



TEXAS CONSERVATION ACTION PLAN

Edwards Plateau

ECOREGION HANDBOOK August 2012



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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 Edwards Plateau (EDPT) 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 EDPT 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 EDPT 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 EDPT 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 In addition, work with the Texas Land Trust Council to find a local lands and waters conservation organization near you:
<http://www.texaslandtrustcouncil.org/>

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

Best known as the Hill Country, the Edwards Plateau is more than scenic hills west of IH-35. Wholly contained within the Texas borders, at a crossroads of arid grasslands, woodlands, and brushlands, its habitats are supported by unique geohydrology. Geology and hydrology are two of the greatest influences in this region on wildlife and fish distribution, rarity and endemism. Many geologic features such as karst or pseudokarst⁴ are each their own little microcosms even though many are conduits to large freshwater aquifers, hosting rare salamanders, invertebrates, fishes and plants. Underlain by the Edwards, Edwards-Trinity, and Trinity aquifers, artesian expressions punctuate this ecoregion primarily along the edges of the Balcones Escarpment, but also throughout the Balcones Canyonlands. These sites provide clean, clear waters and specialized habitats for several plants like wild rice, rare communities, spring and cave invertebrates and troglolbitic fishes. The aquifers which underlie the region contribute significantly to environmental water flows, water quality, and aquatic habitats from streams throughout the region and downstream to the estuaries which feed the Gulf of Mexico.

The ecoregion's western, more arid extent shares most of its western border with the Chihuahuan Desert and High Plains arid grasslands as a broad plateau or plain, where historically vast grasslands and savanna were the dominant vegetation community, dissected by steep limestone canyons with few springs, arid-adapted shrubland and small woodland species. Creeks and rivers in this portion of the Plateau cut west to east to the Colorado River or southwest to the Rio Grande.⁵

The Llano Uplift lies somewhat at the heart of the ecoregion. Its unique geology is best known by the iconic granite mound of Enchanted Rock, north of Fredericksburg. Soils tend to be more acidic over granitic geology in contrast to the alkaline soils supported by the surrounding limestone-dominated subregions. This "island" supports vegetation more closely allied with the Cross Timbers. Rainwater catchment basins, perched water table seeps, and crevices in this region provide habitats for some very unique plants and invertebrates.

The northeast portion of the Edwards Plateau ecoregion is the Lampasas Cut Plain – generally flatter than the Llano region with deeper soils and less-incised streams and canyons. Streams and valleys here are broader, more mesic. The Lampasas and San Gabriel Rivers bisect the area.

The ecoregion's colloquial namesake comes from the vision presented by the Balcones Escarpment (a fault line) and Balcones Canyonlands along an arc that forms this region's southwest to northeastern boundary. Steep, mesic canyons, artesian expressions of the underlying aquifer, old-growth juniper-hardwood woodlands and an abundance of karst make for very interesting and rare terrestrial and aquatic resources. Elevations drop sharply from the top of the Plateau off the edge of the Escarpment, to the Blackland Prairies and South Texas Plains.⁶ The Nueces, Frio, Sabinal, Medina, Guadalupe, Blanco and Pedernales are some of the more well-known spring-fed systems in this region. Just off the

⁴ More discussion about karst and groundwater connectivity is provided in the Statewide handbook on the TCAP website.

⁵ Riskind, D.H. and D.D. Diamond. 1986. The Balcones Escarpment: Plant Communities of the Edwards Plateau ... (emphasis), p. 20-32 *in* The Balcones Escarpment Geology, Hydrology, Ecology and Social Development in Central Texas (Eds. P.L. Abbott and C.M. Woodruff, Jr.) for Geological Society of America Annual Meeting (San Antonio, TX, November 9-14, 1986) online: http://www.lib.utexas.edu/geo/balcones_escarpment/cr.html (accessed 2011)

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).

Escarpment at San Marcos and New Braunfels, large springs sourced by waters collected over the Plateau host a suite of endemic imperiled invertebrates, fishes, and plants, where they begin major tributaries to coastal bay-bound rivers, providing important freshwater inflows to estuary systems which support Whooping Cranes.

Most of the ecoregion is still in livestock production, orchards (pecan, vineyards, stonefruits) or large ranches held for recreational values; however, burgeoning development along the IH-35 corridor from Fort Hood to San Antonio has created widespread bedroom communities in the beautiful woodlands and hills within driving distance, mostly east of an arc from San Saba to Uvalde. Many of these communities are on aquifer-sourced water supplies and few have centralized or regulated wastewater collection and treatment.

Table 1 crosswalks this ecoregion with other conservation planning units.⁷

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), Reservoirs and Ecologically Significant Stream Segments⁸ (ESSS) which occur in this area.

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

⁷ For more information about planning boundaries, see the Overview handbook on the TCAP 2012 website <http://www.tpwd.state.tx.us/landwater/land/tcap/>

⁸ TPWD. 2002/2005. *Ecologically Significant Stream Segments*.

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

Table 1. Crosswalk of EDPT 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.

2010 TCAP *	2005 TXWAP (Gould 1960)	The Nature Conservancy Terrestrial Ecoregions (1999)	Ecological Drainage Units (Watersheds) From the National Fish Habitat Action Plan TX = Southeast Aquatic Resources Partnership and Desert Fish Habitat Partnership (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)
Edwards Plateau (EDPT)	Edwards Plateau	Edwards Plateau (29)	Brazos River – Prairie Colorado River – Ed Plateau Colorado River – Prairie Corpus Christi – Frio – Nueces Guadalupe – San Antonio Lower Brazos River Lower Rio Grande/Bravo	Oaks and Prairies JV Edwards Plateau BCR	Gulf Coast Prairie	Trans Pecos – Rio Grande (1) Nueces Coastal Bend (3) Guadalupe – San Antonio (4) Colorado Upper (5a) Colorado Lower (5b) Brazos Upper (6a)	Southwest Plateaus and Plains Range and Cotton Region: <i>Edwards Plateau Western Part (81A), Edwards Plateau Central Part (81B), Edwards Plateau Eastern Part (81C), Texas Central Basin (82A), Northern Rio Grande Plain (83A)</i>	Edwards Plateau and Llano Uplift

Figure 1. EDPT Ecoregion with County Boundaries

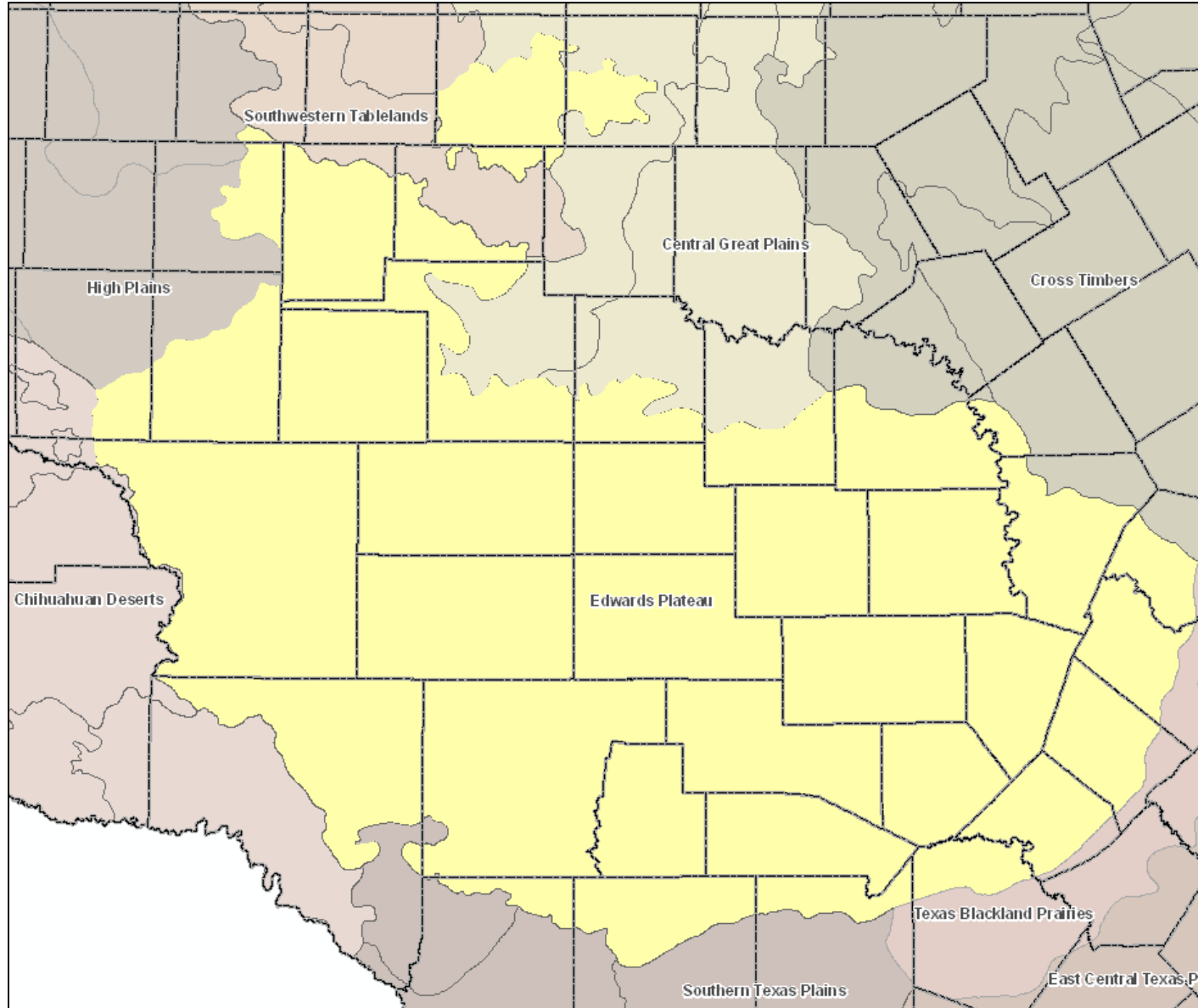


Table 2. EDPT EDUs with Ecologically Significant Stream Segments and Reservoirs

ECOLOGICAL DRAINAGE UNIT SubBasin (HUC 8)	<i>Ecologically Significant Stream Segment TPWD 2002, w/updates 2005</i>	Lakes and Reservoirs
LOWER PECOS		
Lower Pecos	Pecos River, Live Oak Creek	
Howard Draw		
LOWER RIO GRANDE/BRAVO		
Lower Devils	Devils River	Amistad Reservoir
Elm-Sycamore		
Upper Devils	Devils River	
Dry Devils		
BRAZOS RIVER - PRAIRIE		
Upper Clear Fork Brazos		Lake Abilene
LOWER BRAZOS RIVER		
San Gabriel	Oatmeal Creek, San Gabriel River	Lake Georgetown
COLORADO RIVER - PRAIRIE		
Colorado Headwaters		
Beals		
COLORADO RIVER - EDWARDS PLATEAU		
Jim Ned		
San Saba	Clear Creek, San Saba River	
Buchanan - Lyndon B	Gorman Creek, Colorado River	Lake Buchanan, Inks Lake, Lake LBJ
Middle Colorado - Elm		
Middle Concho	West Rocky Creek	
North Concho		
Concho		
Brady		Brady Creek Reservoir
Upper Colorado		
South Concho	Spring Creek	
North Llano		
South Llano	South Llano River	
Llano	James River, Llano River	Lake LBJ (upper)
Pedernales	Pedernales River	Lake Travis
Austin - Travis Lakes	Bull Creek, Little Barton Creek, Barton Creek, Colorado River, Onion Creek	Lake Marble Falls, Lake Travis, Lake Austin, Town Lake (Ladybird Lake),

ECOLOGICAL DRAINAGE UNIT SubBasin (HUC 8)	<i>Ecologically Significant Stream Segment TPWD 2002, w/updates 2005</i>	Lakes and Reservoirs
GUADALUPE - SAN ANTONIO		
Medina	Medina River	Medina Lake
Upper Guadalupe	Johnson Creek, North Fork Guadalupe, South Fork Guadalupe, Guadalupe River, Honey Creek	Ingram Lake, Canyon Lake
San Marcos	Carper Creek, Little Blanco River, Blanco River, Cypress Creek, Willow Springs Creek	
Upper San Antonio		
Cibolo		
Middle Guadalupe	Guadalupe River	
CORPUS CHRISTI - FRIO - NUECES		
West Nueces	West Nueces River	
Nueces Headwaters	Nueces River	
Upper Nueces		
Upper Frio	Frio River, Sabinal River	
Hondo	West Verde Creek	

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

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.⁹ 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.¹⁰

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.¹¹ Each species has a NatureServe calculated state and global conservation rank, which accounts for abundance, stability and threats.¹² Additionally, several species have federal¹³ and/or state¹⁴ listing (endangered, threatened, candidate) status. See the key to conservation status and listing ranks¹⁵ 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

⁹ Association of Fish and Wildlife Agencies. 2011. State Wildlife Action Plans. <http://www.wildlifeactionplans.org/>

¹⁰ TPWD. 2012. Texas Conservation Action Plan: Overview Handbook. http://www.tpwd.state.tx.us/landwater/land/tcap/documents/tcap_draft_overview.pdf

¹¹ 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>

¹² NatureServe. 2011. A network connecting science and conservation (online resources). <http://www.natureserve.org/explorer> (accessed 2011).

