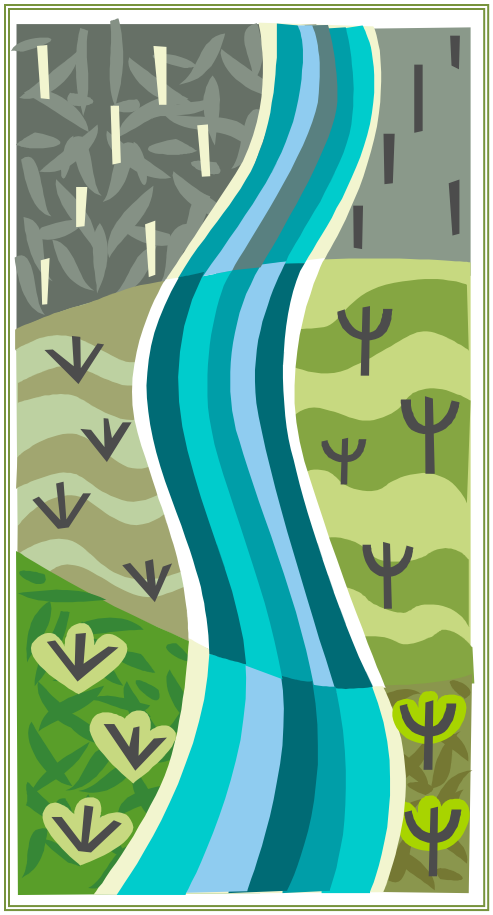

TEXAS CONSERVATION ACTION PLAN

Chihuahuan Desert and Arizona-New Mexico Mountains

ECOREGIONS 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 Chihuahuan Desert and Arizona-New Mexico Mountains (CHIH-AZNM) Ecoregions Handbook is one of the Texas Conservation Action Plan (TCAP) thirteen handbooks, available at Texas Parks and Wildlife Department's TCAP website:

- 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 CHIH-AZNM 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 CHIH-AZNM 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 CHIH-AZNM 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.

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. [1] 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 the handbooks,[2] please contact the TCAP Coordinator at the TPWD Headquarters in Austin, Texas:

Phone (512) 389-4800

Email tcap@tpwd.state.tx.us

[1] 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

[2] 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/

ECOREGIONS OVERVIEW

"West Texas" conjures the images many of us have of Texas legends – one foot in truth and the other in great works of fiction (thank you, Larry McMurtry) – endless open space, mountains in the distance, cultural icons of cowboys and cattle, and inhospitable environments full of prickly pear and little to no water. Most of us experience west Texas at more than 70 miles per hour, driving IH-10 from one side of the state to the other, rarely slowing to meander the backroads and take in the details of this truly beautiful landscape. The truth, it turns out, is an incredibly diverse landscape, complex spring-fed oases and lush riparian areas, golden grasslands, and cool mountain canyons.

The Chihuahuan Desert and Arizona-New Mexico Mountains (CHIH-AZNM) ecoregions[3] are a matrix of hardscrabble rock-strewn scrublands and lush vast grasslands, pockets of isolated geologically dependent plants and animals found only on "mountain islands" (Gelbach 1993), biologically diverse and critically important cienegas (springs) that form an "O!" of surprise in a hot desert environment, and stream/riparian complexes that support flora and fauna found nowhere else in the world. At first glance, the entire region appears as we imagine it did hundreds of years ago – sparsely populated, wild, and "untouched;" however, while human settlements in west Texas are few and far between, our imprint on the land has been widespread, across generations, and continues today. Our cultural history of barbed wire, water development, working lands and range management have shaped most of Texas's natural history, and the "deserts" of west Texas are no exception. Livestock ranching, oil and natural gas exploration, alternative energy development, the movement of goods and services from Mexico and points west across and through Texas, and water development are all complex issues which shape the distribution and well-being of natural resources in this region. Ownerships in the Trans Pecos are still large, by any standard, in the thousands of acres, although the difficulty in retaining these large ownerships and pressures for subdivision are evident here as they are throughout Texas. And, while there are several large public sites – Guadalupe Mountains National Park, Big Bend National Park, Big Bend Ranch State Park, and others – in this ecoregion, west Texas remains mostly privately held. Conservation through private partnerships is crucial. Outdoor recreation leases and uses – hunting, fishing, birding, hiking, mountain biking – and retirement sites have replaced or now significantly augment traditional land uses in some areas. These ecoregions combined cover approximately 22,677,181 acres out of Texas's 171,904,640 acres. Table 1 crosswalks these ecoregions with other conservation planning units.[4]

