sensitivity to perturbations. It is clear that this species has become rare on the Sam Houston NF due to the same conflicts with ORVs, roads and private land uses that have caused siltation and made habitat unsuitable for many mussels in the San Jacinto watershed. The soils are too fragile for standard protocols and large storm-flow volumes exacerbate exposed soil problems.

Need for Change
In terms of this species as an indicator, it should be dropped in favor of an IBI guild system during the next Plan Revision process. This species does not have near the distribution of the dusky darter and may be interchangeable with the redfin darter in some areas. It also appears to have a guild relationship with other aquatic indicators this year. Given its decline and apparent rarity, our responsibility dictates that we not contribute to range reductions, which would narrow our focus on the East Fork of the San Jacinto River and any actions there pertaining to ground disturbance, channel alteration and fish barriers. Although no scaly sand darters were noted in 2011, a collapsed double 64" culvert was surveyed for removal on the East Fork of the San Jacinto River and Forest Development Road 261. The species was found at this locale in 1993 and the habitat still appears to be in good condition. Removal of this fish passage impediment this FY will allow free migration into 1.5 miles of suitable habitat.

Sabine Shiner (*Notropis sabinae)*

Background
This Region 8 Sensitive species is found in clear, silt-free streams with sandy bottoms and once ranged throughout the Angelina, Neches, Sabine and San Jacinto River watersheds. This species is very uncommon due to reservoir construction and reduction in preferred contiguous stream habitat, which has been greatly fragmented due to land uses and migration barriers. Despite their preference for high water quality, they can survive in very adverse conditions. Shiners have been found in a sluggish swampy area in Louisiana, a draught pool on the Sam Houston and one even survived for months in buried under algae in a neglected, non-aerated aquarium.

Selection
This species Selected as an indicator for unimpeded rivers and streams, primarily due to its protected status.

Monitoring Methods
This species is surveyed by backpack electrofishing or seining.

Results
The Sabine shiner was documented for the first time (post-reservoir) on the *Sabine NF* in 2005 (D. Work et al), but was not found there again in 2006 at any of four McKim Creek sites in either spring or fall samples. 2009 Surveys, relative to the current Toledo Bend FERC relicensing, found Sabine shiners to be quite common downstream from the dam in the Sabine River. However, no shiners have ever been found in any east-slope stream associated with the reservoir (above the dam), even despite intensive surveys by Golder Inc. and on the north Sabine NF.

Surveys on other Forests as detailed above in the dusky/scaly sand darter discussion. We do know they continue to thrive in the Lanana/Banita stream complex on private land north of the *Angelina NF*. The NFGT funded study by Simpson (2011), did cover this stream complex and collected 2 Sabine shiners from Banita Creek Site 1 on June 23,

2010, as well as one each from Lanana Bayou Site's 3 and 4 on June 23, and July 22, respectfully. Simpson was only able to collect shiners by seining. Although his electrofishing samples yielded good diversity, the Sabine shiner was not present. This lends some credence to opinions that some of the shiner's presumed rarity may be attributable to difficulty in collecting, which counters requisite for a good management indicator ("ease of collection").

Evaluation

Another historic record added to NFGT database comes from an area just north of the *Angelina NF* in Lavaca Creek near Etoile. Although the record is from 1950 (F.A. Dickins, SFA), it still has merit given that the Nacogdoches populations that range south to the Angelina River are now known to be the most stable for the species (Williams 2003). Simpson (2010) did find Sabine shiners still present in Nacogdoches watersheds. Layers of intensive surveys now seem to indicate that major reservoirs are a problem for this species. Jered Simpson's NFGT/Sabine River Authority (SRA) commissioned thesis concluded that "habitat within the Sabine National Forest might not be adequate for the Sabine shiner (Simpson, 2011)." The NFGTs, aside from the Davy Crockett NF, are all impacted by major reservoirs, future outlook for finding or restoring populations does not hold much promise.