¹³ USFWS. 2011. Endangered Species List, by state and county. <http://www.fws.gov/southwest/es/EndangeredSpecies/lists/ListSpecies.cfm> (accessed 2011).

¹⁴ TPWD. 2011. State Listed Species. http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species (accessed 2011)

¹⁵ 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

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 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.¹⁶

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*.¹⁷

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.

¹⁶ http://www.tpwd.state.tx.us/landwater/land/tcap/documents/habitat_categories_tcap_2011.pdf

¹⁷ 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. EDPT Priority Habitats

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

GENERAL HABITAT TYPES	EDWARDS PLATEAU (EDPT)	EDPT Ecological Systems
NATURAL AND SEMI-NATURAL TYPES	<i>Habitats in this column were primarily 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' Edwards Plateau. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 08 October 2009.</i>
Barren/Sparse Vegetation	Igneous/granitic outcrops (e.g. Enchanted Rock) Limestone, shale, and granitic cliffs/ledges	Edwards Plateau Carbonate Glade and Barrens Edwards Plateau Cliff LLano Estacado Caprock Escarpment and Breaks Shrubland and Steppe
Desert Scrub	Desert shrublands	Chihuahuan Creosotebush Desert Scrub Chihuahuan Mixed Desert and Thornscrub Chihuahuan Succulent Desert Scrub Tamaulipan Calcareous Thornscrub
Grassland	mixed prairie tallgrass prairie midgrass prairie shortgrass prairie	Central Mixedgrass Prairie Llano Uplift Acidic Forest, Woodland and Glade Texas Blackland Tallgrass Prairie Western Great Plains Shortgrass Prairie Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (mixed upland and wetland)
Shrubland	mixed shrubland (oak - yaupon - forestiera - agarita)	Edwards Plateau Limestone Shrubland Western Great Plains Sandhill Steppe
Savanna/Open Woodland	Mixed oak savanna	Edwards Plateau Limestone Savanna and Woodland
Woodland	north and east facing mesic hardwood-juniper woodlands	Edwards Plateau Dry-Mesic Slope Forest and Woodland

GENERAL HABITAT TYPES	EDWARDS PLATEAU (EDPT)	EDPT Ecological Systems
Forest <i>See also</i> Riparian and Wetlands	hardwood dominated (oak, elm, cherry, maple) mesic canyons	Crosstimbers Oak Forest and Woodland Edwards Plateau Mesic Canyon
Riparian	periodically flooded or subirrigated floodplain woodlands (oak, elm, hackberry) and gallery forests (sycamore, cypress) associated with the Colorado River, southeastern-lower Pecos, and the northeastern-lower Rio Grande/Bravo rivers and perennial/ephemeral tributaries	Edwards Plateau Floodplain Edwards Plateau Riparian
Riverine	Instream habitats of the watersheds which intersect this ecoregion, <i>especially aquifer- and spring-dependent rivers/creeks</i> <i>Ecologically Significant Stream Segments</i> - Pecos River, Live Oak Creek, Devils River, Oatmeal Creek, San Gabriel River, Clear Creek, San Saba River, Gorman Creek, Colorado River, West Rocky Creek, Spring Creek, South Llano River, James River, Llano River, Pedernales River, Bull Creek, Little Barton Creek, Barton Creek, Onion Creek, Medina River, Johnson Creek, North Fork Guadalupe, South Fork Guadalupe, Guadalupe River, Honey Creek, Carpers Creek, Little Blanco River, Blanco River, Cypress Creek, Willow Springs Creek, West Nueces River, Nueces River, Frio River, Sabinal River, West Verde Creek	
Freshwater Wetland	aquifer-dependent and perched water table springs, seeps, vernal pools (granite tinajas)	Edwards Plateau Upland Depression

GENERAL HABITAT TYPES	EDWARDS PLATEAU (EDPT)	EDPT Ecological Systems
Aquifer	Edwards BFZ, Edwards – Trinity Plateau, Trinity (outcrop)	NA
Caves/Karst	Caves, Grottos, Sinkholes pseudokarst fissures/crevices <i>see also Statewide Handbook for karst/pseudokarst discussion and priorities</i>	NA
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</i>	urban forests (important primarily for migratory birds) bridges, culverts (bats)	NA
<i>Rural</i>	Rock structures, barns, and other sites without or with limited human habitation (bats)	NA
<i>Industrial</i>		NA
<i>Rights of Way</i>	Some road and transmission line ROW (rare plants, black-capped vireo)	NA
Cultural Aquatic	Reservoirs: Abilene, Georgetown, Buchanan, Inks, LBJ, Brady Creek, Travis, Marble Falls, Austin, Town (Ladybird), Medina, Ingram, Canyon	NA

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.¹⁸

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 EDPT Ecoregion Handbook in Table 4 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.

¹⁸ TPWD. 2012. Texas Conservation Action Plan: Broad Issues Categories
http://www.tpwd.state.tx.us/landwater/land/tcap/documents/broad_issues_categories.pdf

Table 4. EDPT Priority Issues Affecting Conservation

Table formatted 11"x17", landscape scale

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>), giant reed/river cane (<i>Arundo donax</i>) Cultivated and Old World grasses (e.g. King Ranch (KR) bluestem, Bermuda grass) Hydrilla, water hyacinth Ligustrum, chinaberry, nandina, Chinese tallow</p>	<p>In more aridland streams of this ecoregion, salt cedar and <i>Arundo</i> affect hydrology, monotypic stands, and outcompetes native riparian vegetation (cottonwood, sycamore) at all seral stages and canopy levels; these invasive plants armor the banks and contributing significantly to channel incision and narrowing, which reduces the diversity and quality of habitat for aquatic SGCN and can adversely affect stream-adjacent spring habitats</p> <p>Non-native grass dominated areas have claimed millions of acres of native grassland throughout Texas and are a leading cause of steep population declines for wildlife dependent on native grasslands (e.g. bobwhite quail, dickcissel, loggerhead shrike, scissor-tailed flycatcher, many types of pollinating insects, and the plants which in turn depend on these). More than 97% of the native grasslands of the U.S. have been lost, primarily to agricultural conversion; therefore, grassland birds are among our nation's fastest declining species, yet only 2% of all U.S. grassland is both publicly owned and managed primarily for conservation. Four grassland species have 5% or less of their distribution on public lands: breeding Dickcissels, Scissor-tailed Flycatchers, and Eastern Meadowlarks, and wintering Harris's Sparrows; across the nation, 48% of grassland-breeding bird species are of conservation concern, including four with endangered populations. <i>For more detail see North American Bird Conservation Initiative, U.S. Committee, 2011. The State of the Birds 2011 Report on Public Lands and Waters. U.S. Department of Interior: Washington, DC. 48 pages.</i> Non-native grasses introduced either as livestock forage and monoculture pastures or naturally expansive after introduction have established in many grasslands, are a substantial threat to grassland-dependent species (e.g. grassland-obligate birds).</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>Aquatic invasive plant species are highly successful in area lakes, and up into riverine systems, crowding out native aquatic vegetation, inhibiting access by nesting freshwater fishes to bottom substrates, depleting nutrients and degrading flow/natural hydrograph</p> <p>Urban areas harbor numerous invasive plant species installed in residential and municipal landscapes which escape and spread into nearby wildlands and all points downstream (once in waterways, these infestations can spread as far as the floodwater will carry them within the water system and into adjacent areas) spread naturally during rain events, bird and mammal droppings, and through vegetative spread. Degradation in mesic canyons, riparian areas, and headwaters are particularly</p>
Non-native Animal	<p>feral and/or free-ranging "pets" FERAL HOGS Nutria Domestic waterfowl Introduced ungulates for hunting introduced fishes and mollusks - freshwater springs, streams and marshes Red Imported Fire Ants (RIFA) Raspberry Crazy Ants (RCA)</p>	<p>Free ranging pets (cats, dogs as individuals and as packs) are introduced predators which primarily adversely affect small mammals, small reptiles, and birds; in packs, can also adversely affect larger mammals and ground-nesting birds; also contribute pathogens and diseases. It is estimated that 60-100 million feral cats reside in the US and another 60 million pet cats are allowed to roam outside. "Neuter and release" programs only address fecundity in a limited way, and do not address the impact to natural resources. The number of birds predated by feral cats in the U.S. is annually is more than 1 Billion; numerous SGCN are affected. The IUCN ranks feral cats as one of the world's worst invasive species. (see The Wildlife Society, Wildlife Professional publication, Spring (March) 2011, Vol. 5 No. 1).</p> <p>Feral hogs decimate important and fragile habitats (e.g. springs, seeps, riparian areas, wetlands), degrade instream water quality, change topography and runoff/collection patterns, and decrease hardwood seedling viability (rooted up, eaten) and vegetation community composition. Hogs also decimate new restoration sites, making recovery expensive or even untenable without hog control.</p> <p>Nutria have been documented to damage rare aquatic plants (e.g. wild rice) and important rare streamside communities and dig up and destabilize banks which can adversely affect some stream margin aquatic SGCN (fishes and insects). Loss of bank stabilization and vegetation can contribute to siltation and instream habitat degradation and loss for other aquatic SGCN.</p> <p>Aoudad, axis, and other introduced exotic hoofstock alter and destroy habitat, compete with native small mammals and ungulates for food, and can be disease vectors which can affect native ungulates and domestic livestock; axis and aoudad are particularly fecund and in some areas cause more widespread damage than hogs (e.g. western portions of the Plateau)</p> <p>Nonnative aquatic fishes can be a predatory risk (e.g. smallmouth bass), some are detrimental to native aquatic vegetation (tilapia, carp) which adversely affects cover for small natives, compete or hybridize with natives (small mouth bass with Guadalupe Bass, baitfish released "minnows" may hybridize with certain <i>Gambusia</i> sp.), may be densely successful and crowd out natives and/or affect water flow and quality (zebra mussels)</p> <p>RIFA are highly invasive, successful predators on many EDPT SGCN: karst invertebrates, karst dependent amphibians, black-capped vireos and other low-shrub nesting SGCN, grassland birds at all periods; unknown effects of RCA</p>