ARIZONA - NEW MEXICO MOUNTAINS

With lower elevations than the nearby Southern Rockies, the Arizona – New Mexico Mountains (AZNM) ecoregion is characterized as warmer and drier than that area. The majority of this ecoregion occurs in the midsection of Arizona, with disjunct pockets in New Mexico. The eastern- and southern-most extents of this ecoregion spans the New Mexico – Texas border as the Guadalupe Mountains formation with higher elevation ponderosa pine forests; surrounding foothills of oak, pinyon and juniper woodlands; and adjacent chapparal. Known locally as "The Guads", it shares a unique geologic history with the Apache Mountains near Van Horn and the Glass Mountains near Alpine as exposed fossil

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

[4] For more information about planning boundaries, see the Overview handbook on the TCAP 2011 website http://www.tpwd.state.tx.us/landwater/land/tcap/

remnant reefs of the larger Capitan Reef, a Permian Period formation (NPS, n.d., Hayes 1964). This limestone foundation contributes to the area's landscape of eroded sheer cliffs and sheltered wooded canyons, spring systems, cave features, and gypsum dunes. Guadalupe Mountains National Park is the majority of this ecoregion's extent in Texas. The remainder of the ecoregion is privately held as rangeland, recreation areas, and research sites for regional universities. Figure 1 illustrates the location and extent of this ecoregion, embedded in the Chihuahuan Desert ecoregion in Texas. Table 2 documents the Ecological Drainage Units (EDU) and Hydrologic Units ("HUC 8", finer scales within EDUs), Ecologically Significant Stream Segments (ESSS)5 which occur in this area. Figure 2 shows those EDUs, HUC 8s, and ESSS by ecoregion.

CHIHUAHUAN DESERT

Most of west Texas, also known as the Trans Pecos, is Chihuahuan Desert, extending into central New Mexico to the north and more than 500 miles south into Mexico. The region is arid with annual precipitation of approximately 13 inches or less, occurring mostly in the summer months (the "monsoon" of west Texas usually occurs in August). The area is incredibly diverse given the altitude changes – desert grassland and arid shrubland lowlands to high elevation islands of oak, juniper, and pinyon pine woodland – typical of "basin and range" topography. Historic and current livestock grazing operations – stocking levels, fencing, watering – have done much to shape the lower elevations' vegetation communities. Agricultural production is also prevalent – dryland and irrigated row crops (cotton, onions, alfalfa, "hay"), irrigated pecan orchards, and hydroponic tomatoes. Most regional streams are ephemeral, many are spring and groundwater dependent; isolated springfed wetlands dot the landscape infrequently. Steep canyons and arroyos gather what little rainfall reaches the land; these areas have very different and diverse native plants and plant communities. The Texas - Mexico boundary in this ecoregion runs the Rio Grande/Rio Bravo course from El Paso through Big Bend to Amistad Reservoir, near Del Rio. Many people consider Del Rio (and the Devils River watershed to its north) part of this ecoregion, south Texas, *and* the Edwards Plateau. Elements of the Chihuahuan Desert (especially the fish assemblages) need to be addressed in this crossroads area by all three ecoregions. The larger urban and settled areas in the region include El Paso, Presidio, Alpine, Pecos, and Fort Stockton. Mexico's borderlands communities – Juarez and Ojinaga – and Parque Nacional Cañon de Santa Elena and Parque Nacional Maderas Del Carmen, across the river from Big Bend, are also important influences in this ecoregion. Figure 1 illustrates the location and extent of this ecoregion in Texas. Table 3 documents the EDUs and HUC 8s, ESSS, and mapped reservoirs which occur in this area. Figure 2 shows those EDUs, HUC 8s, and ESSS by ecoregion.

[5] TPWD. 2002/2005. *Ecologically Significant Stream Segments*.
http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/

Table 1. Crosswalk of CHIH-AZNM Ecoregion with Other Conservation Plan Units

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

2012 TCAP	**2005 TXWAP** Gould 1960	**The Nature Conservancy** Terrestrial Ecoregions 1999	**Ecological Drainage Units** (*Watersheds*) National Fish Habitat Action Plan *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
Chihuahuan Desert (**CHIH**) and Arizona/New Mexico Mountains (**AZNM**)	Trans-Pecos	Chihuahuan Desert (24) and Arizona – New Mexico Mountains (21)	Lower Pecos River Middle Rio Grande/Bravo Lower Rio Grande/Bravo	Rio Grande JV Chihuahuan Desert BCR	Desert	Trans Pecos – Rio Grande (1)	Western Range and Irrigated Region: *Southern Desertic Basins, Plains and Mountains (42)* Western Great Plains Range and Irrigated Region: *Central New Mexico Highlands (70C)* Central Great Plains Winter Wheat and Range Region: *Southern High Plains Southwest (77D)* Southwest Plateaus and Plains Range and Cotton Region: *Edwards Plateau Western Part (81A), Southern Edwards Plateau (*81D*), Western Rio Grande Plain (83B)*	Trans Pecos