Need for Change

It is apparent that this species is extremely depleted on the NFGTs. Reintroduction into a suitable watershed that lies mostly within USFS holdings would be a logical course of action. However, what we have learned from their life cycle requirements, suitable habitat must include an unimpeded reach of at least 13 miles (Casey Williams 2003). The only streams that might meet that criteria are the Piney-Lynch-Caney complex on the *Davy Crockett NF*, some of which is still in private holding, and the Caney Creek complex on the *Sam Houston NF*. Another wrinkle is that the species has never been documented from the Piney watershed, although it is associated with the parent Neches River. The most suitable on the *Sabine NF* would be the Walnut-Cooper-Brushy-Sixmile complex even though Sixmile does not exhibit the best water quality. The *Angelina NF*, does not have a reach of suitable length. The best approach for the species there is to protect and expand the Angelina River compartments of 107-111, which are integral to Lanana Bayou and the Nacogdoches population.

<u>Stonefly Guild</u>

Selection

The stonefly guild was chosen as an MI or index for rapid evaluation of stream quality and possible pollution problems. This guild includes all the macroinvertebrates as a group, rated by an established scoring system, such as the abbreviated EPA form used by the NFGTs or Hilsenhoff's Biotic Index (HBI), which is similar to an IBI. The NFGT uses the abbreviated EPA method, while the extensive Hilsenhoff procedure is usually requisite of surveys we have contracted through universities.

Results

Crayfish can exist in a wide range of water quality conditions, but are not considered tolerant of pollution. They do not make ideal water quality MIs, but are a component of the EPA scoring system that we use for evaluating macroinvertebrate guilds. Due to the presence of three R8 Sensitive crayfish on the NFGTs, major watersheds have been trapped prior to large-scale ground disturbing projects. As such, an annual regimen has been carried out for the five years of this reporting period and prior. Refer to crayfish table updates below.

Amid reports of "blue water" in a Turkey Creek tributary south of FDR 342 on the Angelina NF, we sampled macroinvertebrates downstream. We noted stonefly nymphs and riffle beetles, both high quality indicators, along with moderate indicator, crayfish, for a cumulative poor score. This was due to low diversity, but the indicators noted should not have been able to survive in poor water quality. John Turner sampled Turkey Creek (2001) just downstream from our location in 2000. During year-long sample period, 14 taxa were collected giving a Hilsenhoff Biotic Index (HBI) rating of good to fair. The HBI is a weighted tolerance average similar to our abbreviated EPA protocol. Our results were like skewed due to lack of woody material and gravel in the reach we sampled. Large woody debris increases substrate for macroinvertebrates. However, the occurrence of stoneflies in 190 uS conductivity belies their published "intolerant" status. EPA types a stream as polluted at 200 uS and above. Other analyses indicate there is probably a problem in Turkey Creek relative to high conductivity inputs.

Evaluation

The EPA form assigns tolerance values to individual organisms. Those with a low tolerance value are more susceptible to pollution, while organisms with a higher tolerance value are more tolerant of pollutants. Ground-disturbing activity in and/or near streamside zones lowers habitat quality for many of the guild species monitored. The *Plan* objectives dictate that we move toward a "good to excellent" rating in the short term. At this point, most of our streams are still in the "good" range. It is difficult to determine if pollution and sediment related disturbance is caused by NFGT actions or actions on private lands interspersed within the NFGT administrative boundaries. Using the EPA technique is good for identifying the existence of population problems, but does not help personnel pinpoint the cause of the problems.

Need for Change

Although more finite in displaying causative parameters, macroinvertebrates basically reflect what is being found in the fish community. This is a good technique that should be continued for evaluation of water quality and identification of stream species composition.

Amphipods (crayfish) are moderately to very intolerant of nutrient pollution, depending on species.

