



TEXAS CONSERVATION ACTION PLAN

Cross Timbers ECOREGION HANDBOOK August 2012



Citing this document:

Texas Parks and Wildlife Department. 2012. **Texas Conservation Action Plan 2012 – 2016: Cross Timbers Handbook**. Editor, Wendy Connally, Texas Conservation Action Plan Coordinator. Austin, Texas.

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See links on Texas Parks and Wildlife Department’s Texas Conservation Action Plan 2012 website

<http://www.tpwd.state.tx.us/landwater/land/tcap/>

or the Wildlife Diversity Program website

http://www.tpwd.state.tx.us/huntwild/wild/wildlife_diversity/

for additional references and supporting documents related to this handbook.

“Action that grows out of urgency, frustration, or even determination is missing a critical ingredient. For action to be effective, for action to be meaningful, it must also grow out of respect and a deep sense of connection to the things and people that surround us.” – Orion Magazine Editors, March/April 2011

SUMMARY

The Cross Timbers (CRTB) Handbook is one of the Texas Conservation Action Plan (TCAP) thirteen handbooks, available on the Texas Parks and Wildlife Department’s Texas Conservation Action Plan website¹:

- an **Overview** – background information about how this Plan came about and was revised;
- a **Statewide/Multi-region handbook** – broad resource concerns and opportunities; and
- 10 other ecoregion handbooks like this one for different areas of Texas with more local information.

This handbook provides insight into specific CRTB resources and conservation issues, including a list of Species of Greatest Conservation Need (SGCN), rare communities, and important habitats that support these unique features. The CRTB handbook also presents a compiled list of issues – things that prevent us from doing our best conservation work here – and proposed solutions or actions. Throughout this document, there are resources – web links, programs, incentives, and contacts – to help you participate in implementation and learn more about the natural resources this region of Texas has to offer.

The TCAP CRTB Ecoregion Handbook takes advantage of many different perspectives to understand local changes and identify actions that will reduce threats to specific natural resources: SGCN, rare communities and the habitats on which they rely. The Plan aims to ensure that we are able to share our natural heritage with future generations of Texans and that they understand what we did to make *progress* toward that goal.

It’s important to prioritize where we need to work to the degree that we can: human and financial resources are limited, certain issues demand more immediate resolution, and some species and habitats are simply more in need. The TCAP 2012 taps into a broad network of conservation service providers, natural resources managers, alliances and working groups, policy makers, stakeholders and the public to define **what’s at risk, what issues are most important, where we need to work, how to best engage the right partners to solve the problems, and what to do.**

This handbook is divided into sections to guide priority setting and actions:

- resources at risk - SGCN, rare communities, and the habitats on which they rely;
- issues that are most important, which could benefit from targeted stakeholder involvement; and
- conservation actions to benefit resources and make progress toward solving issues.

Certain resources also have a statewide context – riparian areas, grasslands – and additional actions at that level are proposed in the Statewide/Multi-region handbook. For more information about how content was developed for all handbooks of the Action Plan, please see the Overview handbook.

¹ TPWD. 2012. Texas Conservation Action Plan – all handbooks and supporting documents can be found online at <http://www.tpwd.state.tx.us/landwater/land/tcap/>

HOW TO GET INVOLVED

This handbook contains a list of partners and programs that provide conservation services and/or information in this area. Additionally, certain conservation actions at the end of this handbook may help you connect with partners working on specific issues.

There are many wonderful, energetic public and private conservation providers in Texas who have active volunteer networks, strategic needs, and programs. For more information, check the Natural Resource Conservation Programs and Services for Texas Landowners.²

If you have questions about the TCAP content and cannot find what you need on the TPWD Texas Conservation Action Plan website or in one of the handbooks,³ please contact the TCAP Coordinator at the TPWD Headquarters in Austin, Texas:

Phone (512) 389-4800

Email tcap@tpwd.state.tx.us

² TPWD. 2007 Natural Resource Conservation Programs and Services for Texas Landowners.
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_1198.pdf

³ TPWD. 2012. Texas Conservation Action Plan – all handbooks and supporting documents can be found at this website: <http://www.tpwd.state.tx.us/landwater/land/tcap/>

OVERVIEW

Historically, settlers traversing Oklahoma and Texas for points west found the Cross Timbers a thick, vexing place, rough country of woodland thickets and impenetrable vegetation. The Ellsworth expedition, accompanied by Washington Irving, entered the cross timbers in 1832; later he wrote, "... It was like struggling through forests of cast iron." Because of the woodlands presence between the Blackland Prairies and the Plains, it was historically a "marker" of sorts for progress along east-west trails. Accounts depict certain areas as mature woodland canopy under and through which a wagon could pass with ease.⁴

Woodland and savanna in the Cross Timbers are dominated by post oak and blackjack oak on coarse, sandy soils. These oaks were historically not favored by settlers for building timbers, so much of the area was simply cleared for farmland; those areas which were not cleared may be of the least disturbed forest types in the eastern United States, with some 890,000 acres (3,600 km²) of old-growth forest scattered throughout the region. These old-growth forests contain millions of post oak from 200 to 400 years old and redcedar over 500 years old. In some areas degraded by overgrazing and fire suppression, Eastern redcedar and yaupon are more abundant than they would be naturally. Tall and midgrass prairies are interspersed in this region's mosaic of habitats. Land uses include rangeland, cleared converted pastures, farmland, and oil extraction.

The woodland, glade, prairie and escarpment habitats of the Cross Timbers lend a great deal of diversity to a relatively "small" area in Texas, about which few people know. Some of the plant communities mapped in the Cross Timbers occur nowhere else.⁵ Not much has changed in five years since the last Action Plan as far as conserved status of this ecoregion – still, there is little public land, few private preserves and a low percentage of private land under wildlife management plans when compared to other Texas ecoregions. Given the proximity to several large urban areas, predominately the Fort Worth – Dallas Metroplex, and several interstate systems (20 and 35) - the potential for land conversion is high.⁶ The Cross Timbers Conservancy and Vision North Texas both promote the conservation of the remaining old growth woodland/forest remnants, native riparian corridors, and native prairies in this region.

While extensive research was done in the late 1990's to the early 2000's to model and map the remaining potential old growth post oak⁷, very little work has been done in the last 5 to 10 years to describe or update the status of mature woodlands, riparian corridors, pockets of prairie, other special plant communities (e.g. glades, escarpments) in this region. There is much work to be done on this little understood, important "island" of biodiversity among the prairies and plains.

⁴ Oklahoma Historical Society. 2007. The The Encyclopedia of Oklahoma History and Culture, subverbo "Cross Timbers." <http://digital.library.okstate.edu/encyclopedia/entries/C/CR016.html> (accessed 2011).

⁵ David W. Stahle account of the Ancient Cross Timbers Consortium. April 30, 2004. Gilcrease Museum in Tulsa, Oklahoma.

⁶ Griffith, G. 2010. Level III North American Terrestrial Ecoregions: United States Descriptions. Prepared for the North American Commission for Environmental Cooperation (www.cec.org), version May 11, 2010. Corvallis, Oregon.

Griffith, G.E., S.A. Bryce, J.M. Omernik, J.A. Comstock, A.C. Rogers, B. Harrison, S.L. Hatch and D. Bezanson. 2007. Ecoregions of Texas. R.S. Geological Survey, Reston VA. http://www.epa.gov/wed/pages/ecoregions/tx_eco.htm (accessed May 2009).

⁷ Tree Ring Laboratory, University of Arkansas. ca. 2004. Map of the Ancient Cross Timbers. <http://www.uark.edu/misc/xtimber/map/index.html> (click in map to zoom in to specific areas).

Table 1 crosswalks this ecoregion with other conservation planning units.⁸

Figure 1 illustrates the location and extent of this ecoregion in Texas.

Table 2 documents the Ecological Drainage Units (EDU) and Hydrologic Units (“HUC 8”, finer scale watersheds within EDUs), larger mapped reservoirs, and Ecologically Significant Stream Segments⁹ (ESSS) which occur in this area.

Figure 2 shows those EDUs, HUC8s and ESSS by ecoregion.

⁸ For more information about planning boundaries, see the Overview handbook on the TCAP 2012 website <http://www.tpwd.state.tx.us/landwater/land/tcap/>

⁹ TPWD. 2002/2005. *Ecologically Significant Stream Segments*.

http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/

Table 1. Crosswalk of CRTB Ecoregion with Other Conservation Plan Units

Note Table is formatted 8-1/2" x 11" landscape orientation; see also Ecoregions map on TCAP 2012 website.