Figure 1. Ecoregions with County Boundaries

Chihuahuan Deserts in brown, Arizona – New Mexico Mountains in yellow

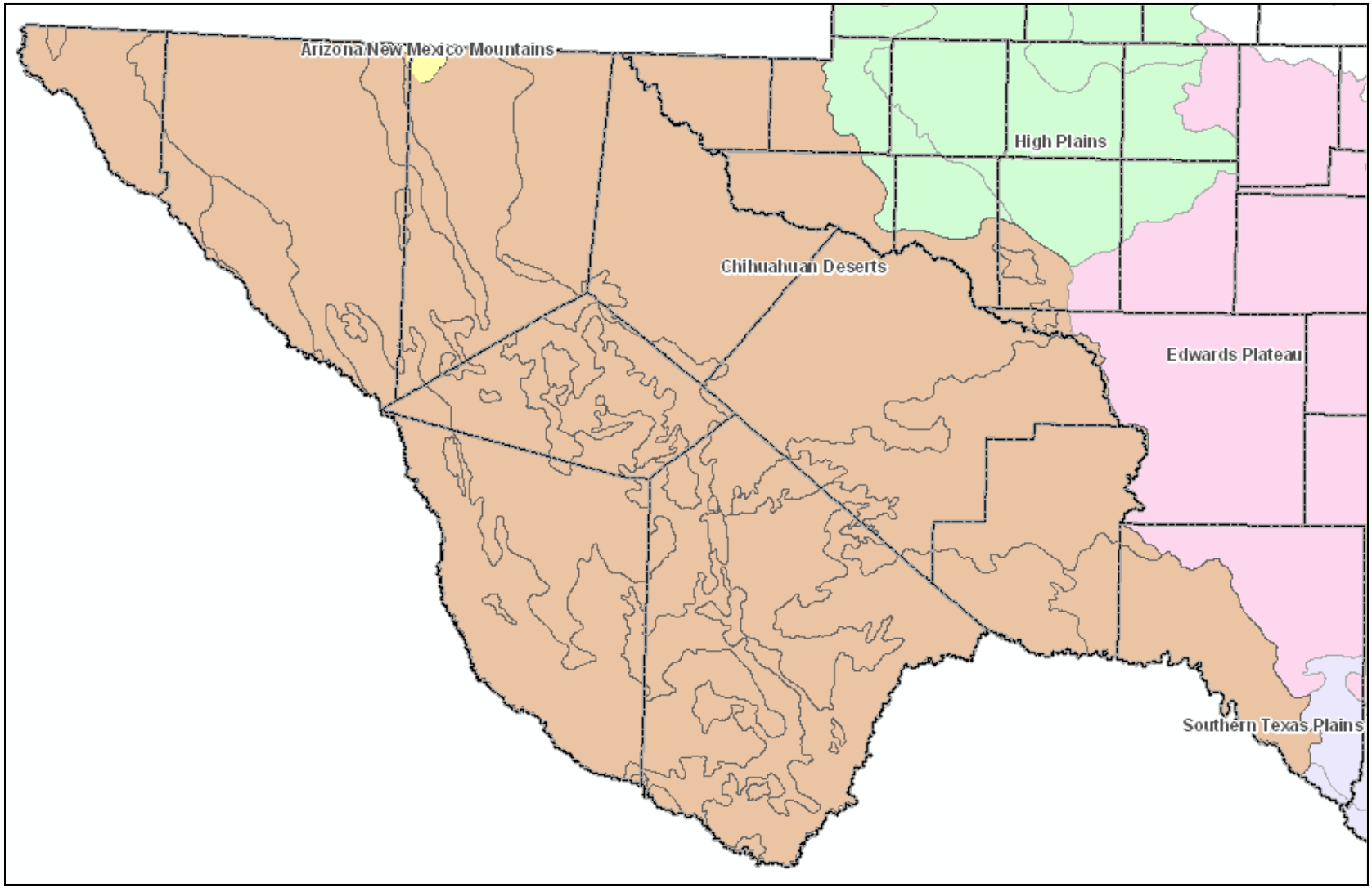


Table 2. AZNM EDUs with Ecologically Signifcant Stream Segments and Reservoirs

ECOLOGICAL DRAINAGE UNIT SubBasin (HUC 8)	*Ecologically Significant Stream Segment TPWD 2002, w/updates 2005*	**Lakes and Reservoirs**
LOWER PECOS		
Upper Pecos - Black	na	na
Delaware	na	na
MIDDLE RIO GRANDE/BRAVO		
Salt Basin	na	na

Note: there are significant aquatic resources in this ecoregion and they are discussed in the Priority Habitats section. This table simply indicates that there are no segments identified in the TPWD 2002/2005 ESSS process for this ecoregion, primarily because most of the region lies within the boundaries of the Guadalupe Mountains National Park.