Table 24. Crayfish trapping efforts on the National Forests and Grasslands in Texas 1999-2011.											
FOREST (R8 Sensitive in bold)	**DATE**	*C diogenes*	*C ludovicianus*	*P kensleyi*	*O palmeri l.*	*P durpratzi*	*P clarkii*	*P simulans*	*P acutus*	***P nigrocinctus***	***P nechesae***
Am Fisheries Society Rank		Stable	Stable	*Sp Concern*	Stable	Stable	Stable	Stable	Stable	**Endangered**	**Endangered**
DCNF (location)											
Armstrong Cr @ 527	5/29/02	0	0	1	0	0	0	0	0	0	0
Armstrong Cr @ Ivie Spr off 596	12/12/95	0	0	2	0	0	0	0	0	0	0
Bluff Cr @ 511	4/23/01	0	0	2	0	0	0	0	0	0	0
Bushy Cr @ Co 4740	5/11/00	0	0	1	0	0	0	0	0	0	0
Spring Cr @ 524	5/13/97	0	0	3	0	0	0	0	0	0	0
Camp Cr @ 526	3/22/99	0	0	1	0	6	0	0	0	0	0
Camp Cr @ 511	4/23/01	0	0	1	0	0	0	0	0	0	0
Hagen Cr @ 527	5/29/02	0	0	1	0	0	0	0	0	0	0
Lynch Cr @ FM 2781	5/7/01	0	0	0	0	0	0	0	0	1	0
Piney Cr @ FM 2781	5/7/01	0	0	0	0	0	0	0	1	0	0
Piney Cr @ SH 94	5/22/02	0	0	0	0	0	1	0	0	0	0
Sandy Cr @ 511	4/23/01	0	0	0	0	1	0	0	0	0	0
Lynch Cr @ FM 2781 C71	4/11/03	0	0	0	0	0	0	0	0	1	0
C56 Pond off FS 503B	10/03	0	0	1	0	0	0	0	0	0	0
Pond 5- 503 past plantation C56	4/14/04	0	0	0	0	0	0	0	0	0	1
Angelina NF (location)											
Ang River floodplain burrows near US 59	5/3/06	0	4	0	0	0	0	0	0	0	0
Ang River floodplain swamp near US 59	5/3/06	0	0	0	0	0	0	0	5	0	0
Big Cr slough.25 NW 303	6/4/08	0	0	0	0	0	0	0	1	0	0
Big Cr @ 303, 3 mi N 314	6/5/08	0	0	0	0	1	0	0	0	0	0
Cypress Cr @ Boulware Rd	4/2001	0	0	1	0	0	0	0	0	0	0
Graham Br @ FS 314	6/4/08	0	0	0	0	2	1	0	0	0	0
Mill Cr @ Co 344- Boulware Rd	6/12/97	0	0	0	0	3	0	0	0	0	0
Mill Cr @ Co 344- Boulware Rd	4/8/99	0	0	0	0	3	0	0	0	0	0
Oil Well Cr @ Boulware Rd	6/5/08	0	0	0	0	4	0	0	0	0	0
Phoenix Bog off SH 64	6/3/99	2	0	0	0	0	0	0	0	0	0
Trout Cr @ 333A	7/18/97	0	0	0	0	5	0	0	0	0	0
Turkey Creek @ 342	2/17/11	0	0	0	0	1	0	0	0	0	0
SFA Exp Forest - Pond 3	5/13/03	0	0	0	0	0	0	0	0	0	1
Prairie Cr @ FS 300 C16	4/23/03	0	0	0	0	2	0	0	0	0	0
Spears Cr @ 1277 S of Goodwin	4/30/03	0	0	0	0	1	0	0	0	0	0
Steptoe Br @ FM 1992 C7	4/30/03	0	0	1	0	0	0	0	0	0	0
Pophers Cr @FM 2109 C55	5/10/04	0	0	0	0	0	2	0	0	0	0
Angelina River Trib @ FS308A	5/28/04	0	0	1	0	0	0	0	3	0	0
Pond #3 SFA Exp Forest	5/13/03	0	0	0	0	0	0	0	2	0	1
Lucas Cr SW White City-5 sites	5/22/04	0	0	11	0	0	0	0	0	0	0