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Native Problematic	Native shrub (e.g. Ashe juniper, mesquite, creosote, whitebrush) or "brush" White-tailed deer Brownheaded Cowbird	Invasive native brush/trees where they are not supposed to naturally occur (naturally occur and are protected from fire in canyons, steep slopes, swales, karst areas – depending on species; less naturally prevalent in healthy upland systems); a significant threat to habitats for grassland-obligate birds: grassland loss decreases habitat availability and quality for grassland nesting birds, trees provide perches for hunting raptors which also decrease grassland bird, small mammal and reptile success; Whitetailed deer are insufficiently harvested in this region and in many areas overbrowse hardwood seedlings, decreasing hardwood regeneration in important closed woodland habitats Overly abundant and expansive into most every type of habitat, BCHB have been documented parasitizing nests of many SGCN, decreasing successful nests for those species.
Pests, Parasites, Pathogens		
Pests	Cactus moth (<i>Cactoblastis cactorum</i>) Soapberry borer Emerald Ash borer	<i>Cactoblastis cactorum</i> has been used as a biological control for prickly pears (<i>Opuntia</i> spp.) in areas where prickly pears are non-native; however, introductions to the Caribbean have led to the moth's appearance along the eastern Gulf Coast of the US and potentially the moths could arrive in Texas and Mexico. The loss of biodiversity, habitat, forage, agricultural products, and the nursery industry could be substantial. Both borer species adversely affect hardwoods which are essential components to desired ecological condition in this region
Parasites	Fountain darter gill parasite	Found in rare fountain darter, this parasite can cause mortality of the fish through gill degradation; unknown thresholds or triggers and unknown whether gill parasites are known in other spring-dependent rare SGCN fishes.
Pathogens	White-nose Syndrome (WNS) Oak wilt, oak decline, thousand canker Chytrid fungus	WNS affects hibernating bats and is distributed through human (caving equipment, clothing, skin, hair) and bat vectors, through hibernacula (and potentially other roost) visitation. Mortality is high; prevention and treatment are unknown. Plant pathogens listed adversely affect hardwoods in this region, a component of many important SGCN habitats and rare communities in closed canopy mesic canyon woodlands and open savanna Amphibian decline and population decimation are potential from this fungus; not much is known about its extent in Texas; many of our amphibian species in this region are extremely rare and vulnerable even if not threatened by other factors; an infection of this type in one of the highly isolated <i>Eurycea</i> populations may have extremely serious consequences
Power Development and Transmission		
Wind Generation	See also full discussion in Statewide Handbook Competitive Renewable Energy Zones (CREZ): McCamey, Central Turbine operations	High ridges and elevated plains in the region are of high potential for wind development and have been mapped as priority areas; these features typically intersect raptor migration corridors (impacts to Golden Eagle, Ferruginous Hawk, Swainson's Hawk) network of maintenance and access roads can impact small mammals, birds, and reptiles; typically these are avenues for invasive plants typically impacts vegetation communities that occur on these ridges - grasslands, shrublands (grassland birds, black-capped vireo, shrikes) deep footings may impact karst in certain areas even if these features don't harbor SGCN, could impact recharge ability, connectivity Migratory birds (especially nocturnal) and bats adversely affected through barotrauma and direct collision See also <i>Transmission</i> below
Solar or PV (photovoltaic) array siting	level or nearly level sites with high PV potential occur throughout the region	array siting, with the network of maintenance and access roads, impacts shortgrass mesa and other open lowland grassland communities (direct loss and invasive species competition), blocks sun and rain needed for photosynthesis and recovery of vegetation communities; plant and plant community protections are insufficient to trigger environmental compliance in this industry; deep footings may impact karst in certain areas; some may require large quantities of water
Hydro (Dam and Reservoir)		see also Water Development, Management and Distribution
Biofuels	Row Crop, Switchgrass, Herbaceous: native rangeland and open grasslands converted to croplands (monotypic stands of switchgrass and others)	Loss of native and open grassland birds' habitats for foraging, nesting, and shelter -- Baird's Sparrow (winter), Eastern Meadowlark, Long-billed Curlew, and Cassin's Sparrow These crops are not food crops and may have higher rates of fertilizer and pesticide applications; water quality (from stormwater runoff) and adjacent wildlands (from overspray) may be more affected near these sites than food production sites.

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Transmission	New development and expansion of existing lines/corridors construction of new power infrastructure corridors to meet urban user needs, from CREZ generation projects in this region to central Texas urban load centers maintenance and operations maintaining clear right-of-way for vehicle clearance/access, prevention of line and tower danger	<p>In this ecoregion, broad, long, linear transmission lines create fragmentation of all habitat types; however impact to dense shrubland, mesic canyon and woodland habitats, and riparian zones is most detrimental if not avoided during construction and maintenance. While some facilities have capacity to span riparian areas and diverse important hardwood canyons, several companies do not have the fiscal capacity or inclination to do so. Contributes to edge through interior closed canopy habitats in the same way that oil/gas pipelines and road networks for wind generation sites, causing potential for more predator, brood parasitism (brown-headed cowbirds are edge related) and invasive species access. May hinder daily or seasonal movements and behavior for species which avoid open areas adjacent to remaining woodlands. While some of these facilities are compatible with grassland communities in this ecoregion, operators are not required to reclaim or maintain with native seed or plant sources. See comment above in "Invasives."</p> <p>During route selection, environmental considerations are given lower avoidance consideration than agricultural and developed areas.</p> <p>Mowing and trimming activities during bird breeding seasons or migratory events adversely impact species success; inappropriate seasonal oak trimming can contribute to oak wilt, oak decline; "brushhogging" borders leaves splintered, jagged cuts and adjacent vegetation communities vulnerable to disease and infestations (oak wilt, oak decline, others).</p> <p>Transmission lines can be strike hazards for Whooping Cranes and raptors during migration</p>
Distribution	Development to power grid and retail users: construction of new power infrastructure corridors to meet urban user needs	<p>Similar impacts to transmission lines, but on smaller scales</p> <p>Bird collisions have been documented to occur more in distribution line corridors than transmission line corridors</p> <p>Occasionally, because the area to be maintained is less than a transmission line, the company may employ herbicides</p> <p>Oak trimming or construction through oak woodlands in inappropriate seasons, with inappropriate post-trimming treatment, can cause spread of oak wilt and decline</p>
Oil and Natural Gas Production and Delivery		
Seismic exploration	surface and subsurface impacts - linear networked vegetation clearing and soil disturbance, vibration and "explosive" disturbance	<p>habitat loss and fragmentation in arid lands that do not recover quickly</p> <p>seismic testing in woodlands creates the same vectors for predator, nest parasitism and invasive species access as discussed above in "Transmission Line" section</p> <p>disruption of daily and seasonal activities for fossorial animals (small mammals, reptiles, ground-foraging and ground-nesting birds) and potential collapse for karst features, many of which harbor rare invertebrates</p> <p>Typically, no reclamation is required in cleared areas</p>
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	<p>Similar to electrical transmission lines, communications lines, and transportation corridors, oil and gas pipelines create edge through woodland, canyon, and riparian habitats; impact wetlands which are not jurisdictionally protected (isolated seeps, springs); little to no native reclamation is required. These openings create opportunity for enhanced predator access to interior woodlands, invasive species (many thrive in disturbed sites), and microclimate changes that dry water features.</p> <p>limited surface waters are in many areas interconnected with groundwater resources (cieneegas, swale wetlands, springs, seeps), both of which are highly sensitive to change/contamination are at risk from chemical, drilling material, and oil spills and groundwater contamination caused by salt water injection</p> <p>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. nocturnal migratory birds and bats can be adversely impacted by the light and noise pollution)</p> <p>Road networks, constant traffic and noise, and mechanical infrastructure interrupt seasonal and daily movements, foraging and mating behaviors of some mammals, reptiles, and birds; small geographically limited populations of aridland plants fragmented or lost</p>
Hydraulic fracturing ("fracking") or "shale gas" extraction	http://www.energyindustryphotos.com/shale_gas_map_shale_basins.htm Part of the Permian and Barnett Shale deposits lie under the western edges of this ecoregion; the hydraulic fracturing process requires large amounts of water and deeply injects chemical-laced liquid to fractures substrates and releases gas for capture and delivery: groundwater amounts, groundwater contamination, chemical spills, geologic destabilization are concerns.	<p>Groundwater and its surface expression in seeps, springs and other subirrigated wetlands and riparian zones, in addition to cave and karst features, are extremely important habitats in this ecoregion (e.g. darters, Eurycea sp., several springfed river minnows, karst invertebrates)</p> <p>Groundwater contamination or surface spills (and uncontained runoff) could cause loss of related 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. <i>Fracturing activities may also adversely affect the recharge capacity of porous rock layers and networked karst features.</i> Unmanaged groundwater withdrawal without consideration for connection or effects to karst and surface water features is also a concern.</p>

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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 contours or vegetation (invasive species allowed to colonize or are directly planted for soil stabilization); typically equipment left on site
Mining		
Sand and Gravel - upland and riverine	sand and gravel mining along and within streams and rivers	loss of riparian habitats for instream and adjacent mining, sedimentation in streams contributes to loss and degradation of high quality 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; several SGCN plants and plant communities may be affected
Limestone and Granite	"boutique" operations on private lands Larger commercial operations	Small by industry standards, "boutique" rock, limestone and granite mining operations to serve the landscaping, tile and countertop industry with one-of-a-kind locally sourced materials; these are typically unregulated private operations and can adversely impact cave and karst feature integrity, connectivity to larger networked sites, groundwater quality and quantity (can impact recharge ability), and the fauna within these features. Sometimes these smaller quarry operations also provide rock for local transportation projects, driveway or creek armoring. Larger commercial limestone quarries are also present in the region and can have the same kinds of impacts on larger scales; limited to no reclamation is required to native site conditions
Communications Infrastructure		
Cell and other communication towers	towers need to be limited in height and lit to minimize bird strikes (bird-friendly)	Species impacted by towers include all nocturnal migrants including Yellow-billed Cuckoo, Painted Bunting, Summer Tanager, and other species.
Transportation		
road and bridge construction (new)	Largescale National Transportation Corridor priorities Bridge/culvert construction without consideration for stream gradient, downstream scour, passage for seasonal and daily movements	Population growth in this region is high and transportation improvements continue between growing urban areas and bedroom communities. Because several of the regions' sensitive resources can be adversely affected by stormwater runoff, deep footings (into karst), and lack of passage for stream and terrestrial species, impacts from transportation facilities are an issue. A portion of one of the other National Highway System Congressional Priority Corridors (http://www.fhwa.dot.gov/planning/nhs/hipricorridors/hpcor.html#156 , 2008) – Ports to Plains, from Laredo TX to Denver CO – intersects this region. Texas Department of Transportation coordinates with TPWD regarding potential natural resources impacts to listed species; however, there is little accommodation for sensitive habitats unless those features are related to federal protections (federally listed species habitat, critical habitat, jurisdictional wetlands). State-listed species habitats, SGCN, rare communities and the habitats on which they rely would benefit protection during the planning process, to the same level as federally listed species (avoidance, minimization, mitigation/compensation). The transportation improvements proposed under regional upgrades of existing facilities and new construction may create barriers to fish and wildlife resources' daily and seasonal movements, vectors and opportunities for nonnative species invasions, water quality impacts through stormwater runoff, loss of nonjurisdictional wetlands, and important riparian, grassland and savanna habitats that are not protected under regulation. In addition to any planned larger facilities, local connection transportation projects may also contribute to the same kinds of losses and may require even less coordination regarding environmental impacts from planning to implementation if no federal money is used.
right of way maintenance	maintaining clear right-of-way for vehicle clearance/access, minimizing fire danger, and maintaining driver visibility	Mowing, trimming timing (season, frequency) inhibit natural regeneration of grassland plant species and don't provide key habitats (structure, seedheads) at best times of year to accommodate grassland animal and insect needs; brushhogging woody species adjacent to grassy ROW can provide vectors for plant pathogens. Most roadsides are reseeded after construction with nonnative species or plant materials and regular maintenance activities also provide additional ground disturbance favorable to invasives; see comments under "Invasive Species" above regarding grasses and grassland birds. herbicide application runoff can adversely affect very sensitive aquatic features and aquifer conduits which harbor SGCN 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 and standard operation procedures in some areas