2012 TCAP	2005 TXWAP Gould 1960	The Nature Conservancy Terrestrial Ecoregions 1999	Ecological Drainage Units (Watersheds) National Fish Habitat Action Plan <i>TX = Southeast Aquatic Resources Partnership and Desert Fish Habitat Partnership</i> AFWA 2006 Fish Habitat Partnership 2009 Esselman et.al. 2010	All Bird Joint Ventures (JV) and Bird Conservation Regions (BCR) NABSCI-US 2004, USFWS 2009a	Landscape Conservation Cooperatives (LCC) USFWS 2009b	2010 TPWD Land & Water Plan Strategic Regions TPWD 2010	Major Land Resource Regions and Areas (MLRA) NRCS 2006	Natural Regions of Texas LBJ School of Public Policy 1978
Cross Timbers (CRTB)	Cross Timbers and Prairies	Cross Timbers and Southern Tallgrass Prairie (32)	Brazos River – Prairie Lower Brazos River Colorado River – Ed Plateau Upper Red River Upper Trinity Lower Trinity	Oaks and Prairies JV Oaks and Prairies BCR Edwards Plateau BCR	Gulf Coast Prairie	Colorado Upper (5a) Colorado Lower (5b) Brazos Upper (6a) Trinity – San Jacinto (7) Plains Rivers (10)	Central Great Plains Winter Wheat and Range Region: <i>Central Red Rolling Prairies (80A), Texas North Central Prairies (80B)</i> Southwestern Prairies Cotton and Forage Region: <i>West Cross Timbers (84B), East Cross Timbers (84C), Grand Prairie (85)</i> Southwest Plateaus and Plains Range and Cotton Region: <i>Edwards Plateau Eastern (81C)</i>	Oak Woods and Prairies and Blackland Prairie

Figure 1. CRTB Ecoregion with County Boundaries

Cross Timbers ecoregion in pale green

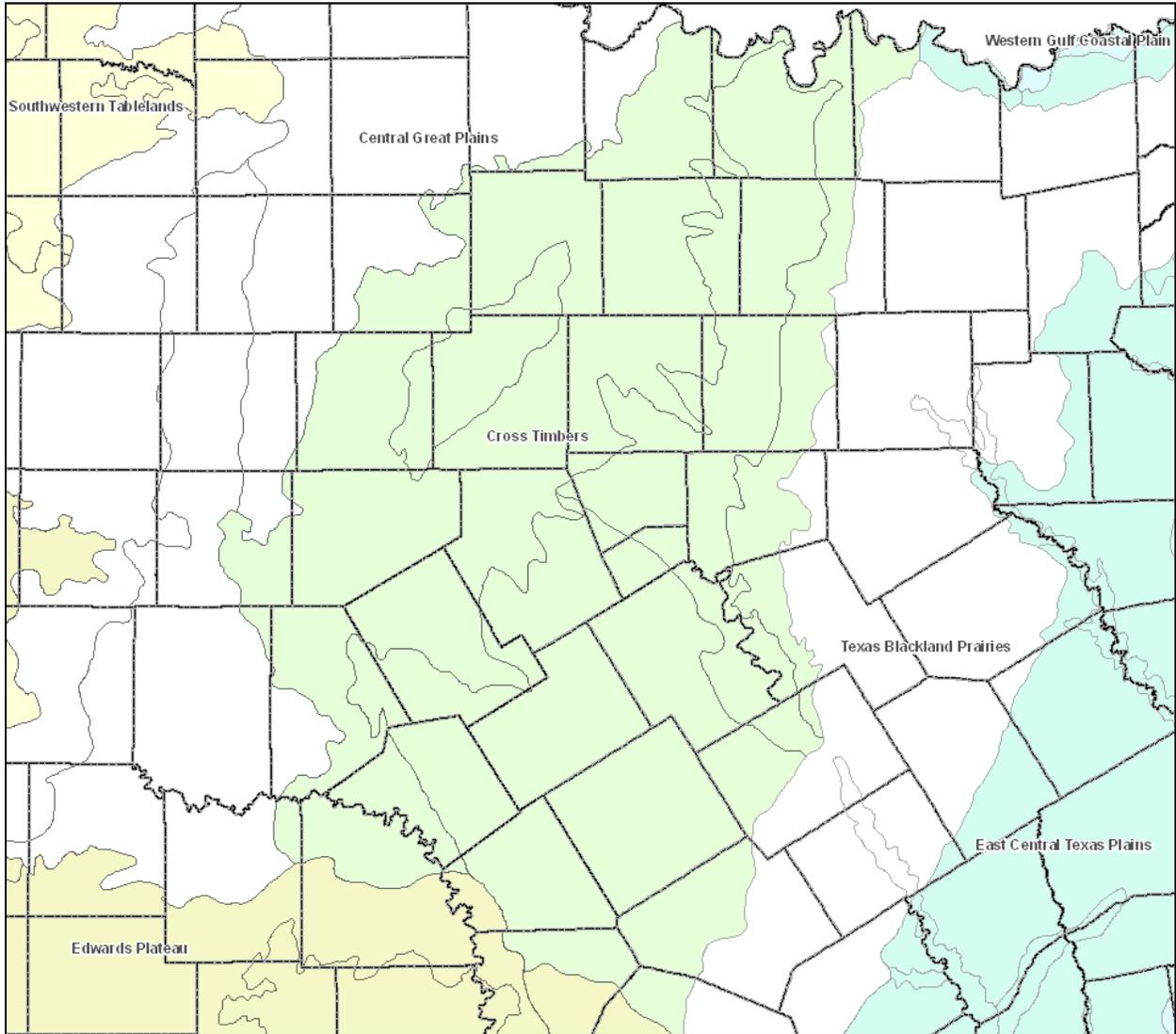


Table 2. CRTB EDUs with Ecologically Significant Stream Segments and Reservoirs

ECOLOGICAL DRAINAGE UNIT SubBasin (HUC 8)	<i>Ecologically Significant Stream Segment TPWD 2002, w/updates 2005</i>	Lakes and Reservoirs
UPPER RED RIVER		
Farmers - Mud		Lake Nocona, Hubert H. Moss Lake
Lake Texoma		Lake Texoma
UPPER TRINITY		
Upper West Fork Trinity	Lost Creek	Lost Creek Reservoir, Lake Amon G. Carter, Lake Bridgeport, Eagle Mountain Lake
Denton		Grapevine Lake
Elm Fork Trinity	Clear Creek, Elm Fork Trinity River	Lake Kiowa, Lake Ray Roberts, Lewisville Lake
Lower West Fork Trinity		Lake Worth, Lake Weatherford, Benbrook Lake, Lake Arlington
LOWER TRINITY		
Chambers		
BRAZOS RIVER - PRAIRIE		
Middle Brazos - Millers		
Lower Clear Fork Brazos		
Hubbard		Hubbard Creek Reservoir, Lake Daniel, Lake Cisco
Middle Brazos - Palo Pinto	Brazos River	Lake Graham/Lake Eddleman, Possum Kingdom Lake, Lake Mineral Wells, Lake Palo Pinto, Lake Granbury
Middle Brazos - Lake Whitney	Paluxy River, Brazos River, Steele Creek	Squaw Creek Reservoir, Lake Pat Cleburne, Lake Whitney, Aquilla Lake
North Bosque	Nells Creek	Lake Waco
Bosque		Lake Waco
Leon	Colony Creek	Lake Leon, Proctor Lake, Belton Lake
Cowhouse		Belton Lake
Lampasas	Rocky Creek	Stillhouse Hollow Lake

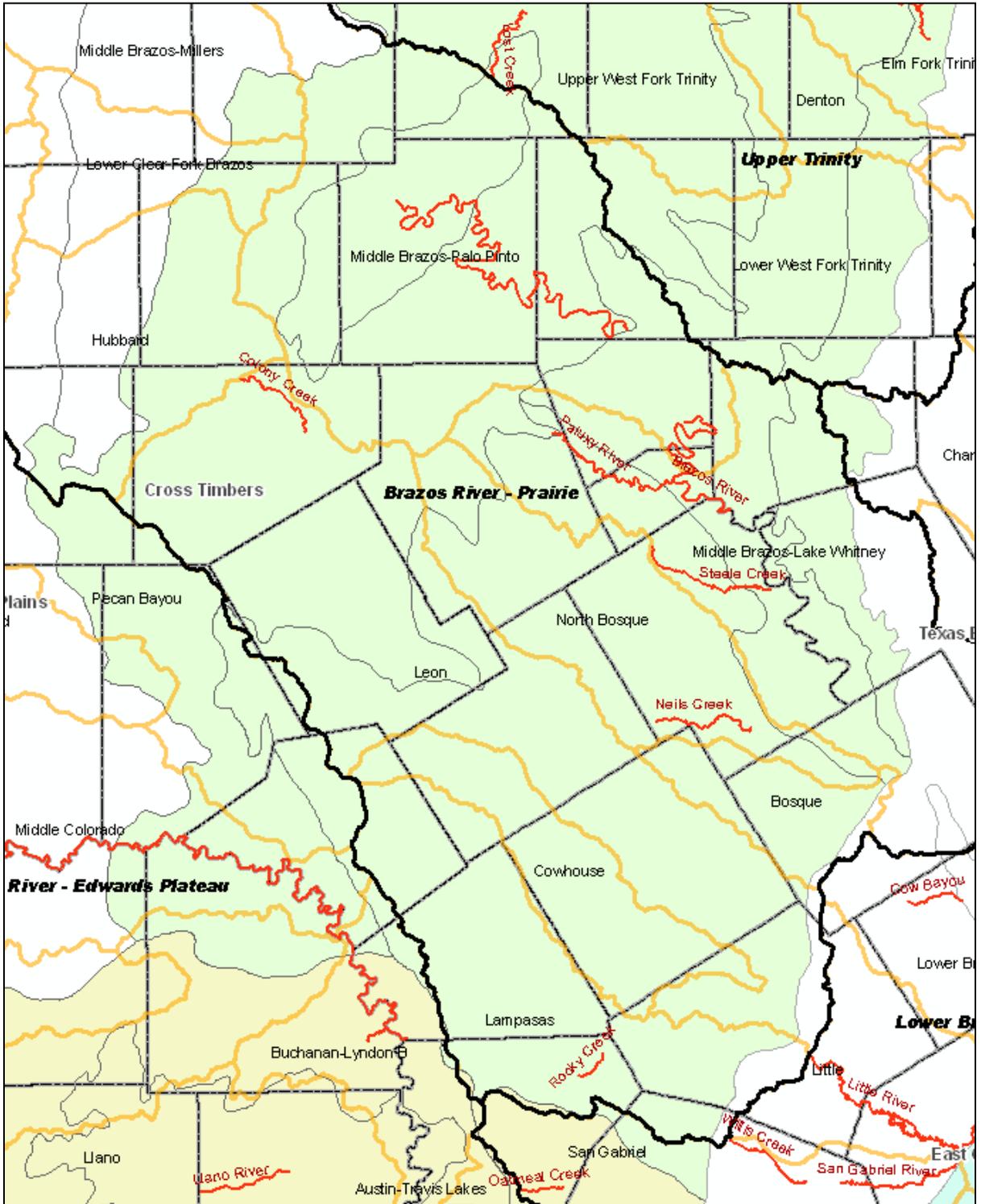
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Table 2. continued