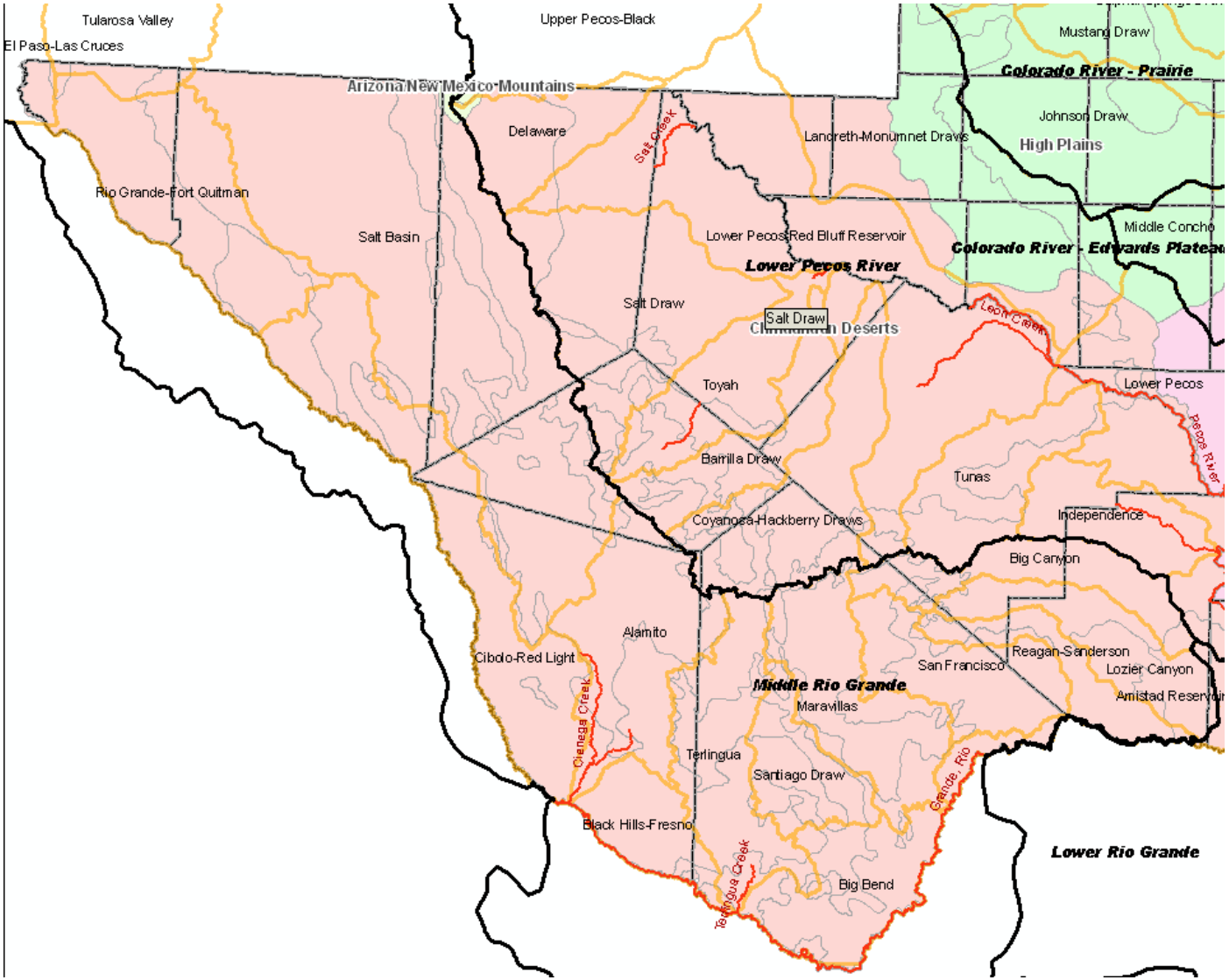
Table 3. CHIH EDUs with Ecologically Significant Stream Segments and Reservoirs