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Timber Production & Management		
Salvage	Instream salvage: cypress, oak, elm	Removes instream naturally occurring large woody debris important for many species – turtles, frogs, fishes, invertebrates Large mature woody debris is natural in many of these areas and contributes to stream rehabilitation, decreases scouring from flash flood events, provides cover for many smaller species to escape predation; removal also disturbs important substrates and can create detrimental turbidity, bank loss, and riparian damage
Land & Water Mgmt: FARM	See also Water Development section	
Lack of soil and water management and conservation practices	chemical-laden irrigation water runoff	There is very little rowcrop agriculture <i>in</i> this region; however orchards, vineyards and some concentrated animal feeding operations without stormwater pollution prevention protection in place contribute to adverse impacts to sensitive aquatic insects and other invertebrates, fishes, and amphibians
Unsustainable irrigation	See also <i>Groundwater Planning and Distribution</i>	Most irrigation affecting resources of the Plateau occurs off of the Plateau in the South Texas Plains, Blackland Prairie and Gulf Coast Prairies and Marshes ecoregions. Because these areas tap the aquifers recharged by the Plateau and surface artesian expressions also draw from that same source, these uses are sometimes in conflict. See Edwards Aquifer Recovery Implementation Plan at http://earip.org/ for more background
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) historic and/or current range-intensive livestock operations out of sync with land capacity non-native hoofstock for hunting operations	Overgrazing or intensive non-rotational grazing can contribute to the decline of native grasslands, reduced diversity in some of these plant communities, impacts to rare plants, invasion of brushy species into grasslands, loss of hardwood diversity and riparian integrity Overstocking can lead to excessive brush clearing out of drainages, steep slopes, canyons, karst areas, and other sites where woodland and shrubland species would naturally occur to meet “out of capacity” stocking objectives, reap more grass cover; is detrimental to shrubland, woodland, and karst dependent species; these practices can also contribute to a shift in the overall vegetation community, microclimate of the site (drier), and decreased recharge (recent science indicates that brush clearing is not always site-appropriate for increased water yield or recharge). Introduction of non-native hoofstock (hogs, axis, aoudad, others) depletes resources for native wildlife, damages sensitive features (springs, seeps, upland grasslands) and can contribute disease to native populations ... see Invasive Species comment above
Fire suppression and lack of or inappropriate application of Rx fire	reduced or no efficacy of applied fire - scale of application does not match ecological need managing wildfire (more Rx burning needed to reduce the risk of wildfires) inappropriate application	Native grassland and savanna plant and wildlife species are adapted to periodic fire disturbance and its effects are necessary to create the habitat requirements of many species. Grasslands are easily invaded by woody shrubs if the grasslands are in degraded condition, leading to further changes in water infiltration, herbaceous cover, and erosion. Additionally, forb and grass species’ production is often lost without disturbance due to dense, matted perennial herbaceous cover and ground litter. Fire in these systems is needed to maintain/restore the desired ecological structural diversity, successional stages, community composition, insect type and abundance, nutrient cycling and microbial activity. Smaller land holdings, even if fire is applied, cannot mimic the landscape scale fires that are needed for system function and maintenance. Additionally, there is some research to indicate that timing, periodicity, and seasonality of current applications is out of sync with natural cycles (summer, more intense, less frequent) which can adversely affect grassland communities. Rx fire is also not the “tool of choice” although it most closely mimics the natural system as many landowners do not have the capacity to apply this tool. Inappropriate fire application (trying to get 100% burn coverage on some sites such as drainages, steep slopes, canyons, karst areas, and other sites where woodland and shrubland species would naturally occur) is detrimental to shrubland, woodland, and karst dependent species; these practices can contribute to a shift in the overall vegetation community, microclimate of the site (drier), and decreased recharge (recent science indicates that brush clearing is not always site-appropriate for increased water yield or recharge).

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Clearing and loss of important natural sites/habitats	<p>conversion of native grasslands to nonnative “improved” pastures</p> <p>Brush management on inappropriate sites</p> <p>riparian and floodplain clearing for livestock watering access, allowing livestock access to spring features</p> <p>Small impoundments on tributary creeks, streams, springs, seeps to form stock tanks, ponds, private lakes.</p>	<p>See grassland conservation comments under “Invasive Species” above</p> <p>In this region, many sites are cleared to the river or creek margins to allow for livestock watering access, maximum forage production, and/or recreational/viewshed access. Riparian loss is a strong contributor to the decline of riparian and aquatic SGCN and rare communities (soil loss and bank degradation, poor water quality, higher water temperatures, more evaporative losses, invasive species opportunities).</p> <p>The desire to increase forage or water production can lead to excessive brush clearing out of drainages, steep slopes, canyons, karst areas, and other sites where woodland and shrubland species would naturally occur to meet “out of capacity” stocking objectives, reap more grass cover; is detrimental to shrubland, woodland, and karst dependent species and communities; these practices can also contribute to a shift in the overall vegetation community, microclimate of the site (drier), and <i>decreased</i> recharge on some sites (recent science indicates that brush clearing is not always site-appropriate for increased water yield or recharge).</p> <p>Impoundments: similar to reservoir development on mainstem rivers, negative impacts caused by impoundments on creeks and springs are just at a smaller scale: loss of instream habitats, loss of wetlands, loss of riparian habitats and natural floodways. The replacement value – still deeper water for flowing waters, pond for stream – is not ecologically synonymous. This may be more of an issue in the emerging “urban/suburban” areas.</p>
Lack of soil management and conservation practices	<p>lack of soil conservation (vegetation conservation/restoration) along stream courses (Streamside Management Zones, Streamside Best Management Practices/Buffers)</p> <p>Overgrazing (see above)</p> <p>“Clean Pastures”</p>	<p>Hydrology and streamside vegetation are altered, soil and vegetation is lost in upland areas, water quality is degraded through sediment-laden runoff; dealing with historical and contemporary issues, need, in some instances, different approaches for recovery/restoration</p> <p>Similar to clean farming, clean pastures are a widespread problem for species with long term population declines. This practice looks as if all tall grasses, beneficial bunchgrasses, and every woody species which could provide cover have been removed. Desired ecological condition, even in prairies, has dense diverse woody species in the drainages and deeper swales. A mixture of woody brush, vines, and trees along fencerows, drainages, and scattered around fields is paramount for many SGCN. Streamside management zones, retaining riparian forest, are often not a consideration within cattle and hay pastures. Scattered woody growth provides escape cover, thermal cover, loafing areas, nesting substrates, foraging areas, and display areas for SGCN. Increased structural diversity equals increased wildlife species diversity or a higher return of species per unit area. In times of drought, woody cover may be the only structure available.</p>
Subdivision of larger lands into smaller parcels ("ranchettes")	<p>Ownership changes in values, approaches to management (not always a detriment to conservation practices)</p> <p>Subdivided lands create many more land management philosophies, approaches in one area</p>	<p>While not all land subdivision is necessarily a negative event for conservation, subdivision typically brings with it very diverse land ownership styles and objectives, increased potential for feral animal and escaped non-native landscaping, additional surface and groundwater demands on regional resources, and loss of habitat for homesite development and “ponds” (see small impoundment comment above)</p> <p>Some landowners bring their vision of manicured and “tamed” landscaping to suburban and rural areas, mowing native grasslands or converting them to invasive turf grasses, removing brush and woodlands from drainages, clearing fencerows. Typically, these sites also apply fertilizers and herbicides at unspecified rates, causing issues in riparian areas and aquatic habitats from runoff. Forage production is not a consideration in these locations. Most of these sites are too small to qualify for technical assistance or landowner incentives. Outreach, technical guidance and incentive programs have a more difficult time serving this constituency because the effort and resources required are multiplied, but no more service resources (people, time, money) are available. Additionally, it is difficult to provide conservation services that are of value to the ecological needs of the area with many fractured landscapes and objectives. Some tools (e.g. RX fire) and incentive programs are not available for use at smaller scales or cannot be effective to improve conservation values.</p>
Fencing	high game fencing	<p>High game fencing reduces genetic viability and concentrates disease so can be detrimental to all species which cannot cross the fence if intensive, deliberate management is not applied (and sometimes, even then, can be detrimental to some species not targeted by management); contains and concentrates non-natives which can degrade natural habitats quickly without VERY intensive management (hogs and destructive ungulates), makes management of a public resource onerous on the landowner, requires intensive planning and resources; is not suitable for most wildlife species or the longterm financial condition of most ranches</p>
Land & Water Mgmt: Municipal	See also Water Development section	

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Lack of Zoning and Planning	<p>Throughout this and adjacent ecoregions, urban expansion, sprawl, and suburban development into the outlying counties to escape city jurisdictions is an evergrowing issue. Much of the eastern portion of this region is considered “emerging”, as identified in the Texas State Forest Resources Strategy 2012</p> <p>County authority to regulate growth or guide environmental protection during planning processes is lacking</p>	<p>Metropolitan Planning Organizations, Councils of Government, Regional Transportation authorities, and other planning entities which encompass emerging and outlying communities rarely consider fish and wildlife resources, rare communities and habitats as part of their constraints process. Additionally, more of a burden is placed on county resources to deal with environmental issues outside of city jurisdictions in many of these areas; however counties rarely have such authority to require stormwater pollution prevention, flood control projects, appropriate road development, conservation of nonjurisdictional wetlands, open space planning, or water or other conservation measures from developers. And, even those authorities which have this ability rarely use it during planning processes to set aside, plan around, or plan to mitigate for areas important to fish and wildlife resources – floodplains and riparian areas (intact and those with restoration potential), grasslands, wetlands of all kinds, groundwater.</p> <p>Urban sprawl, bedroom communities, suburban commuter communities all continue to contribute to woodland clearing, filling non-jurisdictional wetlands, and degradation of instream and stream-adjacent habitats from water quality and quantity impacts. This is not just an issue for fish and wildlife resources, but also for prime rangeland in these areas. Zoning current agricultural or ranching lands for future commercial or municipal use removes the opportunity to restore these lands to functional habitats and contributes to their disconnection/fragmentation.</p> <p>Development is concentrated in these outlying areas where it’s most scenic, and this coincides in many instances with sensitive features – canyons, cliffs, near lakes waterways and floodplains, springs. While some cities have sensitive environmental feature protection, most non-jurisdictional areas do not. Karst filling, stream armoring and the lack of stormwater pollution prevention are also issues.</p>
Unsustainable groundwater withdrawals	<p>Unaccounted withdrawals for “personal use”</p> <p>Municipal and agricultural uses outside of the ecoregion</p>	<p>Most of the municipal and irrigation water sources from approximately San Marcos south in the Texas Blackland Prairies and in the South Texas Plains (areas around Uvalde) draw from aquifer-sourced freshwater stream resources originating on the Edwards Plateau. All of San Antonio’s water comes from the Edwards Aquifer. Because these areas tap the aquifers recharged over the Plateau and surface artesian expressions in the Plateau support rare species with waters also from that same source, these uses are sometimes in conflict. See Edwards Aquifer Recovery Implementation Plan at http://earip.org/ for more background</p>
Land & Water Mgmt: Conservation & Recreation		
Inadequate Management	<p>managing wildfire (more Rx burning needed to reduce the risk of wildfires)</p>	<p>Wildfire would have historically been a natural community modifier, occurring periodically usually during summer months; however, wildfire is typically suppressed and because human structures, life, and livestock would be at risk, wildfires have not been left to burn at natural scales (except where unpreventable as was recently the case in some areas). Periodic prescribed fire is a tool that can be used to mimic the effects of wildfire, with fewer or no catastrophic effects to humans or livestock, but with all of the benefits to natural community restoration. That said, periodicity, timing, and seasonality are all factors which are rarely mimicked (Rx fire in the fall or winter when more easily controlled, rather than in the summer when it would mimic more natural occurrences); therefore, vegetation communities and the habitats they provide may be shifting to favor other assemblages (more shrub mosaic, different grasses).</p>
Inappropriate Recreational Uses	<p>ORV use in sensitive areas (stream beds, riparian corridors, steep hillsides)</p> <p>Unsponsored cave and karst recreation</p>	<p>Disruption and loss of instream habitats, increased turbidity and chemical releases (oil, gasoline, mechanical fluids) into systems where fishes dependent on consistent temperature gradients and extremely clear spring-fed waters can be adversely affected.</p> <p>Thin soils and eroded sites damage not just the area driven, but the areas downslope as the erosion continues.</p> <p>Add info re karst rec – physical damages can contribute to groundwater degradation, can introduce contaminants; lack of decontamination protocols could introduce WNS/Gd; disturbance of hibernacula or maternity colonies impacts bat populations</p>
Not all "public" or "managed" lands are "conservation" lands	<p>While 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>Streamside and arroyo trails, camping areas, and recreation zones need to be routed and/or designed to prevent erosion-based damage to rare plant communities, instream and stream-adjacent resources which provide important habitats for SGCN fishes and riparian wildlife. Erosion and vegetation losses do not recover in some instances even in a generation given arid conditions.</p>
Lack of connectivity between public lands managed for conservation	<p>A great deal has been done in the last 20 years to network federal refuges, state park sites and wildlife management areas, habitat conservation plan preserves, NGO preserves, and land trust holdings in this ecoregion; however there are some disconnected landscapes and resources in the region which need attention to enhance ecological function</p>	<p>Several wide-ranging SGCN and potentially genetically connected populations of SGCN with smaller home ranges (or which rely on pollinators which span those ranges) would greatly benefit from some connection among public conservation lands, which would be best achieved in this ecoregion through landowner incentives for perpetual conservation management</p>
Water Development, Management and Distribution	<p>SEE ALSO STATEWIDE HANDBOOK</p>	