ECOLOGICAL DRAINAGE UNIT SubBasin (HUC 8)	<i>Ecologically Significant Stream Segment TPWD 2002, w/updates 2005</i>	Lakes and Reservoirs
LOWER BRAZOS RIVER		
San Gabriel	Oatmeal Creek, Willis Creek, San Gabriel River	Lake Georgetown, Granger Lake
COLORADO RIVER - EDWARDS PLATEAU		
Middle Colorado	Colorado River	
Jim Ned		Lake Brownwood
Pecan Bayou		Lake Brownwood
San Saba		
Buchanan - Lyndon B	Colorado River	

Note: Ecologically Significant Stream Segments and Reservoirs which occur in the Subbasin (HUC 8) but not in the ECOREGION are not included in this table. There may be other significant stream resources mentioned in the Priority Habitats section

Brazos River Prairie and Colorado River Edwards Plateau EDUs in black outline, HUC8s orange outline, ESSS red lines



Note: other important stream segments may be mentioned in the Priority Habitats section

RARE SPECIES AND COMMUNITIES

While most conservation work is done at the habitat level to address issues and threats, Action Plans' stated primary purpose is to improve and sustain *species'* populations and prevent the need to list species as federally or state threatened or endangered.¹⁰ The Species of Greatest Conservation Need (SGCN) list, one of the Eight Required Elements in all states' Action Plans, is the foundation for the habitat- and issues- based actions in the Plan. In Texas, we've also identified Rare Communities for this planning process. For more information about how the SGCN and Rare Communities lists were developed, including the changes from the 2005 list, see the Overview Handbook.¹¹

Species and rare communities included in the 2012 TCAP Final SGCN and Rare Communities lists are supported by current science, peer-reviewed references and/or other dependable, accessible source documentation, and expert opinion.¹² Each species has a NatureServe calculated state and global conservation rank, which accounts for abundance, stability and threats.¹³ Additionally, several species have federal¹⁴ and/or state¹⁵ listing (endangered, threatened, candidate) status. See the key to conservation status and listing ranks¹⁶ on the TPWD TCAP 2012 website.

The revised lists for TCAP 2012 are substantial and representative of conservation targets needing attention in this Plan and are sorted into the following categories:

Mammals	Birds
Reptiles and Amphibians	Freshwater Fishes
Invertebrates	Plants
Plant Communities	

Both the SGCN and Rare Communities Lists are on the TCAP 2012 website as large-but-sortable Microsoft Excel files: <http://www.tpwd.state.tx.us/landwater/land/tcap/sgcn.phtml>

Once you open this webpage, you can choose to look at the SGCN or Rare Communities lists. In each workbook, the first bottom tab is the complete final statewide compiled list, with habitat information and additional references where available; **each ecoregion tab in the workbook provides an excerpt of the statewide list, sorted to contain just the ecoregion's species or communities.**

PRIORITY HABITATS

Nationally, an SGCN list forms a basis for every Action Plan; however, *species* conservation cannot be successful without defining the *lands and waters species need to survive and thrive*. If it was only important to know about individuals or even populations, we could put representatives in zoos or herbaria or other curated collections and that would be enough; but, it's not **It's important to**

¹⁰ Association of Fish and Wildlife Agencies. 2011. State Wildlife Action Plans. <http://www.wildlifeactionplans.org/>

¹¹ TPWD. 2012. Texas Conservation Action Plan: Overview Handbook.

http://www.tpwd.state.tx.us/landwater/land/tcap/documents/tcap_draft_overview.pdf

¹² TPWD. 2012. Texas Conservation Action Plan: Species of Greatest Conservation Need List and Rare Communities Lists. <http://www.tpwd.state.tx.us/landwater/land/tcap/sgcn.phtml>

¹³ NatureServe. 2011. A network connecting science and conservation (online resources). <http://www.natureserve.org/explorer> (accessed 2011).

¹⁴ USFWS. 2011. Endangered Species List, by state and county.

<http://www.fws.gov/southwest/es/EndangeredSpecies/lists/ListSpecies.cfm> (accessed 2011).

¹⁵ TPWD. 2011. State Listed Species.

http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species (accessed 2011)

¹⁶ TPWD. 2011. Texas Conservation Action Plan: Key to Conservation Status and Listing Ranks.

http://www.tpwd.state.tx.us/landwater/land/tcap/documents/species_key_tcap_2011.pdf

conserve populations in the *context* in which they thrive, to the best of *their* abilities, where they can *contribute to and benefit from* the systems in which they live.

Broad habitat categories were developed to organize all ecoregional handbooks.¹⁷

See also the Statewide/Multi-region handbook for habitats that are of broader importance – shared with many other regions and/or other states or nations (e.g. riparian or migratory species' habitats as a general category).

See documentation for *Ecoregions of Texas* and the *Texas Ecological Mapping Systems Project*.¹⁸

Priority habitats in these ecoregions which support SGCN were identified through workshops, surveys and other ecologists' and/or literature and are listed in Table 3.

¹⁷ TPWD. 2011. Texas Conservation Action Plan: Broad Habitat Categories

http://www.tpwd.state.tx.us/landwater/land/tcap/documents/habitat_categories_tcap_2011.pdf

¹⁸ Griffith, G. 2010. Level III North American Terrestrial Ecoregions: United States Descriptions. Prepared for the North American Commission for Environmental Cooperation (www.cec.org), version May 11, 2010. Corvallis, Oregon.

Griffith, G.E., S.A. Bryce, J.M. Omernik, J.A. Comstock, A.C. Rogers, B. Harrison, S.L. Hatch and D. Bezanson. 2007. Ecoregions of Texas. R.S. Geological Survey, Reston VA. http://www.epa.gov/wed/pages/ecoregions/tx_eco.htm (accessed May 2009).

TPWD, Missouri Resources Assessment Partnership, and Texas Natural Resources Information Service. In progress, 2005 – 2012. Ecological Systems Classification and Mapping Project <http://www.tpwd.state.tx.us/landwater/land/maps/gis/tescp/index.phtml> (accessed 2010). Austin TX.

Table 3. CRTB Priority Habitats

Note Table is formatted 8-1/2" x 11" landscape orientation

GENERAL HABITAT TYPES	CROSS TIMBERS (CRTB)	CRTB Ecological Systems
NATURAL AND SEMI-NATURAL TYPES	<i>Habitats in this column were identified in the workshop; additions were made by editor to riverine and cultural aquatic</i>	<i>NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications for Ecological Systems of Texas' Cross Timbers. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 08 October 2009.</i>
Barren/Sparse Vegetation <i>See also Caves/Karst</i>	Limestone cliffs Loosely consolidated sands Other specific barren geologies??	Edwards Plateau Cliff Southeastern Coastal Plain Cliff
Grassland	Midgrass prairie (e.g. Henrietta, Grand) Shortgrass prairie	Central Mixedgrass Prairie Southeastern Great Plains Tallgrass Prairie Texas Blackland Tallgrass Prairie Western Great Plains Sand Prairie
Shrubland	Shinoak shrubland	Edwards Plateau Limestone Shrubland Western Great Plains Sandhill Steppe
Savanna/Open Woodland	post oak-blackjack oak woodland/savanna mesquite woodlands	Edwards Plateau Limestone Savanna and Woodland
Woodland	Oak/hardwood-juniper woodland Post oak - blackjack oak woodland	Edwards Plateau Dry-Mesic Slope Forest and Woodland
Forest <i>See also Riparian and Wetlands</i>	Oak/hardwood – juniper mature forest	Crosstimbers Oak Forest and Woodland Edwards Plateau Mesic Canyon
Riparian	periodically flooded or subirrigated floodplain woodlands (oak, juniper) and forest (oak, elm, ...) associated with the central Red (TX-OK), upper Trinity, middle Brazos, and northeastern Colorado Rivers and their tributaries midstream sand and gravel bars	Edwards Plateau Floodplain Edwards Plateau Riparian Southeastern Great Plains Floodplain Forest Southeastern Great Plains Riparian Forest

GENERAL HABITAT TYPES	CROSS TIMBERS (CRTB)	CRTB Ecological Systems
Riverine	Instream habitats of the watersheds which intersect this ecoregion (see EDU Workbook) Ecologically Significant Stream Segments - Lost Creek, Clear Creek, Elm Fork Trinity River, Brazos River, Paluxy River, Steele Creek, Nells Creek, Colony Creek, Rocky Creek, Oatmeal Creek, Willis Creek, San Gabriel River, Colorado River	NA
Lacustrine <i>See also</i> Cultural Aquatic	oxbow lakes	NA
Freshwater Wetland	springs and seeps shallow (12 - 18") natural wetlands	NA
Saltwater Wetland	Headwater saline springs	NA
Estuary/Estuarine	NA	NA
Coastal	NA	NA
Marine	NA	NA
Aquifer	Trinity and Trinity Outcrop	NA
Caves/Karst	Crevices and karst features Caves	NA