ECOLOGICAL DRAINAGE UNIT SubBasin (HUC 8)	*Ecologically Significant Stream Segment TPWD 2002, w/updates 2005*	Lakes and Reservoirs
LOWER PECOS		
Upper Pecos - Black		
Delaware		
Lower Pecos	Pecos River	
Lower Pecos - Red Bluff Reservoir	Salt Creek, Leon Creek, Comanche Creek	Red Bluff Reservoir
Salt Draw		
Toyah	Toyah Creek, Madera Canyon	Lake Balmorhea
Barilla		
Coyanosa - Hackberry Draws		
Tunas		
Independence Creek	Independence Creek	
Howard Draw	Pecos River	
Landreth-Monument Draws		
MIDDLE RIO GRANDE/BRAVO		
Salt Basin		
El Paso - Las Cruces		
Tularosa Valley		
Rio Grande - Fort Quitman		
Cibolo - Red Light		
Alamito	Cienega Creek, Alamito Creek, Rio Grande/Bravo	
Terlingua	Rio Grande/Bravo	
Blackhills - Fresno	Rio Grande/Bravo	
Santiago		
Big Bend	Terlingua Creek, Rio Grande/Bravo	
Maravillas	Rio Grande/Bravo	
San Francisco		
Reagan - Sanderson	Rio Grande/Bravo	
Lozier Canyon		
Big Canyon		
LOWER RIO GRANDE/BRAVO		
Amistad Reservoir		Amistad Reservoir
Lower Devils		Amistad Reservoir

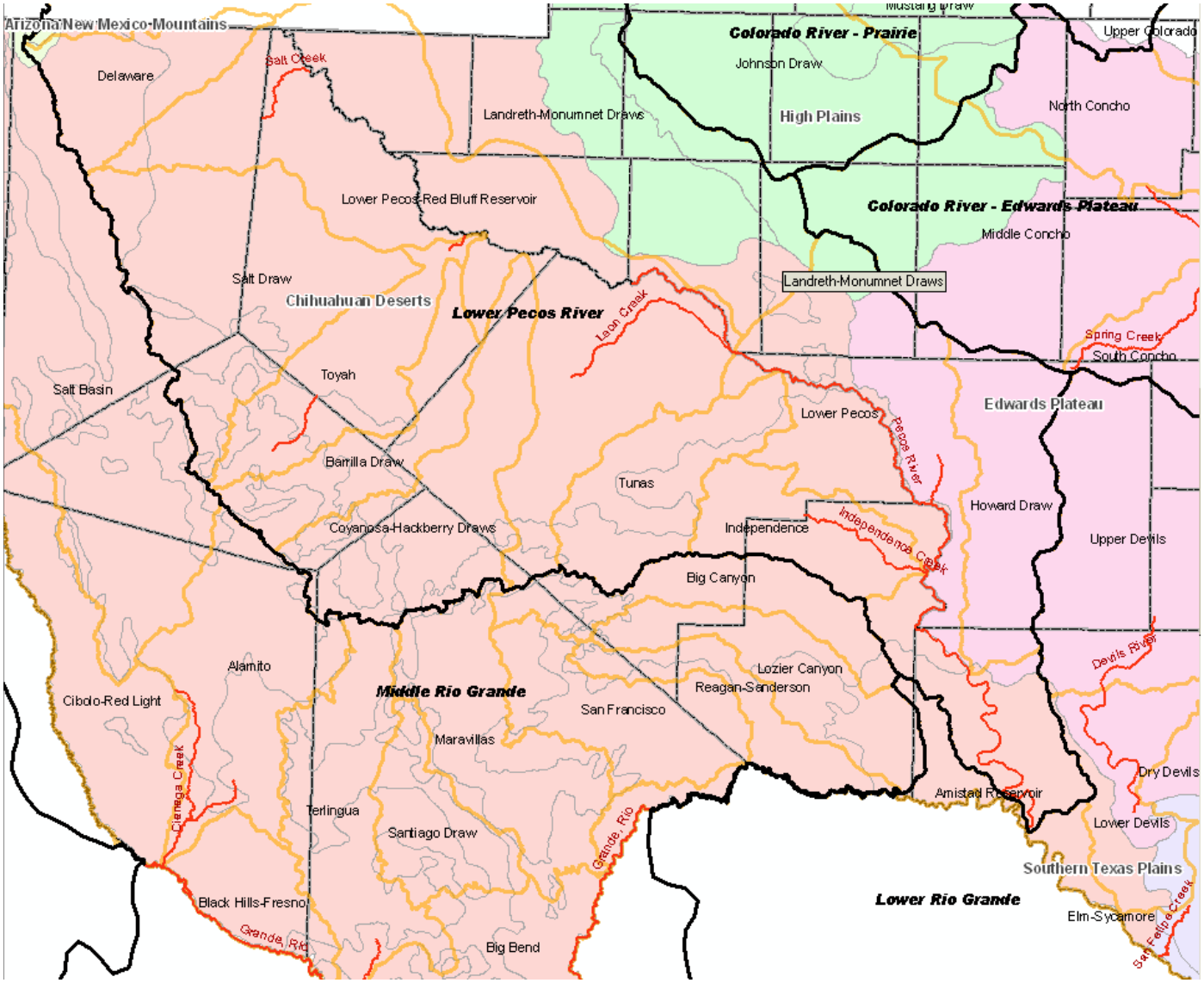
Note: Ecologically Significant Stream Segments and Reservoirs which occur in the Subbasin (HUC 8) but not in the ECOREGION are not included in this table.