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Surface Water Planning	<p>Natural resources needs not well-defined or required as a consideration in Regional Water Planning (RWP) processes</p> <p>Natural resource professionals are not consistently involved in RWP processes</p> <p>Large municipalities' demands, especially out of the region, are a driving force in surface and groundwater planning</p> <p>TMDL recommendations need to consider fish and wildlife resources needs as well</p> <p>Instream flow recommendations need to be stepped out from headwaters to estuaries to influence regional water planning processes</p> <p>Overallocation/dewatering and damming of region's principle rivers</p>	<p>Most people in this ecoregion are keenly aware of water needs for humans – agricultural, municipal, industrial, commercial and recreational – however, the connections among groundwater recharge (features and amounts), groundwater contributions to surface waters, and surface water quality and quantity related to environmental flows (water for natural resources, from recharge to estuary) are rarely considered in many surface water planning efforts. Nearly every surface water resource in this region is sourced from groundwater – spring-fed headwaters and river margins feed high quality (incl. Ecologically Significant, see Table 3) streams and rivers, all support or have potential to support SGCN and rare communities in this ecoregion. Understanding, consideration, and protection of ground and surface water resources, from land management over recharge zones to decisions about impoundment placement to direct withdrawals from ground and surface water from ALL users, are critical for most of the SGCN and rare communities on this ecoregion's list. Additionally, as many of the surface water resources of this region eventually feed the water resources of adjacent ecoregions and eventually the Gulf, consideration of environmental flow needs related to downstream uses and SGCN is needed during all Regional Planning processes.</p> <p>See also Groundwater Planning below.</p>
Reservoir Construction and Operation (ties in with Surface Water Planning above)	<p>Creation of new and modification (expansion) of existing reservoirs</p> <p>Unregulated small stream impoundments on private lands</p> <p>Timing/Periodicity/Intensity of Water Releases releases are unnaturally intense, in the "wrong" season to mimic natural flooding processes, and change water chemistry and sediment load in all areas downstream, to the estuaries</p> <p>Shoreline development - vegetation removal to water's edge for viewshed, recreational access; hardening and armoring banks (bulkheading), on-site septic leakage or non-compliance, development on steep sites.</p> <p>Invasive species</p>	<p>Reservoir construction: Several streams in this region are of high quality (Ecologically Significant); riparian zones (some are ancient gallery forests, rare communities) are important to instream aquatic and stream-adjacent SGCN habitats; ES and high quality riparian are rarely considered during site selection for new reservoirs or operations. These areas support SGCN and rare communities, contribute high quality water to reservoirs and downstream segments. Reservoir construction and operation creates a barrier to SGCN movement, completely inundates important and irreplaceable riparian zones, spring systems, and instream habitats.</p> <p>Impoundments: similar to reservoir development on mainstem rivers, negative impacts caused by impoundments on creeks and springs are just at a smaller scale: loss of instream habitats, loss of wetlands, loss of riparian habitats and natural floodways. The replacement value – still deeper water for flowing waters, pond for stream – is not ecologically synonymous. This may be more of an issue in the emerging “urban/suburban” areas.</p> <p>Unnatural hydrograph from reservoir operations/dam releases scours instream and stream-adjacent habitats, shifts vegetation communities out of sync with other riparian communities where flooding is more "natural", rare communities and instream SGCN (invertebrates and fishes) cannot "rely" on the seasonal changes under which they evolved and decline</p> <p>Shoreline Development: In addition to the loss of instream and riparian habitat following inundation, the now-“riparian” and upland habitats surrounding the lake edge is at risk from development. In this region, these habitats were usually cliff edges, recharge features, upland shrubland, canyonlands – many of these sites support SGCN and rare communities. Regional reservoir managers do not reserve much in the way of “setback” from the inundation pool level in their easements. This allows residential development (water withdrawals and septic installation), bulkheading shorelines, clearing and “landscaping” to the water's edge. These lakeside activities contribute fertilizers and other chemicals (e.g. boat gas/oil), untreated or poorly treated human waste (some lake authorities actually have permitting programs to manage/reduce this factor, but not all), and sedimentation to the lake, which eventually impacts in-lake and downstream habitats. Typically, residential development in these areas is also a vector for invasive aquatic and terrestrial plants and feral pets. See Invasive species section above.</p>

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Groundwater Planning and Distribution	<p>Not all aquifers have groundwater districts; groundwater districts are political subdivisions, not aligned necessarily with aquifer boundaries</p> <p>Extraction: groundwater pumping without full accounting of all uses and without consideration of natural resources as a "use"</p>	<p>Some of the municipal and irrigation water sources from approximately San Marcos south in the Texas Blackland Prairie and areas around and south of Uvalde in the South Texas Plains ecoregions draw from aquifer-sourced freshwater stream resources originating on the Edwards Plateau. All of San Antonio's water comes from that source. Because these areas and many unaccounted residential wells on the Plateau tap the aquifers recharged over the Plateau and surface artesian expressions in the Plateau support rare species and communities with waters from that same source, these uses are sometimes in conflict. See Edwards Aquifer Recovery Implementation Plan at http://earip.org/ for more background</p> <p>Subirrigated plant communities (even in dry creek beds) and instream aquatic habitats throughout the region rely on springflow and springfed rivers. Lower groundwater levels and loss of groundwater decreases amount of water near the surface or coming into the stream (flow, depth, substrate changes, adjacent riparian habitat changes from dry conditions) and changes in instream and stream-adjacent conditions such as temperature, oxygen availability, and other nutrient and chemical factors (including factors related to the age of water source that comes from the aquifer)</p> <p>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)</p> <p>Most people in this ecoregion are keenly aware of water needs for humans – agricultural, municipal, industrial, commercial and recreational – however, the connections among groundwater recharge (features and amounts), groundwater contributions to surface waters, and surface water quality and quantity related to environmental flows (water for natural resources, from recharge to estuary) are rarely considered in many surface water planning efforts. Nearly every surface water resource in this region is sourced from groundwater – spring-fed headwaters and river margins feed high quality (incl. Ecologically Significant, see Table 3) streams and rivers, all support or have potential to support SGCN and rare communities in this ecoregion. Understanding, consideration, and protection of ground and surface water resources, from land management over recharge zones to decisions about impoundment placement to direct withdrawals from ground and surface water from ALL users, are critical for most of the SGCN and rare communities on this ecoregion's list. Additionally, as many of the surface water resources of this region eventually feed the water resources of adjacent ecoregions and eventually the Gulf, consideration of environmental flow needs related to downstream uses and SGCN is needed during all Regional Planning processes.</p> <p>See also Surface Water Planning above.</p>
Other Water Source Developments and Technologies	<p>Interbasin Transfers (Surface and Groundwater)</p> <p>Off channel reservoir development</p> <p>Municipal demands on water and potential for well field development for commercial export out of the region or to the largest municipalities</p>	<p>Water chemistry differences can adversely affect SGCN aquatic species with narrow thresholds for change (especially those which have evolved in or near springfed rivers), environmental flows need to be considered in both receiving and withdrawal basins; water transfer may enhance potential transfer of exotic aquatic species (hydrilla, water hyacinth, zebra mussels, gill parasites)</p> <p>Interbasin transfers have increased the potential for opportunistic waterwell field development – right of first capture – which could adversely affect groundwater resources and the SGCN which depend on them in many regions.</p>
Lack of Information & Resources	<p>One response stated this is an issue, but did not provide additional information</p>	
Lack of Data/Information for Monitoring Progress and Making Conservation Decisions	<p>It is possible given the nature of the ownership landscape - large and privately held in this region - that SGCN populations and rare communities occur on private lands and may be more abundant than current data depicts. Lack of access to those sites prevents a complete understanding of how rare a species may be and limits cooperative stewardship and best management practices.</p> <p>Climate change models, GIS analysis of land conversion and change overtime, species specific information, community-specific information</p>	<p>Need distribution, abundance, and trend information specifically on SGCN breeding birds of riparian, shrubland and grassland ecosystems; mountain lion range and effects on natural systems and ranching resources; distribution and health of spring systems; population distribution and stability of SGCN karst invertebrates, bats, other small mammals, amphibians.</p> <p>See Climate Change section in Statewide Handbook and below</p>
Perception of Management Needs More Information	<p>Predator control without biological standards or supporting management</p>	<p>It is unknown whether predator control activities are affecting the stability of SGCN populations or their contribution to natural system function. Predator control efforts cannot be declared "insufficiently regulated" or "underreported" as limited information is available to assess the stability of these populations. Community-based solutions will need to be devised based on a full and accurate accounting of these populations and their effects on the natural systems and ranching communities in which they range.</p> <p>Predator trapping and/or baiting has an adverse effect on non-target species including black bears and smaller mammals such as hooded skunks, foxes</p>