Table

GENERAL HABITAT TYPES	CROSS TIMBERS (CRTB)	CRTB Ecological Systems
CULTURAL TYPES	<i>habitats in this column must support SGCN or rare communities to be considered in this plan</i>	
Agricultural		NA
Developed		NA
<i>Urban/Suburban/Rural</i>	Green roofs (potentially important to pollinators, needs more information) Bridges, culverts (bats)	NA
<i>Industrial</i>	mines	NA
<i>Rights of Way</i>		NA
Cultural Aquatic	Reservoirs: Nocona, Hubert H. Moss, Texoma, Lost Creek, Amon G. Carter, Bridgeport, Eagle Mountain, Grapevine, Kiowa, Ray Roberts, Lewisville, Worth, Weatherford, Benbrook, Arlington, Hubbard Creek, Daniel, Cisco, Graham/Eddleman, Possum Kingdom, Mineral Wells, Palo Pinto, Granbury, Squaw Creek, Pat Cleburne, Whitney, Aquilla, Waco, Leon, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Brownwood Stockponds, primarily important for migratory waterfowl	NA
ARTIFICIAL REFUGIA		
Created mitigation wetlands	moist soil units, important for waterfowl	NA

Texas shares its border with four states – New Mexico, Oklahoma, Arkansas, and Louisiana. CRTB shares a its northern border with Oklahoma. Table 4 identifies habitat priorities which have been identified in the Oklahoma Wildlife Action Plan which may be adjacent to the CRTB. Every adjacent state’s Action Plan mentions the importance of **intact native riparian zones** and **floodplains, high quality instream habitats, wetlands** of all types, and **native grasslands**. These habitat types are also found in the CRTB and are priorities for conservation in this ecoregion. See Statewide/Multi-region handbook for broadscale Conservation Actions for these priorities.

Table 4. Shared Habitat Priorities with Adjacent State – Oklahoma

Adjacent States	Ecoregions Shared with Texas	Habitat Priorities Shared with CRTB Texas ¹⁹
Oklahoma (OK)	High Plains Southwestern Tablelands Central Great Plain Cross Timbers East Central Texas Plain Western Gulf Coastal Plain	springs and other wetlands mixed grass prairie ephemeral and perennial tributaries and mainstem of the Red River, and associated riparian zones and floodplains tall grass prairie oak woodlands and savanna bottomland forests TX – OK HUC 8 at moderate risk: Farmers-Mud TX – OK HUC 8 at very high risk: Lake Texoma

¹⁹ Priorities were determined by reviewing the state’s Action Plan online (Oklahoma Comprehensive Wildlife Conservation Strategy. 2006. <http://www.wildlifedepartment.com/CWCS.htm>) and the National Fish Habitat Risk Assessment Viewer online (NBII and USGS. 2011. http://fishhabitat.org/index.php?option=com_content&view=category&layout=blog&id=42&Itemid=61).

ISSUES

There are **activities and conditions** which may negatively affect the SGCN populations, rare communities, and the habitats on which they depend in this region. These issues can include **direct or indirect harm** (e.g. inappropriate mining reclamation which uses non-native vegetation or indirectly provides an opportunity for non-native invasive vegetation, streambed gravel mining that directly removes spawning habitat and/or indirectly creates poor water quality downstream) **plus basic “gaps” that prevent us from acting most effectively** (e.g. lack of information, lack of coordination to share current data, incompatible practices among land managers, lack of funding). For information about how this list was developed, see the Overview Handbook and the descriptions of the broad issue categories.²⁰

Habitat fragmentation and habitat loss, including open-space land conversion, are always going to be broad issues that need to be addressed, at various scales – local, regional, statewide, interstate, and international. These are such broad categories and, depending on the scale of the problem, these three issues can be symptoms or causes of many other issues. These three issues are not specifically included in the Issues list, although they may be implied in many of the categories presented.

The issues covered in the CRTB Ecoregion Handbook in Table 5 attempt to present more of the specific causes of SGCN, rare communities, and habitats’ decline, providing appropriate context to help target our actions, identified later in this handbook. Several of the habitat types in this handbook are also considered priority habitats in the Statewide/Multi-region handbook.

²⁰ TPWD. 2011. Texas Conservation Action Plan: Broad Issues Categories
http://www.tpwd.state.tx.us/landwater/land/tcap/documents/broad_issues_categories.pdf

Table 5. CRTB Priority Issues Affecting Conservation

Table is formatted 11" x 17", landscape orientation

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Invasive Species		
Non-native Plant	<p>Salt cedar/tamarisk (<i>Tamarix spp.</i>) (primarily on the western edge of the region)</p> <p>Cultivated and Old World grasses (e.g. King Ranch (KR) bluestem, Bermuda grass)</p> <p>Chinese tallow, Chinaberry, Tree of heaven, Japanese honeysuckle</p> <p>Golden alga (see also <i>Native Problematic Species</i>; it is not conclusively known whether golden alga is native or non-native)</p>	<p>Salt cedar affects water use, monotypic stands, and outcompetes native riparian vegetation (cottonwood, sycamore) at all seral stages and canopy levels; salt cedar line the banks of the Rio Grande in the Big Bend reach, armoring the banks and contributing significantly to channel incision and narrowing, which reduces the diversity and quality of habitat for aquatic species</p> <p>Prairie pockets and woodland edges are adversely affected by non-native and sod-forming grasses (introduced as improved pastures or naturally expansive), a substantial threat to grassland-dependent species (e.g. grassland-obligate birds)</p> <p>Urban/suburban landscaping introduction primarily in riparian zones: ligustrum, chinaberry, Nanina, tree of heaven, and Japanese honeysuckle</p> <p>Non-native plant invasion may also contribute to loss of native pollinators (e.g. honey bee, moths, hummingbirds, others) and the animals which rely on insect fauna now changed by these invasions</p> <p>Toxic algal blooms primarily in lakes in this ecoregion</p> <p>Non-native aquatic plants are a significant threat in this area, predominantly in reservoirs and upper reaches of reservoirs where rivers enter the waterbody</p>
Non-native Animal	<p>feral and/or free-ranging "pets" (mostly urban/suburban issue, where interfacing with wildland or openspace)</p> <p>FERAL HOGS</p> <p>Introduced ungulates for hunting (more of an issue in the southern part of the ecoregion)</p> <p>introduced fishes and mollusks - freshwater springs, streams and marshes</p> <p>Red Imported Fire Ants (RIFA)</p>	<p>Free ranging pets are introduced predators which adversely affect small mammals, small reptiles, and birds; also contribute pathogens and diseases</p> <p>Feral hogs decimate important and fragile habitats (e.g. springs, seeps, riparian areas, swale depressional wetlands), degrade instream water quality, and decrease hardwood seedling viability (rooted up, eaten)</p> <p>Non-native hoofstock introduced into our systems alter and destroy habitat, compete with native small mammals and ungulates for food, and are disease vectors which can affect native ungulates and domestic livestock</p> <p>Within streams, nonnative species compete with natives, and are a predation risk (e.g. small mouth bass are voracious non-native predators)</p> <p>Bait fish releases ("minnows") can cause problematic congeneric hybridization (e.g. <i>Gambusia</i> sp.)</p> <p>Zebra mussels have been detected in this ecoregion and are a potential significant threat to native freshwater mussels, several of which are already listed by the state as threatened</p> <p>RIFA are a reproductive menace to all ground-nesting and some shrub-nesting birds, including BCVI, small mammals, reptiles and amphibians; RIFA will invade and destroy/eat a nest of eggs and/or young</p>
Native Problematic	<p>Native shrub (e.g. juniper, mesquite, whitebrush, yaupon, prickly pear) or "brush" encroachment into prairie systems and understory in mature savanna systems</p> <p>Golden alga (see also <i>Non-native Invasive Species</i>; it is not conclusively known whether golden alga is native or non-native)</p> <p>Brown-headed cowbird</p>	<p>Invasive native brush/trees are a significant threat to prairie-obligate birds, where grassland/prairie habitats are desired ecological condition in this region (mostly along western edge adjacent to CGPL ecoregion): habitat availability decreased and degraded for prairie nesting birds</p> <p>Toxic algal blooms</p> <p>brood parasites on several threatened and endangered species (black-capped vireo, other woodland and shrubland bird species)</p>
Pests, Parasites, Pathogens		
Pathogens	<p>White-nose Syndrome (WNS)</p> <p>Oak wilt and oak decline</p> <p>West Nile virus</p>	<p>WNS affects hibernating bats and is spread through human (we think) and bat vectors, through cave visitation. Mortality is high; prevention and overall cause is unknown. Caves, karst and potentially some human structures that serve as bat hibernacula may be vulnerable.</p> <p>Oak wilt and oak decline adversely affect hardwoods in this ecoregion, contributing to declines in hardwood diversity, suitable woodland songbird nesting areas, and forage for native browsing animals</p>
Power Development and Transmission		