Figure 2. EDUs, HUC 8s, and ESSS

Middle Rio Grande EDU boundary in black, HUC 8 boundaries in orange, ESSS in red



Lower Pecos, Lower Rio Grande EDU boundary in black, HUC 8 boundaries in orange, ESSS in red



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

CHIH – AZNM 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.[6] 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.[7]

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.[8] Each species has a NatureServe calculated state and global conservation rank, which accounts for abundance, stability and threats.[9] Additionally, several species have federal[10] and/or state[11] listing (endangered, threatened, candidate) status. See the key to conservation status and listing ranks[12] 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 IN THE CHIH-AZNM

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

[6] Association of Fish and Wildlife Agencies. 2011. State Wildlife Action Plans. http://www.wildlifeactionplans.org/
[7] TPWD. 2012. Texas Conservation Action Plan: Overview Handbook. http://www.tpwd.state.tx.us/landwater/land/tcap/documents/tcap_draft_overview.pdf
[8] 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
[9] NatureServe. 2011. A network connecting science and conservation (online resources). http://www.natureserve.org/explorer (accessed 2011).
[10] USFWS. 2011. Endangered Species List, by state and county. http://www.fws.gov/southwest/es/EndangeredSpecies/lists/ListSpecies.cfm (accessed 2011).
[11] TPWD. 2011. State Listed Species. http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species (accessed 2011)
[12] 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.[13]

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*.[14]

Priority habitats in these ecoregions which support SGCN were identified through workshops, surveys and other ecologists' and/or literature and are listed in Tables 4 and 5.

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

[14] 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 4. AZNM Priority HabitatsTable

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

GENERAL HABITAT TYPES	ARIZONA - NEW MEXICO MOUNTAINS (AZNM)	AZNM Ecological Systems
NATURAL AND SEMI-NATURAL TYPES	*Habitats in this column were identified in the workshop; additions were made by editor to riverine and cultural aquatic*	*NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications for Ecological Systems of Texas' Arizona / New Mexico (Guadalupe) Mountains. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 08 October 2009.*
Barren/Sparse Vegetation	igneous cliff and rock outcrops salt flats/Pleistocene "lake" southwest of Guadalupe Mountains National Park	North American Warm Desert Bedrock Cliff and Outcrop North American Warm Desert Pavement North American Warm Desert Volcanic Rockland Rocky Mountain Cliff, Canyon and Massive Bedrock
Grassland	Montane grasslands Plains shortgrass grasslands	Apacherian-Chihuahuan Semi-Desert Grassland and Steppe Chihuahuan Loamy Plains Desert Grassland Chihuahuan Sandy Plains Semi-Desert Grassland Southern Rocky Mountain Montane-Subalpine Grassland
Shrubland	Shrub-steppe mosaic Montane foothill shrublands	Madrean Oriental Chaparral Rocky Mountain Lower Montane-Foothill Shrubland
Savanna/Open Woodland	Ponderosa pine woodlands Woody mottes punctuating open grasslands in swales and drainages	Madrean Juniper Savanna Southern Rocky Mountain Ponderosa Pine Savanna
Woodland	Mixed oak – pine and oak – juniper woodlands	Madrean Encinal Southern Rocky Mountain Pinyon-Juniper Woodland Southern Rocky Mountain Ponderosa Pine Woodland
Forest *See also* Riparian *and* Wetlands	closed canopy pine forests	Madrean Lower Montane Pine-Oak Forest and Woodland Rocky Mountain Aspen Forest and Woodland
Riparian	periodically flooded or subirrigated floodplains, tributary ravines and creekside vegetation in McKittrick Canyon, Guadalupe Arroyo	Rocky Mountain Bigtooth Maple Ravine Woodland North American Warm Desert Lower Montane Riparian Woodland and Shrubland (woody wetland) North American Warm Desert Riparian Mesquite Bosque North American Warm Desert Riparian Woodland and Shrubland