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Lack of Data/Information Synthesis	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	Rare plant monitoring, SGCN breeding bird survey data, mountain lion sighting data, springs distribution, spring flow relationships to individual stream segments especially Ecologically Significant Stream Segments and the SGCN supported by these areas, several of the freshwater fishes, nearly all freshwater invertebrate collections
Lack of Best Management Practices	Lack of written, easily accessible, well-distributed, ecologically based Best Management Practices for technical advisors as well as landowners	Primarily related to riparian buffers and floodplain extents, invasive species (aquatic and terrestrial), prescribed fire, brush management
Inadequate Policies, Rules, Enforcement		
Unregulated or Inadequately Regulated Harvesting	Several predatory species (e.g. coyote, bobcat, mountain lion) are routinely trapped, hunted and killed in the region (see also <i>Perception of Management Needs More Information</i> above)	It is unknown whether predator control activities are affecting the stability of these populations or their contribution to natural system function. Predator control efforts cannot be declared "insufficiently regulated" or "underreported" as limited information is available to assess the stability of these populations. Community-based solutions will need to be devised based on a full and accurate accounting of these populations and their effects on the natural systems and ranching communities in which they range. They are important contributors to these ecosystems.
Wetland Regulations	Loss of and impact to "non-jurisdictional" wetlands and other waters	In this ecoregion, wetlands, springs and seeps which are not connected to a navigable waterway are imperiled The disconnection between surface and ground water management and planning contributes to the lack of wetland protection All spring and wetland dependent SGCN and rare communities are affected.
Unregulated or Insufficiently regulated development	Reservoir, river, stream shorelines; floodplains Karst and Cave Features	See <i>Reservoir Construction and Operation and Ranching: clearing and loss of important natural sites/habitats</i> above – similar issues for river and floodplain development, including riparian losses Inadequate protections over the aquifer recharge zone to prevent impervious cover or fill in karst and cave habitats which contribute to groundwater and related surface water quality and quantity OR harbor unregulated SGCN – special geologies are rarely protected unless the development approaches or exceeds water quality permitting thresholds.
Human disturbance	Different from development, this category addresses human presence or activities with direct impacts to persistence of SGCN or rare communities	caves and karst features which harbor hibernating bats, maternity colonies (see also <i>Pathogens – White Nose Syndrome</i>) karst features accessible to cavers and which harbor SGCN colonial bird roosting or nesting areas (rookeries, overwintering congregations) breeding bird areas or instream river habitats which are also attractive recreation zones for humans
Other Cross-Cutting Issues		
Climate Change	Downscale, ecoregional climate modeling for Texas does not exist and hinders conservation practitioners decision-making in longterm planning efforts	highly localized and intrinsically rare species associated with specific geologic features – karst, outcrops, ridges, mountain ranges, seeps, springs – will have few options to adapt as habitats shift, change, or disappear with climate change in this region; options for transplanting or translocation are few to none as many of these habitats are edaphically specialized in the region Grassland – Shrubland vegetation shifts are anticipated and will affect this and other arid grassland ecoregions perhaps more than more temperate ecoregions in Texas. Riparian and instream aquatic species' habitats may shift significantly with water availability, recharge of aquifers from precipitation changes highly localized and intrinsically rare species will have few options to adapt as habitats shift, change, or disappear with climate change in this region; options for transplanting or translocation are few to none as many of these habitats are edaphically specialized in the region
Population Growth	Urbanization Unregulated or unzoned development occurs outside of urban municipal centers into differently regulated county jurisdictions who do not have the authority to prevent resource loss or degradation (includes lack of stormwater and impervious cover controls)	Burgeoning development along the IH-35 corridor from Fort Hood to San Antonio has created widespread suburban and suburban/rural communities in former ranchlands within driving distance, mostly east of an arc from San Saba to Uvalde. Many of these communities are on aquifer-sourced water supplies, few have centralized wastewater collection or treatment other than septic systems, all impact transportation capacity and eventually require additional services development which usually form connector corridors to larger urban areas or between smaller communities directly takes habitat and species during construction (loss), degrades adjacent habitat (fragmentation), and may hinder movement (daily or seasonal)

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010) and Surveys (2011)
Economics	Working Lands, Ranches	<p>Landowner incentives cannot compete currently with market forces – acres are being pulled out or are not tapping into NRCS and Farm Service Agency conservation programs</p> <p>Incentives cannot provide perpetual conservation benefits in areas where a temporary approach is insufficient</p> <p>Market forces in some areas cannot support continued large ranch ownership – production prices and hunting revenues are too low to maintain large ranches in ownership as a single source of income, in some instances.</p>

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*.¹⁹

Actions proposed for the EDPT ecoregion (Table 5) 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.²⁰ 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

¹⁹ 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.

²⁰ 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.²¹ 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*²² 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.

²¹ 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>

²² Same as above

Table 5. EDPT 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
Provide site-, season- and slope-appropriate brush removal advice and project implementation to restore native grasslands and savanna, retain intact riparian areas and all canyonlands, and <i>protect wetlands, karst, slope and outcrops</i> . Promote use of site-appropriate methods – herbicides, Rx fire, or mechanical – to preserve water quality and prevent soil erosion and invasive grass colonization. Document and share site-appropriate restoration and maintenance plans for the benefit of other conservation practitioners – document vegetation change over time, trends for specific Ecological Management System and habitat types. Use the effectiveness measures for Direct Management (Stewardship) to assess the efficacy and benefits to <i>site-specific</i> SGCN and rare communities.
Work with adjacent arid lands ecoregions, where Tamarisk and <i>Arundo donax</i> are also a key issue. Review treatment and eradication success rates on different water bodies, relationship to and effects on spring and seep systems and associated SGCN, and determine course-appropriate actions for treatment in this ecoregion for maximum conservation effectiveness. Document results and share information with land managers and River Authorities within similar habitat types across the state.
Work with private landowners and conservation partners to minimize/eradicate feral hog and nutria populations. Provide technical guidance and educational programs to landowners about the impact and management of feral hogs and nutria directly related to SGCN conservation in wet areas, riparian zones, and/or hardwood-dependent habitats. Document what techniques and outreach work best in this ecoregion for SGCN conservation. Work with private landowners and other land managers to address the issue of hog transport into and across the state to prevent further introduction and promote reduction of existing populations. Identify incentives and markets to promote the reduction of feral hogs and nutria in Texas.
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 and cultivars should not be used in any restoration project, especially 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 suitable 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. Promote conversion of nonnative grasses to site appropriate desired ecological conditions especially on lands adjacent to sites already managing for conservation objectives (land trust properties, WMAs, State Parks, some Wildlife Cooperatives and Wildlife Management Plan holders, preserves, etc.).
In and near urban and outlying “bedroom” developments, 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 Bermuda grass, KR Bluestem, other nonnative grasses, Chinese tallow, Chinaberry, Tree of heaven, Japanese honeysuckle, Ligustrum, Nandina and state-prohibited species. Encourage these plant users to adopt a stream segment preferably from headwaters to mainstem 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, suburban areas) 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 (see also <i>Power Development</i> below)
Intensify outreach and public education efforts especially near boat ramps and high-traffic fishing tournament areas to reduce the proliferation or prevent 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. Identify effectiveness measures for this outreach effort and document progress.
Target outreach for red imported fire ant (RIFA) proper identification (not confused with other beneficial ant species) and site-appropriate control in conjunction with other habitat restoration recommendations, especially where karst, grasslands, shrublands and springs may harbor SGCN. Karst-sensitive methods have been tested on sites such as Government Canyon State Natural Area northwest of San Antonio and the Balcones Canyonlands Preserves west of Austin and found to be effective.
Map, document, and share information about the spread and control of Raspberry Crazy Ants to prepare pest managers and create best practices in sensitive areas
Phase out stocking practices of small-mouthed bass and stripers in freeflowing river sections where these introduced predators have the potential to permanently and adversely affect native rare freshwater minnows, shiners, pupfish and others SGCN native aquatics of springfed rivers and streams in this ecoregion.
Pests, Parasites, Pathogens
See oak wilt actions in Invasive Species, Power Development and Transmission, and Transportation sections
Intensify private landowner outreach in karst-prone areas, especially those sites with traversable caves, to promote appropriate decontamination 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.
Monitor <i>Cactoblastus</i> distribution in Texas and document in a public resource (published journal, centralized website, Wildflower Center database?) in order to determine threats to native <i>Opuntia</i> sp.
Power Development and Transmission
Encourage voluntary compliance with the USFWS Wind Power Development Guidelines and coordination with TPWD’s Habitat Assessment section for environmental review of impacts, potential avoidance strategies, and mitigation opportunities for highest ecological value. Map sensitive sites within well-identified migratory pathways for hawks and other raptors, neotropical migrants, and waterfowl potentially impacted by wind tower siting and operations. Provide this information to TPWD Habitat Assessment section so that they can better assess wind tower and operational impacts, propose avoidance and mitigation measures. Support the development of an online resources mapper for developers to use to avoid areas of highest ecological significance.

Conservation Action

Provide conservation outreach to power developers and providers, especially those interested in solar, algal farms and biofuels, to inform them of the importance of native grasslands to regional wildlife and fish resources, areas of highest significance for avoidance, and potential areas to concentrate mitigation dollars and projects in the event avoidance is not feasible or prudent.

Document and publish timing (periodicity, seasonality, frequency) and intensity of barotrauma impacts to regional SGCN migratory and residential birds and bats from wind turbines; share this information with existing and developing wind operations managers, encourage wind generation companies to modify practices to avoid or minimize impacts. Study avoidance and minimization based on practices' modifications and publish results. Adjust management and development recommendations as needed for best practices.

In areas with a high concentration of oak wilt or oak decline, vulnerable species and/or a lot of tree trimming activity (e.g. ROW) deter the inappropriate timing or disposal of oak trimmings to slow/prevent the spread of this disease. Follow Texas Forest Service Guidelines for tree trimming timing, cut treatment, equipment protocols and trimming disposal. Avoid the use of brush-hogging vertically to trim back ROW edges. Document areas of oak wilt, oak decline with the Texas Forest Service to help them concentrate their outreach and incentive programs on this front

Work with Transmission Line and Distribution Line ROW developers and maintenance plans to promote:

- use of locally sourced native grasses in post-construction and maintenance re-seeding
- at least 200' stream and wetland buffers of existing native vegetation
- active eradication of non-native species
- conservation of riparian areas, all wetlands and wet areas
- seasonally-sensitive maintenance to avoid impacts to breeding and migratory birds
- regrowth of certain areas for BCVI conservation, connecting populations

Where possible, emphasize restoration of the desired ecological condition after construction.

Oil and Natural Gas Production and Delivery

Develop a short list of best management practices for site assessment prior to operations (e.g. karst connectivity to the aquifer, surface and karst interior rare species survey), water quality protection and aquatic feature adjacent vegetation protection for oil and gas operators. Identify areas where oil and/or natural gas production is at highest probability to intersect groundwater resources which support SGCN and work with producers and TCEQ to craft and implement better best practices (monitoring, containment, prevention, setbacks) to protect groundwater and connected (springs, spring-fed water bodies) systems with greater surety

Work with oil and gas ROW developers and maintenance plans to promote:

- use of locally sourced native grasses in post-construction and maintenance re-seeding
- stream and wetland buffers of existing native vegetation
- active eradication of non-native species
- conservation of riparian areas, all wetlands and wet areas
- seasonally-sensitive maintenance to avoid impacts to breeding and migratory birds
- regrowth of certain areas for BCVI conservation, connecting populations

In mitigation plans, emphasize restoration of the native ecological condition after construction of wells, pads, roadways, and distribution areas.

Mining

Develop a short list of best management practices for site assessment prior to operations (e.g. karst connectivity to the aquifer, surface and karst interior rare species survey), water quality protection and aquatic feature adjacent vegetation protection for sand and gravel mining and limestone quarries (small and large commercial), and setbacks from sensitive features in this ecoregion. Provide conservation outreach to operators to inform them of the new regulations requiring a TCEQ permit for river and stream adjacent operations. Work with TCEQ permitting requirements to include information about the sensitivity and importance of riparian areas, springs, seeps and other water features, including nonjurisdictional wetlands and swales, to encourage best practices (avoidance, stormwater pollution prevention, minimization).

Work with mining operations developers, maintenance plans, and remediation contractors to promote:

- use of locally sourced native grasses in post-construction and maintenance re-seeding
- stream and wetland buffers of existing native vegetation
- active eradication of non-native species
- conservation of riparian areas, all wetlands and wet areas
- seasonally-sensitive maintenance to avoid impacts to breeding and migratory birds
- regrowth of certain areas for BCVI conservation, connecting populations

In mitigation and remediation plans, emphasize restoration of the desired ecological condition in remediation efforts.