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Wind Generation	See also full discussion in Statewide Handbook Competitive Renewable Energy Zones (CREZ): eastern edge of the Central CREZ Turbine operations	While this ecoregion does not have the high intensity wind potential that western, central and south Texas (including the Gulf) have, one of the CREZ has been mapped into the westernmost edge of this ecoregion, where topography (higher ridges) and less dense vegetation may provide opportunities for higher winds and development. This area is within migration corridors for raptors, neotropical migrants, stopover habitats for Whooping Cranes). Wind turbine operation causes barotraumas in bats and birds, and has resulted in direct strikes to some larger birds (raptors, primarily; and larger flocks of migrants) during operations In some areas the network of maintenance and access roads can be a hazard to fossorial SGCN if not appropriately cited, or if speeds are not controlled in these areas Black-capped vireo habitat and open grasslands on the western edge of the CRTB are vulnerable. deep footings may impact karst in certain areas
Hydro (Dam and Reservoir)		<i>see also Water Development, Management and Distribution</i>
Biofuels	Row Crop, Switchgrass, Herbaceous <i>Editor's Note: "Biofuel production" was mentioned as an issue in the workshop; however, no specifics (what kind) were given - needs information about extent and effects to determine appropriate actions, if any</i>	native rangeland, few open grasslands converted to croplands (monotypic stands of switchgrass and others); some native oak woodlands and shrublands converted to switchgrass or fast-growing timber production for "whole tree utilization"
Transmission	New development and expansion of existing lines/corridors construction of new power infrastructure corridors to meet urban user needs, from CREZ and non-CREZ west Texas and Panhandle wind generation projects to north Texas urban areas (Fort Worth, Dallas) maintenance and operations maintaining clear right-of-way for vehicle clearance/access, prevention of line and tower danger	directly takes habitat and species during construction (loss), degrades adjacent habitat (creates edge, removes contributing nutrients or can contribute to adverse stormwater runoff into karst, creates opportunities for oak wilt/oak decline and other invasive species), and may hinder movement (daily or seasonal) for animals and birds that are more dependent on interior woodland habitats (do not tolerate edge); creates greater opportunities for brown-headed cowbird parasitism and predation when not placed near or on natural edges (instead of cutting through large intact blocks, could route to areas already affected by edge) mowing, trimming (permanent vegetation conversion from woodland to grassland); in some instances, herbicide application or hydraulic fluid spills from maintenance equipment may threaten karst features Strike hazard for Whooping Crane in certain areas along typical migratory pathways and near open waters
Distribution	Development to power grid and retail users: construction of new power infrastructure corridors to meet urban user needs	mowing, trimming (permanent vegetation conversion from woodland to grassland); in some instances, herbicide application or hydraulic fluid spills from maintenance equipment may threaten karst features directly takes habitat and species during construction (loss), degrades adjacent habitat (fragmentation), and may hinder movement (daily or seasonal)
Oil and Natural Gas Production and Delivery		
Seismic exploration	surface and subsurface impacts - linear networked vegetation clearing and soil disturbance, vibration and "explosive" disturbance	habitat loss (clearing transects for lines) and no required precautions or reclamation to prevent invasive species introductions (pathogens, plants) vector for invasive species (plant) introductions from equipment and opportunistic colonization in wake of habitat clearing and no reclamation disruption of daily and seasonal activities for fossorial animals (small mammals, reptiles, ground-foraging and ground-nesting birds)
Traditional extraction site development and operation, including pumping and pad sites, gathering stations, transmission/delivery facilities (distribution lines, roadway)	on-site spill potential salt water injection wells road networks	limited ground and surface waters (cieneegas, swale wetlands, others) highly sensitive to change/contamination are at risk from chemical, drilling material, and oil spills and groundwater contamination caused by salt water injection Extraction operations cause clearing, road networks, pad sites, and large mechanical infrastructure(s) which contribute to direct habitat loss, direct and indirect habitat fragmentation, direct mortality from vehicles and operations, and noise/light disturbance (e.g. sand dunes west of Odessa, dunes sagebrush lizard is threatened by these operations and road mortality; nocturnal birds and bats can be adversely impacted by the light and noise pollution; road networks, constant traffic and noise, and mechanical infrastructure interrupts seasonal and daily movements, foraging and mating behaviors of some mammals, reptiles, and birds; small geographically limited populations of desert plants fragmented or lost).
Hydraulic fracturing ("fracking or frac-ing") "shale gas" extraction	This ecoregion is underlain with Barnett Shale, which is one of the shale gas formations most targeted (at the moment) for extraction by frac-ing. http://www.energyindustryphotos.com/shale_gas_map_shale_basins.htm Requires deeply injected chemical liquid which fractures substrates and releases gas for capture and delivery: potential groundwater risks, potential chemical spill risks, geologic destabilization	Groundwater (Trinity and Trinity Outcrop Aquifers) and its surface expression in seeps, springs are extremely important habitats in this ecoregion (e.g. headwater catfish, karst- and spring-dependent salamanders); groundwater contamination could cause total loss of isolated aquatic populations, adversely affect vegetation that depends on water quantity and quality at springheads, seeps, riparian areas, and instream. Contamination also poses a risk to human and livestock water sources. Fracturing activities may also adversely affect the recharge capacity of porous rock layers and networked karst features.

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Lack of Reclamation	reclamation standards vary, requirements limited unmonitored/unregulated decay of obsolete production sites - toxic chemicals in soils and leftover equipment, decaying equipment	Reclamation not required back to NATIVE vegetation (invasive species allowed to colonize or are directly planted for soil stabilization)
Mining		
Sand and Gravel - upland and riverine	sand and gravel mining along and within streams and rivers	adverse effects to water quality in the upper Brazos loss of riparian habitats for instream and adjacent mining, sedimentation in streams contributes to loss and degradation of instream habitats
Caliche	caliche - small scale on ranches, large scale for county roads	typically for road base, unreclaimed sites, complete/permanent loss of surface communities
Transportation		
road and bridge construction (new)	Large transportation projects are planned for this area (State Transportation Plan) to address burgeoning population growth in and around Fort Worth/Dallas metroplex	Little consideration is given to habitat connectivity and fragmentation in these projects during planning; only regulatory processes with a federal nexus impact how facilities are eventually developed, still with limitations on environmental consideration (jurisdictional wetlands, federally listed species and their habitats). Larger highway corridors have already fragmented rural working lands and created a disruption in habitat continuity; in many instances, the ROW is the only conduit under or along the highway to reconnect these lands and these are not typically designed with wildlife movement in mind (small mammals, reptiles and amphibians, fishes typically suffer the greatest disconnection) Revegetation post-construction or post-improvement is typically not with native seed or plant materials; this creates vectors for non-native species introductions into adjacent native habitats and/or disconnected habitats for species more specifically reliant on native flora and the insect fauna supported by those native plants.
right of way maintenance	maintaining clear right-of-way for vehicle clearance/access, minimizing fire danger, and maintaining driver visibility	mowing, trimming (permanent fragmentation, erosion) herbicide application some rare plants are known only from sites in ROW; these are not always adequately protected as staff changes occur, management plans are filed away, information not passed through entire chain of command - needs better communication in some places
Land & Water Mgmt: FARM	See also Water Development section	
Lack of soil and water management and conservation practices	Incompatible fertilizer, herbicide, fungicide or pesticide applications; chemical- and sediment-laden irrigation water runoff	adverse impacts to sensitive aquatic insects and other invertebrates, fishes, and amphibians
Lack of soil and water management and conservation practices	Concentrated Animal Feeding Operations (CAFOs)	intense concentrations of animals - feces, antibiotics, pesticides are all elements in runoff from many of these sites, if they do not have stormwater controls in place for catchment, filtration, and/or water treatment prior to release back to land and water environments; adversely affects water quality (chemicals, sediment loading which adversely affects instream life) and vegetation communities along stream catchments (over-enrichment can lead to complete loss of riparian and unbalance instream vegetation to favor noxious plants or alga)
Cultivation and loss of of natural sites/habitats	Conversion of bottomlands to agricultural sites	Loss of native bottomland hardwood diversity and floodplain forests for monotypic pecan production and other agricultural clearing on floodplains
Land & Water Mgmt: RANCH	See also Water Development section	
Incompatible stocking practices	In some areas, working lands are still recovering from historic uses, out-of-date stocking and grazing practices (prior to soil, native vegetation, and water conservation knowledge we have today) non-native hoofstock for hunting operations	In some areas, working lands are still recovering from historic uses, out-of-date stocking and grazing practices (prior to soil, native vegetation, and water conservation knowledge we have today) and introduced competition from non-natives degrades grassland and prairie habitats in the woodland matrix; also can contribute to adverse water quality and quantity in some areas with sensitive aquatic invertebrates and fishes
Landowner/land management incentive programs working at cross-purposes	single-objective management such as all-game, all-livestock, all-recreation incentive programs, technical guidance, and management assistance from all providers could be offered with a more complete menu of land and water management options, which includes SGCN and rare communities' needs	single species or single habitat management does not promote diverse or productive habitat values and full-system management