GENERAL HABITAT TYPES	ARIZONA - NEW MEXICO MOUNTAINS (AZNM)	AZNM Ecological Systems
Riverine	Instream habitats of the Upper Pecos - Black, Delaware, and Salt Basin watersheds which intersect this ecoregion	NA
Freshwater Wetland	springs, seeps swale depression wetlands	Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (mixed upland and wetland)
Saltwater Wetland		Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (mixed upland and wetland)
Aquifer		NA
Caves/Karst	Crevices and cliff sites	NA
CULTURAL TYPES	*None noted for this ecoregion*	
ARTIFICIAL REFUGIA	*None noted for this ecoregion*	

Table 5. CHIH Priority Habitats

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

GENERAL HABITAT TYPES	CHIHUAHUAN DESERTS (CHIH)	CHIH Ecological Systems
NATURAL AND SEMI-NATURAL TYPES	*Habitats in this column were identified in the workshop and Core Ecoregion Team Survey April 2011; additions were made by editor to riverine and cultural aquatic*	*NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications for Ecological Systems of Texas' Chihuahuan Deserts. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 08 October 2009.*
Barren/Sparse Vegetation	Aspect-dependent cliff faces, talus slopes, sky islands, arroyos and rock-dominated canyons Dunes Special geologic and soil-dependent habitats: gypsum, Caballos novaculite, bentonite flats, saline evaporative basins Barren ground within the semi-arid grassland matrix (e.g. prairie dog towns) - see also Grassland	North American Warm Desert Active and Stabilized Dune North American Warm Desert Badland North American Warm Desert Bedrock Cliff and Outcrop North American Warm Desert Pavement North American Warm Desert Playa North American Warm Desert Volcanic Rockland Rocky Mountain Cliff, Canyon and Massive Bedrock
Desert Scrub	No habitats were identified in this category by plan participants; however, there are several rare plants, embedded wetland communities, and wide-ranging SGCNmammals which could be dependent on these habitat types – more data is needed – see Conservation Actions information section.	Apacherian-Chihuahuan Mesquite Upland Scrub Chihuahuan Creosotebush Desert Scrub Chihuahuan Mixed Desert and Thornscrub Chihuahuan Mixed Salt Desert Scrub Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub Chihuahuan Succulent Desert Scrub Tamaulipan Calcareous Thornscrub Tamaulipan Mixed Deciduous Thornscrub
Grassland	Elevation-limited (high and low?) montane grasslands Mesa grasslands (near western Edwards Plateau) Non-montane semi-arid grasslands (tobosa, banded, shortgrass)	Apacherian-Chihuahuan Semi-Desert Grassland and Steppe Chihuahuan Gypsophilous Grassland and Steppe Chihuahuan Loamy Plains Desert Grassland Chihuahuan Sandy Plains Semi-Desert Grassland Southern Rocky Mountain Montane-Subalpine Grassland Western Great Plains Shortgrass Prairie Western Great Plains Tallgrass Prairie

GENERAL HABITAT TYPES	CHIHUAHUAN DESERTS (CHIH)	CHIH Ecological Systems
Shrubland	Arroyo canyon shrubland Sky Island foothill slope shrublands	Edwards Plateau Limestone Shrubland Madrean Oriental Chaparral Rocky Mountain Gambel Oak-Mixed Montane Shrubland Rocky Mountain Lower Montane-Foothill Shrubland
Savanna/Open Woodland	Tree "islands" (mottes) within grasslands-mosaic	Madrean Juniper Savanna Southern Rocky Mountain Ponderosa Pine Savanna
Woodland	Montane woodlands Canyon woodlands (both generally dominated by conifer species but also include hardwoods)	Madrean Encinal Madrean Lower Montane Pine-Oak Forest and Woodland Madrean Pinyon-Juniper Woodland Rocky Mountain Aspen Forest and Woodland Rocky Mountain Bigtooth Maple Ravine Woodland Southern Rocky Mountain Pinyon-Juniper Woodland Southern Rocky Mountain Ponderosa Pine Woodland
Forest *See also* Riparian *and* Wetlands	Montane forests Canyon forests (both generally dominated by conifer species but also include hardwoods)	(see forest – woodland referenced above)
Riparian	periodically flooded or subirrigated floodplain shrublands, woodlands (mesquite, plateau live oak mottes) and gallery forests (cottonwood, sycamore, ...) associated with the Lower Pecos River and tributaries, Rio Grande and tributaries ephemerally flooded and/or subirrigated arroyos	North American Warm Desert Lower Montane Riparian Woodland and Shrubland North American Warm Desert Riparian Mesquite Bosque North American Warm Desert Riparian Woodland and Shrubland North American Warm Desert Wash Western Great Plains Riparian (mixed upland and wetland)