Communications Infrastructure

Conservation Action
Provide conservation outreach to regional communications providers to inform them of areas of highest significance for avoidance – migratory bird pathways (especially nocturnal; also known impacted species such as Yellow-billed Cuckoo, Painted Bunting, Summer Tanager), areas adjacent to bat emergence sites -- and potential areas to concentrate mitigation dollars and projects in the event avoidance is not feasible or prudent. Identify non-compliant communications towers and work collaboratively to bring into compliance (lighting, height); outreach to communications companies about the local hazards of communication towers and recommendations to improve practice to improve conditions for all
Transportation
In areas with a high concentration of oak wilt or oak decline, vulnerable species and/or a lot of tree trimming activity (e.g. ROW) deter the inappropriate timing or disposal of oak trimmings to slow/prevent the spread of this disease. Follow Texas Forest Service Guidelines for tree trimming timing, cut treatment, equipment protocols and trimming disposal. Avoid the use of brush-hogging vertically to trim back ROW edges. 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
Provide TXDOT with native grass species lists, seed sources and restoration technique guides to encourage use of natives in ROW remediation following construction and restoration if the opportunities for conversion arise. Native grasses have improved drought tolerance and are adapted to Texas' soils and climates. Native grass seeding also requires less water inputs which would reduce remediation costs.
Provide outreach to landowners adjacent to TXDOT ROW in areas where TXDOT has implemented native restoration (native grasses used) or conservation (rare plant protection plans, maintenance plans to protect rare communities or features) to support SGCN recovery or protection to further understanding of these important resources and their site-appropriate management, reduce landowner maintenance in these areas, and promote SGCN recovery. Use outreach effectiveness measures to document progress.
Identify specific areas for TXDOT Districts, county road managers to improve right-of way (ROW) restoration and management: <ul style="list-style-type: none"> ▪ Post construction, restore sites with native seed sources and materials ▪ Remove invasive species and restore site-appropriate vegetation on ROW to protect adjacent priority habitats (e.g. wetlands, riparian, karst, grasslands ...) ▪ Promote wildlife and fish passage construction for culverts, bridges ▪ Terms of easement need to include native prairie restoration and management (incentivize landowner to retain native vegetation) ▪ When mowing along roadways, mow approximately 15 feet from the shoulder within undeveloped areas; in areas beyond 15 feet and on ROW through rural lands do not mow between April and October in order to allow ground nesting birds to produce and native grassland plants to seed out.; mow on a 4-year cycle at an 8-inch height (if roadway, both sides of the road are not mowed in the same year, saves significant dollars for mowing costs and reduces accidents). ▪ Provide interpretive signage re these practices and outreach to neighboring properties so this can serve as a demonstration, prevent private maintenance of public ROW ▪ Identify monitoring sites which can serve as mitigation as long as information is shared through a public database and conservation practice networks.
Land & Water Mgmt: FARM – while there are few farm operations in this ecoregion, the practices below would be beneficial even on those few sites
A North Carolina State University study of linear and block field borders on 24 farms found that quail populations almost doubled on farms where 2-3 percent of the cropland edge was allowed to go fallow. It also found that blocks of fallow habitat (one quarter acre to 6 acres in size) produced twice the number of quail as narrow (10-foot) linear field borders. While this study targeted quail production, other SGCN grassland birds, small mammals, reptiles, rare plants and insects, and the grassland/shrubland communities themselves, would also benefit from these practices: <ul style="list-style-type: none"> • Leave brushy or grassy borders around fields/orchards. These borders can help with erosion and if left un-mowed can provide nesting areas • Leave jagged edges on fields. Fields with straight edges appear to provide less habitat • Preserve or restore woody draws (cover in draws will re-establish naturally if left unplowed or un-mowed; invasive nonnative plants should be removed). • Alternating crops in the same field is an excellent way to reduce erosion and build soil fertility. Planting row crops followed by wheat or other small grains the next year provides habitat diversity for quail. Planting legumes or grass every third or fourth year is a good rotation for soil conservation and SGCN. • Remove dense sod-forming monoculture grasses. Thick mats of grass hinder movement and make feeding difficult. Native warm-season grasses, properly managed, provide cover and food. Mixing legumes with grasses improves habitat for young quail.
Land & Water Mgmt: RANCH
Conservation easements and landowner incentive programs (e.g. Farm Bill Conservation Title, USFWS Partners Program, Grazing Lands Conservation Initiative, TPWD Landowner Incentive Program ...) are the best instruments for landowner participation in this region. Landowners with intact grassland-woodland mosaic (especially those within priority grassland areas identified by Oaks and Prairies Joint Venture, and The Nature Conservancy, USFWS Partners Program, NRCS Farm Bill wildlife biologists), grasslands with restoration potential for little investment, riparian corridors along Ecologically Significant Stream Segments (and to their headwaters), diverse hardwood canyons, cave or karst landscapes, and/or springs; and adjacent to or along natural system corridors/watersheds related to well-managed conservation lands should be first-eligible. Monitoring of key SGCN from a variety of taxa 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).
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 and cultivars should not be used in any restoration or enhancement project as these are known to be detrimental to native habitats and the wildlife on which they depend. Properly managed native grasses do not require annual fertilization; highly palatable native grasses (i.e. Yellow Indiangrass, Little Bluestem, Big Bluestem, Switchgrass, and Eastern Gammagrass) provide high protein levels required for livestock and hay production. These factors make native grasses a sustainable option for Texas' rangeland and SGCN benefits. Native grasses have improved drought tolerance and are adapted to Texas' soils and climates. Economic analysis comparing introduced grass to native grass in a commercial cow-calf production system has estimated greater returns for native grasses when fertilizer costs are \$40- 50 per acre. In addition to terrestrial and aquatic wildlife benefits, pasture conversion back to native grasslands reap public benefits through improved water quality, groundwater recharge, carbon sequestration, erosion control, outdoor education, and recreational opportunities. A restoration guide to suitable 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. Incorporate SGCN fish and wildlife habitat values and recommendations in rotational grazing system recommendations (Grazing Lands Conservation Initiative). Promote conversion of nonnative grasses to site appropriate desired ecological conditions especially on lands adjacent to sites already managing for conservation objectives (land trust properties, WMAs, State Parks, some Wildlife Cooperatives and Wildlife Management Plan holders, preserves, etc.).

Conservation Action
Provide site appropriate brush removal and prescribed fire advice and project implementation to restore native grasslands and savanna, retain intact riparian areas and all canyonlands, and protect wetlands and outcrop features. Promote use of site-appropriate methods – prescribed fire, herbicides, mechanical – to preserve water quality and prevent soil erosion and invasive grass colonization. Document and share site-appropriate restoration and maintenance plans for the benefit of other conservation practitioners – document what works and what does not in specific site types. Use the effectiveness measures for Direct Management (Stewardship) to assess the efficacy and benefits to SGCN and rare communities.
Work with private landowners and conservation partners to minimize/eradicate feral hog and nutria populations. Provide technical guidance and educational programs to landowners about the impact and management of feral hogs and nutria directly related to SGCN conservation in wet areas, riparian zones, and/or hardwood-dependent habitats. Document what techniques and outreach work best in this ecoregion for SGCN conservation.
As part of landowner incentive program planning and delivery, incorporate native habitat restoration and protection practices which benefit also aquatic SGCN and the habitats on which they depend – protect riparian areas, wetlands, and springs; promote karst setbacks and appropriate gating to prevent trash/debris inflow (also benefits karst invertebrates, bats and other small mammals and reptiles), remove fish passage barriers where possible (e.g. steep-drop low water crossings, inappropriate culverts or bridges).
Host local and absentee landowner workshop series related to SGCN and habitat “target areas” (see Effectiveness Measures for training and technical guidance), add a focus module on conservation instruments – Safe Harbor Agreements, Candidate Conservation Agreements, conservation easements – to dispel myths about regulatory constraints and promote benefits in preventing the need to list and promoting recovery. 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. Share lessons learned in an annual conference through the Land Trust community.
Land & Water Mgmt: Municipal
Work with the planners in urban areas and emerging communities and larger ranches and developments throughout the ecoregion in and adjacent to High and Very High Risk HUC 12 watersheds identified on the National Fish Habitat Action Plan viewer (http://www.nbii.gov/far/nfhap/) to reduce human-induced, identified pollution risks and improve/protect water quality. Focus on those watersheds which also have an intersection with SGCN aquatic species and/or intact streamside rare communities. Identify specific measures that can be implemented and establish monitoring to determine if outreach and coordination with planning entities is effective
Develop one to two page best management practices to target outreach to urban areas and emerging communities and larger ranches and developments focused on the significance of native grasslands, riparian habitat, sensitive geologic/hydrologic features including nonjurisdictional wetlands which host SGCN rare plants and communities, streamside buffers and water quality, drainage and floodway protection, and water conservation 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, stormwater pollution prevention plans). Monitor the targeted outreach effectiveness and determine if the approach could be successfully implemented in other areas (e.g. adjacent ecoregions with similar issues).
Form a working group of ecologists, conservation field practitioners, urban biologists, and recreation services providers to provide <u>consistent</u> information from the conservation community to Metropolitan Planning Organizations, Councils of Government, Regional Transportation Authorities, Parks Boards, Counties, and others in current and emerging urban areas. Key issues may be: <ul style="list-style-type: none"> ▪ Park and open space planning for <i>specific</i> regional habitat connectivity (daily and seasonal movements), riparian and streamside protection, water quality protection, floodplain set asides, mitigation banks for in-jurisdiction projects ▪ Karst, cliff, spring, and other sensitive feature protections ▪ Water quality protection through stormwater pollution prevention plans and facilities even where not required by regulation, leaving natural floodways intact rather than armoring ▪ Water conservation practices and direct relationship to benefits for humans and SGCN in their areas ▪ Invasive species prevention and removal in public land, rights of way, planned developments (e.g. encourage native plant use in new housing areas, incentives for landscape conversion to natives especially in areas near waterways) ▪ Collaboration with counties for environmental protections (stormwater, invasive species, reclamation, dumping, other?) ▪ Tax incentives or disincentives for open land conversion, restoration, conservation planning Identify sources of volunteers and/or funding which could help municipalities employ conservation practices. As with any outreach program, these efforts need to have reporting objectives and monitoring of sorts to determine effectiveness, share lessons learned and hone approaches for future and emerging areas which will be experiencing these issues in the future.
Land & Water Mgmt: Conservation & Recreation
This ecoregion needs ecologically sustainable, publicly accessible, functional native grasslands “connected” throughout the western portion of the ecoregion. While fenceline to fenceline connections are not feasible, large grassland conservation and restoration sites are needed to form a series sites for imperiled grassland birds. This is a highly imperiled habitat type and permanent conservation lands are desperately needed. While sites do not need to be publicly owned, consistent conservation plans and management are needed for highest ecological function and longterm recovery/resiliency. This could be tied with identification of Important Bird Areas for grasslands in this region (incentives, funding).
Establish a regional public lands management experience cooperative to identify restoration needs and sites, invasive species removal priorities, trail development and recreation planning improvement, and management practice (e.g. Rx Fire, Brush Control, Restoration) improvement opportunities. Work together to pursue restoration funding and volunteers to share (e.g. burn teams, burn trailers/equipment, trail teams, riparian restoration teams, go in together on equipment and/or plant materials, schedule) among priority projects to benefit SGCN and rare communities, improve water quality, and provide demonstration areas for public and private landowner outreach. Review effectiveness measures and reporting to determine if this is a viable, useful collaboration; what benefits to agencies/organizations have been realized; what improvements have been made for SGCN conservation (status improvement, resiliency, permanent protection).
Water Development, Management and Distribution

Conservation Action

See <http://www.twdb.state.tx.us/gwrd/gcd/gcdhome.htm> for a current map of Groundwater Planning Districts that intersect this ecoregion; see also <http://earip.org> for information about Edwards Aquifer Recovery Implementation Plan progress.

Groundwater management is a key issue in this ecoregion, which covers many municipalities, emerging communities, watersheds and significant aquatic features which support many of the region's SGCN. Waters which begin in this region feed ecoregional resources to the south and east, to our Gulf coastal estuaries.