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
	<p>inappropriate juniper or other brush management on slopes or canyons (see also statewide handbook re brush management)</p> <p>Landowners do not have a one-stop shop to review best management practices for their site, for their goals</p>	
Land ownership	<p>Near larger urban areas in Texas, ranch subdivision is a constant issue for the conservation service provider.</p>	<p>Mulitple landowners more difficult to target with a conservation incentives than one single larger landowner</p> <p>Each landowner has a different goals for their land</p> <p>Fragmentation of larger habitats and landscapes more likely</p> <p>Large-patch habitat dependencies are adversely affected; land management is more resource- and time-intensive and recovery "starts" at different points</p> <p>SEE ALSO STATEWIDE HANDBOOK FOR THIS ISSUE and ACTIONS</p>
Fencing	<p>high game fencing</p>	<p>High game fencing reduces genetic viability in all species inside the fence (depending on construction), fences in non-natives and can degrade natural habitats quickly without VERY intensive management to control hogs and other destructive non-natives, makes management of a public resource onerous on the landowner, requires intensive planning and is not suitable for most wildlife species or the longterm financial condition of most ranches</p>
Land Management Practices	<p>Fire suppression (or just the lack of fire in the system, whether suppressed or not)</p>	<p>Without fire in these habitats, grassland to shrubland or closed canopy woodland conversion (aforestation) with less of a natural mosaic important to species which co-evolved in this system</p> <p>While some portions of this ecoregion (primarily canyons, karst outcrops, and riparian areas) are supposed to be closed canopy mature woodlands which eventually grow to naturally suppress understory, most upland habitats in this region require fire or some kind of distrurbance to prevent thicketed understory and encourage the natural mosaic of woodland – grassland and allow for mature forest regeneration.</p>
Clearing and loss of important natural sites/habitats	<p>Springs, seeps, other wetlands and smaller streams altered (dammed, pumped) for stock uses, domestic use</p>	<p>Changes vegetation community, hydrology, and aquatic species habitats in these areas</p>
Land & Water Mgmt: Municipal	<p>See also Water Development section</p>	
Lack of Zoning and Planning	<p>Planning efforts are minimal, rarely regional; this entire region is affected by the sprawling urban/suburban growth – direct water use, future water needs, continuous loss of habitat outside of urban jurisdictions, inadequate stormwater pollution prevention</p>	<p>Water: Outlying areas and rural areas with water are targeted to supply municipal needs in other basins (see WATER DEVELOPMENT below)</p> <p>Land: Urban sprawl and little regulation on development type contributes to all land habitat loss, impervious cover and runoff (degradation of water quality)</p>
Land & Water Mgmt: Conservation & Recreation		
Inadequate/Inappropriate Management	<p>managing wildfire (more Rx burning needed to reduce the risk of wildfires)</p>	
Inappropriate Recreational Uses	<p>ORV use in sensitive areas (stream beds, steep slopes)</p>	<p>Adverse water quality effects through direct disturbance, soil erosion, fuel/oil spills, and degradation/loss of vegetation communities and aquatic habitats</p>
Not all "public" or "managed" lands are "conservation" lands		<p>Whle most public lands in this region are managed for recreation compatible with wildlife and fisheries resources, some improvements could be made to trails and recreation facilities to prevent soil erosion, vegetation loss</p> <p>Several public lands in this region would benefit from an ecological "audit" to determine if their size and practices are sufficient to contribute to the conservation of SGCN in this region; many could benefit from additional acreage to address recreation needs and prevent impacts to sensitive areas from concentrated activities</p>
Lack of long-range conservation planning and cohesive land conservation/management strategies in each ecoregion	<p>conversion to tax-producing entities (e.g. City, USACE divesting recreation lands or open space to generate revenue)</p>	<p>Larger "open space" or parkland sites which have historically functioned as stepping stones for migrants through urban areas or water quality protection sold for revenue generation; these may have conservation values that are not protected in the sale through conservation easement or other development-limiting title attachments</p>
Water Development, Management and Distribution	<p>SEE ALSO STATEWIDE HANDBOOK</p>	
Surface Water Planning	<p>Natural resources not well-defined or required as a "constraint" in Regional Water Planning (RWP) processes; natural resource professionals are not</p>	<p>Many urban water users are disconnected from the impact their water use has on the environment and local ecology; where they could save water; how much they use on a daily basis; safety of water re-use; etc. - needs campaign in large urban areas especially where urban water needs may</p>

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
	consistently involved in RWP processes Large municipalities' demands are the primary driving force in surface and groundwater planning Several new reservoirs are planned in ecoregion to address growing urban population water needs; Many natural resource "constraints" are not considered in the planning or site selection process New water line construction not considered in planning or operational impacts/costs to resources	contribute to new reservoir development and large losses in intact native instream and terrestrial habitats Selected new reservoir sites (State Water Plan 2007 and see also the TCAP Statewide Issues handbook) will contribute to direct loss (permanent over-canopy inundation/flooding) of bottomland hardwood forests, riparian areas important as migratory flyways, shallow stream and wetland habitats Reservoirs proposed on the Brazos may adversely affect sharpnose and smalleye shiner
Reservoir Construction and Operation	Timing/Periodicity/Intensity of Water Releases releases are unnaturally intense and short duration in the "wrong" season to mimic natural flooding processes – all larger rivers in this region	Altered flooding regime (timing, periodicity, amounts) that adversely affects flood-dependent riparian and aquatic systems Unnatural hydrograph scours instream and stream-adjacent habitats, shifts vegetation communities out of sync with other riparian communities where flooding is more "natural", vegetation communities and instream animal (invert, fishes, etc.) cannot "rely" on the seasonal changes under which they evolved.
Groundwater Planning and Distribution	Groundwater districts are political subdivisions, not aligned necessarily with aquifer boundaries Extraction: groundwater pumping without full accounting for natural resources as a "use"	physical changes to karst, springs (water amount and quality) adversely impact some species' thresholds for survival and/or sustainable life history (reproduction, foraging, resting); subirrigated and instream aquatic habitats and riparian zones require groundwater reaching the stream (flow, depth, substrate changes, adjacent riparian habitat changes from dry conditions) and changes in instream water conditions such as temperature, oxygen availability, and other nutrient and chemical factors (such as the age of water source that comes from the aquifer) decreased and degraded aquifer recharge capacity ("drying out the sponge or seive" at certain levels within the aquifer can affect the flow quantity and quality into the aquifer from recharge events)
Other Water Source Developments and Technologies	Interbasin Transfers (Surface and Groundwater) Municipal demands on water and potential for well field development for commercial export out of the region or to the largest municipalities	
Interbasin Transfers (Surface and Groundwater)	lack of accounting for instream flow in each basin, timing and amount of withdrawals for transfer	water chemistry is different among basins and "sharing" water can change the chemistry in both systems, potentially adversely affecting tolerances of sensitive aquatic species; instream flows (water quantity) are altered in both systems
Desalination and Chloride Removal Operations	Salt-laden surface waters are extracted, treated mechanically and chemically to create fresh (non-salt) water for human consumption and agricultural uses; brine is repatriated to stream	Water loss out of surface system, changes chemical composition of water in upper Brazos, brine disposal and surface water loss changes water quantity and quality downstream of these operations, adversely affecting instream and stream-adjacent species/communities
Lack of Information & Resources		
Lack of CRTB vegetation community and species information	Not much is fully understood about the Cross Timbers desired ecological condition	Vegetation communities will be mapped through the Texas Ecological Systems Mapping Project and this will contribute to greater understanding of the terrestrial habitats; however, little is known about SGCN distribution and/or needs from these vegetation types. Need more information on instream flow and water quality thresholds for aquatic SGCN (mussels, fishes, insects).
Lack of Processing <i>Existing</i> Data	Where census, survey, records and collections are documented, little is done with the data to detect trends and causes for upward or downward shifts.	Without this information, it is difficult to focus or prioritize management objectives or share information with private landowners about the importance of some sites, populations or communities. Sharing this information with landowners is crucial as most of Texas is privately owned and conservation must occur with their stewardship help.
Best Management Practices	Inadequate understanding or availability of ecologically-based or widely-accepted conservation Best Management Practices	Especially important in areas where flooding and fire processes have been interrupted and not replaced through human intervention or active management; also need better distribution of ecologically appropriate riparian practices.
Inadequate Policies, Rules, Enforcement		
Poaching, Permitting Avoidance and Violations	Insufficient opportunities for law enforcement for non-game issues Baitfishing Unregulated/unmanaged Small Mammal and Reptile "hunting"	Several small fish species in river and stream systems of this ecoregion are rare; indiscriminate bait fish harvesting may impact these rare species

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Wetland Jurisdiction	Loss of and impact to "non-jurisdictional" wetlands and other waters	Isolated wetlands are not protected under USACE regulatory processes; these are important habitats for migratory waterfowl, bog and seep communities See also Statewide/Multiregion handbook
Other Cross-Cutting Issues		
Climate Change	Native vegetation shifts Pollinator shifts and losses Phenology shifts	Potential shifts from or to grassland communities, loss of shrublands and woodlands potential; Need better modeling information
	Economics Ranch	Landowner incentives for wildlife and fish resource conservation in many areas cannot compete with market forces Economic conditions and low livestock market prices in some areas do not support large ranch ownership, or the transfer of that ranch to the next generation See also Statewide/Multiregion handbook

CONSERVATION ACTIONS

“Like the resource it seeks to protect, wildlife conservation must be dynamic, changing as conditions change, seeking always to become more effective.” – Rachel Carson

To make conservation progress, we need to work with the information we have, document our progress, share lessons learned, and adapt our approach when necessary. Conservation actions in this handbook are aimed at reducing the negative effects of issues that affect SGCN, rare communities and their habitats at various scales. Broad actions categories are defined to help organize handbooks. For information about how the Actions framework was developed and for definitions of Action categories, see the *Overview Handbook*.²¹

Actions proposed for the CRTB (Table 6) state what we need to work on, where, and why (what problem we can solve with that action). Actions lay out how that work contributes to a specific desired effect – progress and success.

It is important to acknowledge that one conservation action typically does not solve one conservation problem. There may be several actions employed over time to achieve a conservation goal. In some instances, defining the conservation goal *is* the action – for some things, we don’t yet know enough to define what successful conservation looks like for that SGCN population, rare community, or habitat.

It has become increasingly important to determine if the work we do is actually leading to the overall conservation outcomes we desire – **restoration, recovery, sustainability, and resiliency**. As conservation practitioners, we can use milestones (or intermediate results) and reporting to communicate our progress and leverage future conservation action, partnerships, policy changes, and funding.