Table 24. Crayfish trapping efforts on the National Forests and Grasslands in Texas 1999-2011 (cont')											
Cadell Cr Trib SE&SW 2 sites	5/22/04	0	0	2	0	0	0	0	0	0	0
Lick Br of Turkey @ FM 1992 C2	4/30/03	0	0	3	0	0	0	0	0	0	0
Long Prairie Branch @ 341 C50	6/7/06	0	0	X*	0	0	0	0	0	0	0
Lucas Cr Trib 2.3 SW WhiteCity	5/22/04	0	0	1	0	0	0	0	0	0	0
Cadell Cr Trib SE&SW 2	5/22/04	0	0	2	0	0	0	0	0	0	0
Ditch at SH 147 & Walnut Ridge C55	5/24/06	0	0	0	0	0	0	0	1	0	0
Sabine NF (location)											
Blankenship Cr @ 137A	7/19/01	0	0	0	0	0	0	0	0	0	0
Blue Bayou @ 125	5/12/02	0	0	0	0	0	0	0	0	0	0
Bourgh's Cr @ 131A	7/1/96	0	0	0	0	0	0	0	0	0	0
Conner Cr @ SH 87	8/3/99	0	0	0	0	0	0	0	0	0	0
Curry Cr @ 2426 C116	6/6/07	0	0	0	0	0	0	0	4	0	0
Bayou Siep @ FM 139	6/9/00	0	0	00	0	0	0	0	0	0	0
Coma Cr 1.5 mi SW Sabinetown	5/22/04	0	0	0	0	0	0	0	1	0	0
Cooper Br S of 109 C114	2005	0	0	X	0	0	0	0	X	0	0
Hines Cr Br S off FS 171 C77	5/03	0	0	0	0	0	0	0	0	0	0
Hines Cr Br S off FS 172 C78	5/03	0	0	1	0	0	0	00	0	0	0
Sixmile Catch Basin @ FS152 C91		0	0	0	0	0	0	0	4	0	0
Sam Houston NF (location)											
Bay Br @ FM 1791	6/99-4/00	0	0	0	0	0	2	0	0	0	0
Big Creek	6/99-4/00	0	0	0	28	0	25	0	0	0	0
Brown Br	10/9/99	0	0	0	0	0	24	0	0	0	0
Caney Cr @ FM 1375	6/99-4/00	0	0	22	1	0	0	0	0	0	0
Big Chinquapin Cr	6/99-4/00	0	1	0	0	0	22	0	0	0	0
Clear Creek	7/99-4/00	0	1	20	0	0	64	0	0	0	0
Clear Cr below oil well in C94	5/20/02	0	0	0	0	0	1	0	0	0	0
E Fork Caney	7/99,2/00	0	0	76	0	0	4	0	0	0	0
Double Lake Br @ 220	5/20/02	0	0	0	0	0	2	0	0	0	0
Gum Branch @ FM 1375	6/99-4/00	0	0	1	0	0	75	0	0	0	0
Harmon Cr @ Co 120	1/28/97	0	0	0	0	0	4	0	0	0	0
Henry Lake Br E of 220C	5/20/02	0	0	0	1	0	3	0	0	0	0
Little Creek	7/99-4/00	0	0	14	72	0	45	0	0	0	0
Little Creek @ 217	5/20&22/02	0	0	0	0	0	3	0	0	0	0
Montague Cr @	1999	0	0	0	0	0	5	0	0	0	0
Pea Cr @ 207A	9/99-4/00	0	0	20	7	0	45	0	3	0	0
Prairie Cr @ Elkins Lake Subdv.	1/28/97	0	0	0	0	0	3	0	0	0	0
Roark Cr @ FS 207	6/99-4/00	0	0	0	0	0	35	0	0	0	0
Rocky Br @ FM 1725	5/20/02	0	0	0	0	0	1	0	0	0	0
E Fork San Jacinto R @ Co 945	5/20&22/02	0	0	0	0	0	6,2	0	0	0	0

Table 24. Crayfish trapping efforts on the National Forests and Grasslands in Texas 1999-2011 (cont')											
Rocky Br	7/99-4/00	0	0	22	0	0	50	0	0	0	0
Sand Cr @ FM 1375	6/99-9/99	0	0	0	1	0	5	0	0	0	0
Smith Br	6/99-4/00	0	4	0	42	0	76	0	0	0	0
Unnamed @ FS 261	7/99-4/00	0	2	1	0	0	13	0	0	0	0
Wayne Cr @FS 236	3/25/98	0	0	0	0	0	0	7	0	0	0
East Sandy	6/16/99	0	0	0	1	0	0	0	0	0	0
West Sandy	6/99-4/00	0	0	58	22	0	51	0	0	0	0
Winters Bayou @ FM 1375	6/99-4/00	0	0	2	1	0	41	0	0	0	0
C/LBJ NG (location)											
Bois d' Arc Cr @ 919	1993	0	0	0	0	0	0	0	1	0	0

X* denotes that crayfish were trapped but a number was not determined.

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