Support the establishment of groundwater conservation district(s) that align most closely with the aquifer boundaries and use areas in and out of these basins to support management for conservation, preservation, recharging, and prevention of waste of groundwater resources. Continue to support and contribute to the processes and outcomes of the Edwards Aquifer Recovery Implementation Plan which affects environmental water flows through and downstream of this region. See the following reports and restoration processes supported by the Edwards Aquifer Recovery Implementation Plan: <http://earip.org> Many of the processes and studies supporting development of projects in this stakeholder-driven effort could apply to other aquifer planning processes.

Identify a coalition or natural resources advisory group of terrestrial and aquatic ecologists across natural resources management entities for the ecoregion to craft SPECIFIC science-based recommendations and regionally specific information regarding groundwater-surface water connection for **groundwater required to continue to support environmental flow needs** for aquatic and terrestrial SGCN and rare communities, sensitive and unique areas which may be adversely affected by groundwater withdrawals and/or interbasin transfers. Additional recommendations for accurate and complete water accounting would be useful for all planning processes. Given small budgets for time and travel, elect a spokesperson (or rotating spokesperson) to attend and participate in regional meetings and convey the group's recommendations. Evaluate the effectiveness of this activity and share lessons learned in other regions which could benefit from this experience.

See <http://www.twdb.state.tx.us/wrpi/rwp/map.asp> for a current map of Regional Water Planning Groups that intersect this ecoregion.

Surface water management is a key issue in this ecoregion, which covers many municipalities, emerging communities, watersheds and significant aquatic features which support many of the region's SGCN. Waters which begin in this region feed ecoregional resources to the south and east, to our Gulf coastal estuaries.

Identify a coalition or natural resources advisory group of terrestrial and aquatic ecologists across natural resources management entities for the ecoregion to craft SPECIFIC science-based recommendations and regionally specific information regarding groundwater-surface water connection for **environmental surface water flow needs** for aquatic and terrestrial SGCN and rare communities; sensitive and unique areas which may be adversely affected by reservoir development, interbasin transfers, off channel reservoirs, and withdrawals; opportunities for water quality improvement (see TMDL recommendation). Support the conversion or transfer of existing unused water rights to the Texas Water Trust to protect instream uses. Develop a means to aid in funding the transfer of unused water rights to TWT. Study current water use and rates paid in large urban areas, versus the cost of longterm ecological loss from reservoirs or other water development projects. **Convey the findings to regional surface water planning groups and make recommendations for mitigation to recover desired ecological conditions.** Consider water rates directly proportionate to use to encourage conservation. Additional recommendations for accurate and complete water accounting would be useful for all planning processes. Given small budgets for time and travel, elect a spokesperson (or rotating spokesperson) to attend and participate in regional meetings and convey the group's recommendations. Evaluate the effectiveness of this activity and share lessons learned in other regions which could benefit from this experience.

Evaluate the benefits and outcomes of State Scientific Area Designation for San Marcos River. Convey findings and recommendations to regional surface and groundwater planning group(s).

Lack of Information & Resources

Conservation Action

Create a multi-disciplinary multi-partner regional ecology committee to identify three to five years of highest priority research projects (actual projects, not just concepts) that can be rolled out to educational and research institutions, NGOs and agencies to collect information most needed at the PRACTICAL level for management and conservation improvement on the ground. Some priorities for consideration identified in the TCAP process:

- monitor the status of key suite of breeding and wintering grassland birds within the western and central subregions of the Edwards Plateau to support the Oaks and Prairies JV population recommendations development
- use LIDAR and the methods of the Texas Ecological Mapping Systems project to determine the potential full extent of the rarest SGCN and opportunities for downlisting/delisting, targeted recovery efforts, , landowner incentive programs with longterm or permanent conservation easements and purchase of development rights, Conservation Banking, Safe Harbor and Candidate Conservation Agreements, and SGCN rank updates
- longterm monitoring of regional scale summer wildfire sites to document vegetation community and animal assemblage recovery or shifts, trends over time compared to areas in the same ecotype which have not been burned in 5, 10, 15 years, and compared to areas which are burned in different seasons
- map and monitoring bank stability, native vegetation recovery, and native animal use in areas treated with Tamarisk removal (various means/methods/timing) to recommend most effective and ecologically sound practices for landowners;
- phenology studies related to insect fauna, particularly pollinators of rare plants/communities, and the documented and potential effects of climate change in grassland, shrubland, wetland and geologically isolated plant communities;
- research on effects of managed flows (dam releases), including sediment dynamics and water quality, and their effects on SGCN pupfish, minnows, and aquatic invertebrates.
- Evaluate specific groundwater withdrawal impacts on spring, seep and karst habitats that support SGCN and rare communities; identify key headwater areas for landowner outreach and incentives; also, refine the ranges and relatedness of *Dionda argentosa*, *Dionda serena*, and *Dionda episcopa* to help identify threats and conservation needed for the various “populations”
- Evaluate the role of predators in priority habitats in this Plan; using existing data and a protocol for collecting additional data, identify the frequency, extent, and effects of predator control activities on the stability of certain predators’ populations and their contribution to natural system function; based on findings and other western states’ successful management strategies, identify community-based and community-supported solutions to balance predator control effects with ecological needs.
- Identify areas of hardwood decline and areas showing reduced regeneration; identify opportunities to work with landowners to improve hardwood conservation and diversity in canyonlands and ravines; promote hardwood identification and conservation.
- Building on the work done for the Springs of Texas and the TPWD Springs program, continue to identify and map spring sites, evaluate aquatic fauna and rare plant community associations with these features; use the information to determine watersheds for restoration and conservation focus. Provide spatial information to the TXNDD and the Texas Ecological Mapping Systems program for enhanced conservation planning and landowner outreach.
- Additional information needed about karst connectivity in the region, working toward a network map of karst connections and aquifer conduits to target conservation areas
- Review of existing literature, range maps, Texas Speleological Society data, museum collections to enhance the TXNDD records for hibernating bats in Texas, including identification of important hibernacula which should be monitored annually for the presence/absence (detection) of *Geomyces destructans* and/or White Nose Syndrome.

Many SGCN in this region lack distribution and POPULATION status information – check with TXNDD for data gaps. This lack of information can contribute to “false rarity” determinations or can prevent wildlife managers from being able to make good conservation recommendations to prevent the need to list a species; more information and cooperation from private landowners may reduce the risk of listing, enhance recovery options, and contribute to conservation of many sensitive habitats just through awareness and documentation. Prioritize population health and distribution studies for those SGCN which are not yet listed, are candidates or have been identified as imminently threatened. Document findings in published literature, including specific conservation recommendations, and the Texas Natural Diversity Database.

Technical Guidance FOR Conservation Service Providers (Audubon, NRCS, TPWD, TNC, NPAT, NPSOT, FWS, NWTF, OPJV and NBCI) specific to the issues and resources of this region:

- Land conservation tools – conservation easements, Purchase of Development Rights, fee title, donations, mitigation banking, Safe Harbor, Candidate Conservation Agreements, Candidate Conservation Agreements with Assurances, stewardship/management incentive programs; include how priorities for action are determined, which are most successful and why, best practices – timelines, documentation, monitoring; lessons learned; and how to measure effectiveness of the tool used.
- Wildlife Tax Valuation – benefits, best practices to benefit SGCN and priority habitats; barriers to implementation and lessons learned to overcome barriers; monitoring recommendations
- Landowner Education: how to deliver the best message, what kinds of tools and support landowners expect, how to select and target your audience, levels of response based on type of outreach, how to measure effectiveness and application of the training, costs-benefit analysis, lessons learned.
- Prescribed Fire: technical training requirements, time, and costs for an effective program; how to develop a program and what partner resources are available; how to engage private landowners in Rx fire application; how to best deal with urban – wildland interface issues (what stakeholders need to be involved); how to generate interest in burn cooperatives to enhance the scale of fire application; lessons learned over time in this region; how to measure effectiveness of Rx Fire application (site specific and programmatically).
- Brush Management: where appropriate/inappropriate, current state of the science and practice, best tools for certain soils/substrates and brush species, how to develop a program and roll it out to private landowners, potential partners; lessons learned over time in this region; how to measure effectiveness of brush treatment application (site specific and programmatically).
- Same kinds of training programs for grassland restoration and riparian restoration. See Best Management Practice development recommendation above.

Identify a host website to share ecoregional practitioner (not novice, not landowner, but professional) cross-training opportunities for RX fire, stream rehabilitation, reintroductions, brush management, GIS and corridor identification, other ...

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 sites and heterogeneity in grasslands, but also the 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. Identify key species by subregion of the Edwards Plateau to monitor for effectiveness (e.g. best species to monitor to indicate effectiveness may be different in the Llano Uplift than in the more dissected Canyonlands). Identify data collection repository and reporting to share lessons learned with other conservation practitioners and make changes as science evolves or supports practice.

Form multi-partner working group(s) to establish scientifically sound best management practices for **chemical/mechanical brush control** for the ecoregion and specific watersheds – slope, aspect, species, techniques, avoidance areas. work with brush control technical experts AND rare species experts to identify concerns, barriers, and solutions. Identify key species by subregion of the Edwards Plateau to monitor for effectiveness (e.g. best species to monitor to indicate effectiveness may be different in the Llano Uplift than in the more dissected Canyonlands). Identify data collection repository and reporting to share lessons learned with other conservation practitioners and make changes as science evolves or supports practice.

Conservation Action
Form multi-partner working group(s) to establish scientifically sound best management practices for riparian restoration (cottonwood, sycamore, cypress), 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) Identify key species by subregion of the Edwards Plateau to monitor for effectiveness (e.g. best species to monitor to indicate effectiveness may be different in the Llano Uplift than in the more dissected Canyonlands). Identify data collection repository and reporting to share lessons learned with other conservation practitioners and make changes as science evolves or supports practice.
Identify a host website to share ecoregional practitioner (not novice, not landowner, but professional) cross-training opportunities for RX fire, stream rehabilitation, reintroductions, brush management, GIS and corridor identification, other ...
Inadequate Policies, Rules, Enforcement
Review TPWD policies and regulations on trapping of furbearers and non-game species to reduce unintentional loss of non-target SGCN including (black bear, badger, hog-nosed skunk, hooded skunk, western spotted skunk). Increasing trap inspection intervals from every 36 hours to every 24 hours for furbearers and requiring 24 hour trap checks for non-furbearing target species would potentially reduce the number of non-target losses. Consider implementing trapper education classes to improve trapping techniques that reduce non-target losses
Other Cross-Cutting Issues
Climate Change: This issue is not widely explored in Texas and downscaled models are lacking at the ecoregion level; future work should concentrate on modeling potential adverse effects to rare habitats (in this region, native grasslands, wetlands and riparian areas) to begin to address management and resiliency needs. It is known from other efforts that climate change will likely exacerbate existing conservation problems, so many of the solution proposed above may help provide resiliency, until more definitive information can be modeled: Acquisition and restoration of native grasslands are critical to provide larger habitat patches and movement corridors for bird population sustainability, especially in the face of climate change. Form a working group with adjacent Texas Blackland Prairie and Gulf Coastal Prairies and Marshes aquatic and terrestrial ecologists to identify river rehabilitation goals in/adjacent to undammed stretches below last impoundment to the estuaries to evaluate/implement instream flow recommendations; improve the quality, timing, and seasonality of releases, improve riparian restoration, and increase connectivity to improve resilience to climate
Determine market values that are driving livestock production, hunting and other recreation, and land sales in this region. Craft a recommendation to landowner incentive program providers that can be used to index conservation practice incentives in ecoregions. Monitor whether this approach was effective to change the conservation program values AND landowner participation in those programs before & after the change.

NOTE: Almost all of these actions would benefit from more regular cooperation among conservation practitioners in the region. Use and participation in the coming USFWS TRACS conservation project tracking system would be helpful. 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.