From project inception, well-crafted monitoring and evaluation (cost effective, answers key questions) informs management and allows conservation practitioners to “course-correct” as necessary for effective conservation.²² With the need for Action Plans to take advantage of several “pots of conservation money,” the people we serve and those who govern private and public conservation funds demand reporting, transparency, and *demonstration* that projects are *positively impacting the conservation of species and habitats*. To get beyond reporting that money was spent and projects were done, AFWA TWW convened a committee in 2009 to craft “effectiveness measures” for the conservation actions across all Plans. A toolkit for classifying and measuring conservation action effectiveness was produced in 2011, approved by AFWA TWW Executive Committee comprised of state

²¹ TPWD. 2011. Texas Conservation Action Plan: Broad Action Category Definitions.

http://www.tpwd.state.tx.us/landwater/land/tcap/documents/action_categories_tcap_2011.pdf

The category “*Data Collection, Analysis, and Management*” meets Action Plan Required Element 3 – “priority research and survey”. Many of the proposed actions include a monitoring component (Action Plan Required Element 5) and all actions are encouraged to follow the Effectiveness Measures to assist with adaptive management.

²² Conservation Measures Partnership. 2010. http://www.conservationmeasures.org/wp-content/uploads/2010/04/CMP_Open_Standards_Version_2.0.pdf

Salzer, D. and N. Salafsky. 2006. Allocating resources between taking action, assessing status, and measuring effectiveness of conservation actions. *Natural Areas Journal* 26(3): 310-316.

fish and wildlife agency directors and others.²³ These measures will be an important part of moving the plans and conservation forward.

With this revision, the TCAP becomes more involved in a national movement to track conservation actions and progress across local, state, regional and national levels. As with the 2005 Plan, actions presented in this edition vary in detail, scale, and duration; however, this edition encourages the use of the incremental measures of success for conservation projects' development, implementation, and tracking. To that end, the toolkit in *Measuring the Effectiveness of State Wildlife Grants*²⁴ is **strongly recommended** to define conservation projects, target audiences and partners, identify desired step-wise intermediate results, and collect the “right” data to report our conservation achievements.

²³ Association of Fish and Wildlife Agencies Teaming with Wildlife. *Measuring the Effectiveness of State Wildlife Grants (conservation actions)*. 2011. <http://www.fishwildlife.org/files/TWW-Effectiveness-Measures-FULL-Report-Appendices.pdf>

²⁴ Same as above

Table 6. CRTB Conservation Actions

Note: Table is formatted 11" x 17", landscape orientation – SEE ALL OF THE EFFECTIVENESS MEASURES FOR EACH OF THE OVERALL ACTIONS TO ESTABLISH FINER DETAIL IN PROJECT IMPLEMENTATION

Conservation Action
Invasive Species
Work with adjacent ecoregion ecologists to continue headwater to mainstem Salt cedar/tamarisk (<i>Tamarix spp.</i>) removal on all public lands and on willing private lands with incentives for maintenance, documentation and monitoring; this species occurs primarily on the western edge of the CRTB, so cooperation with the CGPL and EDPT ecoregions would be most directly useful.
Promote the use of native grasses in landowner incentive programs for wildlife and fish resource improvement (e.g. Farm Bill, SWG, LIP, and others). Sod-forming exotic grasses, cultivars and Old World grasses should not be used in any restoration project, much less those with state or federal dollars, as these are known to be detrimental to native habitats and the wildlife on which they depend. A restoration guide to approved native grasses for this ecoregion, local sources for native seed and stock, and techniques would be immensely useful to a wide variety of conservation service providers, landowners, and recreation land operators.
Provide workshops for landscape design and installation service providers, local and "big box" nurseries' producers and buyers, city planning boards for landscaping, managers for urban parks and recreation sites, Home Owners Associations, Texas Master Gardener classes, and garden clubs: <i>in areas upstream and adjacent to high priority streams and water courses, conservation projects and wildlands</i> to deter the promotion or use of Chinese tallow, Chinaberry, Tree of heaven, Japanese honeysuckle, and state-prohibited species. Encourage these plant users to adopt a stream segment for nonnative plant removal and restoration under the guidance of a local ecologist. Follow the outreach effectiveness measures to determine if the workshops are successful in targeted areas to slow or prevent the spread of these very detrimental invaders <i>in areas with a high concentration of oak wilt or oak decline vulnerable species and a lot of tree trimming activity</i> (urban areas, parklands) to deter the inappropriate timing or disposal of oak trimming to slow/prevent the spread of this disease. Document areas of oak wilt or oak decline with the Texas Forest Service to help them concentrate their outreach and incentive programs on this front
Continue golden alga monitoring, but concentrate in areas where aquatic SGCN may be most at risk (freshwater fishes, mollusks and other invertebrates, waterfowl). Use the citizen science networks of the area, catalyzed by the Texas Master Naturalist chapters and local fishing clubs, to document findings in the online invasive species tracking tool sponsored by TexasInvasives.org. Use this information to create eradication and management plans in areas of most direct impact to SGCN.
Intensify outreach and public education efforts especially near boat ramps and high-traffic fishing tournament areas to reduce or eliminate the introduction of aquatic invasives – plants, mollusks and baitfishes. Highly isolated and vulnerable aquatic SGCN in this region would be severely threatened (more so than they are currently) by such introductions.
Target outreach for red imported fire ant (RIFA) proper identification (not confused with other beneficial ant species) and control nearest and upstream of karst and spring features where SGCN may be severely affected by RIFA predation. Promote use of established ecologically sensitive techniques such as those used in karst preserves in Bexar, Travis and Williamson counties.
In counties along the western edge of this ecoregion, adjacent to the CGPL ecoregion, encourage site-appropriate invasive native brush removal with least ecological collateral damage to promote healthy native grasslands for grassland-obligate birds and potentially pronghorn; monitor before and after to determine benefits to target species.
Pests, Parasites, Pathogens
Intensify private landowner outreach in karst-prone areas, especially those sites with traversable caves, to promote appropriate precautionary protocols in equipment use and cleaning to help prevent the introduction of White-Nose Syndrome in caves and karst roosts in this region. Also, post protocols near cavern entrances for public and commercial caves with known roost areas, even if those roosts are only seasonal. Texas needs a documentation protocol and clearinghouse for suspected observances, verification, and reporting structure to the Western Bats Working Group and the USFWS WNS working group.
Power Development and Transmission
Along the westernmost edge of this ecoregion, where topography (higher ridges) and less dense vegetation provide highest opportunities for wind development, and along a wide path between the CREZ potential area and substations near Fort Worth and Dallas, map areas sensitive to this type of development and work with TPWD Habitat Assessment section so that they may provide cooperative wind project developers, generation operators and transmission line developers the best information to avoid migration corridors for raptors, neotropical migrants, nocturnal migrants, stopover habitats for Whooping Cranes, concentrations of black-capped vireo and other important habitats, and bat concentrations. Find opportunities to study wind turbine operations related to direct strike incidence and barotrauma to document operations changes and recommendations which may be helpful to minimize or avoid these impacts. Survey whether turbine footings have impacts to karst features along the southern CRTB areas near the EDPT. Document findings with the TPWD Habitat Assessment section to help craft recommendations that wind power generators can use during project development. Work with transmission and distribution line developers and maintenance operations to minimize effects to SGCN through spanning riparian areas and native hardwood canyons, wetland avoidance even if nonjurisdictional, use of native grasses and shrubs during reclamation after transmission line construction, maintenance timing and intensity compatible with SGCN bird nesting periods and karst protection
Oil and Natural Gas Production and Delivery
In the portion of this region underlain with Barnett Shale, which is one of the shale gas formations most targeted (at the moment) for extraction by frack-ing, monitor Trinity and Trinity Outcrop Aquifers and their surface expressions' quantity and quality and geologic stability both in karst-prone and non-karst areas. Concentrate any studies on the potential to impact specific SGCN and rare communities which are groundwater dependent or karst dependent. Document findings in ecology and geology/geophysical journals; provide findings to TPWD Habitat Assessment section to inform their recommendations to oil and gas industry developers who consult with them.

Conservation Action
Mining
<p>Develop a short list of best management practices for water quality protection and aquatic feature adjacent vegetation protection for sand and gravel mining operations.</p> <p>Provide conservation outreach to mining company operators, especially those in the sand and gravel field, to inform them of the new regulations requiring a TCEQ permit for river and stream operations. Work with TCEQ permitting requirements to include information about the sensitivity and importance of instream gravel bars, riparian areas, springs, seeps and other water features, including nonjurisdictional wetlands and swales, to encourage best practices (avoidance of nesting/roosting islands, stormwater pollution prevention and water quality improvement, minimal damage to vegetation and restoration to native conditions).</p> <p>Identify suitable reseeding and replanting mixtures, sources and habitat-specific techniques for mining reclamation in the Cross Timbers (predominately impacts are over the Barnett Shale and more traditional sites on the western edge). Provide this information directly to the mining companies to encourage reclamation back to native conditions. Promote the monitoring of restoration and the suppression of nonnative invasive species until the site has fully recovered to native conditions and does not require ongoing management. Work with mining companies and the surface rights landowners to craft conservation solutions perhaps through conservation easements or other agreements to improve land and water conditions and set aside sites which may benefit landscape scale SGCN goals.</p>
Transportation
<p>Although this ecoregion does not contain one of the High Priority Transportation Corridors (http://www.fhwa.dot.gov/planning/nhs/hipricorridors/hiprimap.html), the region has several large urban areas and growing populations which require upgraded and maintained roadways. Work with TXDOT District Engineers in this area to identify significant sites, features, and conservation land networks for SGCN, so that TXDOT can avoid or minimize their impacts to these areas during new construction and improvements. These sites may also be good opportunities for mitigation banks, landowner incentives, and collaborative conservation projects to offset impacts. In this ecoregion, sites should focus on any native hardwood canyons, intact headwaters and ecologically significant stream segments, nonjurisdictional and jurisdictional wetlands, riparian corridors to floodplain extent, oxbow lakes and native grasslands (along western edge).</p>
Land & Water Mgmt: FARM
<p>Farms in this area are typically along floodplains and up to margins of larger rivers; very little unconverted floodplain remains in this ecoregion although the riparian zones, oxbow habitats, and waterways are very important to SGCN where intact. Landowner incentive programs, including FEMA buyouts and Wildlife Tax Valuations, could concentrate along and upstream of Ecologically Significant Stream Segments to promote restoration of floodplains, bottomlands, and tributary confluences.</p> <p>All agricultural practices should be encouraged to retain streamside and fieldside buffers of native dense vegetation to assist with runoff control and treatment prior to “discharge” into any waterway. All CAFOs which do not meet the thresholds for stormwater pollution prevention requirements under TCEQ rules should be eligible for conservation practice incentives to encourage the use of stormwater pollution prevention practices.</p>
Land & Water Mgmt: RANCH
<p>Landowner incentive programs through the Farm Bill and Wildlife Tax Valuation for ranches in this ecoregion can be great tools for priority habitat conservation. Incentive programs working on agricultural field conversion to pasture or “wildlife habitat” should offer only native seeds and plants. Nonnatives in this ecoregion are known to be detrimental to groundnesting birds, pollinators, and other taxa which require the more open, nonsod structure of natives. Management practices need to encourage the restoration and management of native habitats for native wildlife. Local ecologists need to provide a list of regional habitat-specific native seeds and plants, sources, and techniques for private landowners to research, use and share.</p>
Land & Water Mgmt: Municipal
<p>Work with the planners of the City of Fort Worth, surrounding urban areas and emerging communities to reduce the human-induced pollution risks and increase water conservation in the following at-risk watersheds: Denton, Elm Fork Trinity and Lower West Fork Trinity (National Fish Habitat Action Plan, high to very high risk HUC 8 watersheds); identify specific measures that can be implemented and establish monitoring to determine if outreach and coordination with planning entities is effective</p> <p>Work with the transportation and urban planning entities in the Fort Worth – Dallas metroplex and emerging communities to identify the best open space and parkland connectivity through and around these areas to benefit migratory species, riparian connectivity, old growth woodland – prairie mosaic sites, and water quality.</p>
<p>Develop one to two page best management practices to target outreach to urban and suburban planners in developing and developed areas focused on the significance of mid and tall grass prairie; riparian habitat, streamside buffers and water quality; drainage way protection and floodway restoration with natives; and water conservation relevant to SGCN <i>specific to their community</i>. Include information on programs available to them for guidance, conservation incentives, and restoration (e.g. FEMA floodplain buyouts). Monitor the targeted outreach effectiveness and determine if the approach could be successfully implemented in other areas (e.g. adjacent ecoregions with similar issues).</p>
Land & Water Mgmt: Conservation & Recreation
<p>Initiate a Conservation Area Designation Incentive Program for landowners to protect wetlands (especially springs, seeps, bogs, and other isolated wetlands); bottomland hardwood and mixed hardwood woodlands – from livestock access, restore surrounding wetland fringe vegetation, and contribute data about the location and condition of these incredibly important and sensitive resources.</p> <p>Identify the top keystone regulated species (e.g. for each broad habitat type most affected by development – wetlands, shrublands, hardwood woodlands) in the ecoregion for which one or two large scale mitigation banks could be the most beneficial to the most SGCN. Identify through the Texas Ecological Systems Mapping Project where these habitat types may best occur and provide landowner incentives to participate in these areas. Depending on success of the mitigation bank concept, determine best targeted effective outreach to developers who would or could use this tool.</p>

Conservation Action
Conservation easements and landowner incentive programs are the best instruments for landowner participation in this region. Landowners with intact, healthy CRTB mosaic habitats of woodlands/grasslands with restoration potential for little investment, riparian corridors along Ecologically Significant Stream Segments (and to their headwaters), and/or springs should be first-eligible. Monitoring of key species (to be identified) must be a part of these projects. Information about methods, short and longterm success (or failure) need to be shared through conservation networks (see Statewide/Multi-region Issues handbook – Information Actions section).
Work with willing landowners <i>especially adjacent to and in corridors between</i> well-managed public lands to restore and manage riparian communities in large single-ownership or smaller acreage cooperatives – opportunities to connect/improve historically fragmented management
Water Development, Management and Distribution
Form a local ecologists’ working group to evaluate instream flow studies’ recommendations and craft/deliver specific environmental water flow recommendations and rationale that connect ground and surface water issues for the following Water Planning Groups (links to sites regularly updated by the Texas Water Development Board are included): Surface Water Regions (see http://www.twdb.state.tx.us/mapping/maps/pdf/sb1_groups_8x11.pdf); Ground Water Management Areas (http://www.twdb.state.tx.us/gwrd/GMA/gmahome.htm); and Groundwater Conservation Districts (see http://www.twdb.state.tx.us/mapping/maps/jpg/gcd_only_8x11.jpg).
Lack of Information & Resources
In creating this ecoregion handbook, it was evident that there is little known about the ecological processes and rare communities distributions in the Cross Timbers. Building on with the previous work of the Tree Ring Laboratory of the University of Arkansas (http://www.uark.edu/misc/xtimber/map/index.html), it is recommended that priority conservation areas for landowner incentives, urban park planning and conservation lands be identified to conserve larger, ecologically functional old growth oak woodland landscapes and the mosaic of prairies and glades within them. Connectivity with existing research areas, conserved lands, and land trust activities should take priority.
Because of the woodland nature of this ecoregion and the desirability of certain flat, floodplain and other suitable soils for ranching practices, occasionally “brush control” projects adversely impact native climax woodland communities. Work with landowners and other conservation practitioners to identify and define suitable characteristics for brush control activities specific to this ecoregion would be helpful in a written guide for technical assistance providers and landowners.
Create a multi-disciplinary ecology committee to identify three to five years of highest priority research projects (actual projects, not just concepts) that can be rolled out to universities and colleges to collect the information most needed at the PRACTICAL level for management and conservation improvement on the ground. Priority projects mentioned in this process include: <ul style="list-style-type: none"> • Groundtruthing the Ancient Cross Timbers map for Texas and relating it to the Texas Ecological Systems Mapping Project, rare plant community records from BRIT and TXNDD, and other sources to identify areas for conservation outreach, planning guidance, and landowner incentives • Continued mapping efforts for rare mussel beds, change detection, and conservation measure recommendations that can be shared with TXDOT, other planning and development entities (including the ORV “working group” to develop appropriate sites for ORV use in this region), and water trusts. • Choose several small mammal, reptile and amphibian, and insect SGCN lacking distribution and population status information to update the TXNDD and use that information in predictive habitat modeling using the Texas Ecological Systems Mapping data to guide recovery options, reduce the risk of listing, and contribute meaningfully to conservation of significant sites in a landscape scale/context. • Research on effects of managed flows (dam construction and dam releases) in the watersheds with Ecologically Significant Stream Segments, including sediment dynamics and water quality
Form multi-partner working group(s) to establish scientifically sound best management practices for prescribed fire application for the ecoregion (timing/season, period/duration, intensity, parameters for RX) for the restoration of particular habitat types and the mosaic desired in the region; focus on longterm health and sustainability of desired ecological conditions (plant communities); work with Rx fire technical experts AND rare species experts to identify concerns, barriers, and solutions. Monitor keystone SGCN grassland birds, reptiles, and insect(s) to determine effectiveness of the applied practices
Form multi-partner working group(s) to write scientifically sound regionally specific best management practices for riparian restoration , including timing, water needs, reasonable recommendations for initial planting diversity, ways to encourage full complement of desired ecological condition of community, how to prevent or control specific invasives without negatively impacting restoration, locally sourced seed and plant materials for the ecoregion (and finer scales if needed). Share widely through landowner incentive program networks.
Identify the best SGCN targets for conservation instruments – Safe Harbor Agreements, Candidate Conservation Agreements, others. Host landowner workshops to dispel myths about regulatory constraints. Showcase specific studies and examples from the region (or adjacent ecoregions) for better relationship building. Document through conservation practice and partner surveys over the course of three to five years whether the workshops increase opportunities for these tools to be used and the SPECIFIC barriers to their use. Use the Effectiveness Measures toolkit for outreach to gauge the success and effectiveness of landowner workshops related to SGCN conservation in this ecoregion.
Other Cross-Cutting Issues
Climate change models specific to this area are needed to determine and plan for eventual effects to grassland – woodland mosaic habitats, riparian areas, and springs/groundwater resources; findings and recommendations should be rolled into a habitat vulnerability analysis, targeting those habitats used by the most SGCN first.

NOTE: Almost all of these actions would benefit from more regular cooperation among conservation practitioners in the region. A share-site for conservation practice would be a useful tool. See Statewide/Multi-region handbook AND the Effectiveness Measures report's evaluation of existing conservation practice sharing tools (Appendix IV). This will go a long way toward landscape-level planning and shared priorities.