GENERAL HABITAT TYPES	CHIHUAHUAN DESERTS (CHIH)	CHIH Ecological Systems
Riverine	Ecologically Significant Stream Segments: Salt Creek, Leon Creek, Comanche Creek, Toyah Creek, Madera Canyon, Independence Creek, Cienega Creek, Alamito Creek, Terlingua Creek, Lower Canyons of Pecos (Iraan to Amistad R), Rio Grande/Rio Bravo from Rio Conchos (near Presidio) to Amistad Reservoir (Del Rio) Other important creeks and reaches: Maravillas Creek, Little and Big Aguja creeks, Cherry Creek, McKittrick Creek, Screwbean Draw (Salt Creek trib), Limpia Creek *Editor's Note: two additional creeks were mentioned in the Survey - Pinto Creek and Live Oak Creek; however, these occur in the South Texas Plains ecoregion and are addressed in that handbook. Devils River is typically associated with CHIH systems and conservation actions in that watershed may need to be coordinated among three ecoregions: CHIH, South Texas Plains (STPL), and Edwards Plateau (EDPT)*	NA
Lacustrine *See also* Cultural Aquatic	Lake Balmorhea	NA
Freshwater Wetland	Natural freshwater springs, cienegas (e.g. Balmorhea Springs) horizontal and vertical seeps along rivers and tributaries Interdunal wetlands Tinajas Oxbows	North American Arid West Emergent Marsh North American Warm Desert Cienega North American Warm Desert Interdunal Swale Wetland Western Great Plains Closed Depression Wetland Western Great Plains Open Freshwater Depression Wetland Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (mixed upland and wetland)

GENERAL HABITAT TYPES	CHIHUAHUAN DESERTS (CHIH)	CHIH Ecological Systems
Saltwater Wetland	Saline springs and seeps, cienegas (e.g. Diamond Y Springs) Saline evaporative basins (Salt flats, Toyah Lake, Pecos Plain salt basins, "salinas")	Western Great Plains Saline Depression Wetland North American Arid West Emergent Marsh North American Warm Desert Cienega North American Warm Desert Interdunal Swale Wetland Western Great Plains Closed Depression Wetland Western Great Plains Open Freshwater Depression Wetland Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (mixed upland and wetland)
Estuary/Estuarine	While no estuaries occur in the CHIH, water quantity and quality in the region contribute to the Rio Grande/Rio Bravo, into (and potentially through) Amistad and Falcon Reservoirs, to the southernmost portions of Laguna Madre (instream flows important)	NA
Aquifer	western Edwards-Trinity aquifer Aquifer feeding Balmorhea Springs complex	NA
Caves/Karst	Caves, sinkholes, grottos, and pseudokarst	NA
CULTURAL TYPES	*habitats in this section must support SGCN or rare communities to be considered in this plan*	
Agricultural	Farm fields and tilled/fallow croplands	NA
Urban, Suburban, Rural	Abandoned barns, structures, small storage facilities	NA
Industrial		NA
Rights of Way	Bridges, overpasses	NA
Cultural Aquatic	Reservoirs: Imperial Reservoir, upper reaches of Amistad on the Pecos, Red Bluff Maintained (“permanent”) windmill or pump-filled stockponds Waste-water wetlands (e.g. Presidio) Shrimp-farm ponds	NA

GENERAL HABITAT TYPES	CHIHUAHUAN DESERTS (CHIH)	CHIH Ecological Systems
ARTIFICIAL REFUGIA		
created wetlands to replace wetlands lost specifically for rare species recovery/persistence	reconstructed cienega	NA

SHARED HABITAT PRIORITIES WITH ADJACENT STATES AND MEXICO

Texas shares its border with four states – New Mexico, Oklahoma, Arkansas, and Louisiana – and Mexico. Migratory bird species use Texas as a critical link in their pathways to points as far north as Canada and far south as Central America. The CHIH-AZNM ecoregion shares a portion of its border with New Mexico and Mexico, and provides important stopover and breeding habitat for several migratory species.

Table 6 identifies habitat priorities which *have been identified in the New Mexico Wildlife Action Plan (link to their plan in the table) and also identified CHIH-AZNM Ecoregions.* Every adjacent state's Action Plan mentions the importance of **intact native riparian zones** and **floodplains**, **high quality instream habitats**, **wetlands** of all types, and **native grasslands**. These habitat types are also found in the CHIH-AZNM and are priorities for conservation in this ecoregion. See Statewide/Multi-region handbook for broadscale Conservation Actions for these priorities.

From 1999 to the present, the North American Bird Conservation Initiative (NABCI) (a working group of government and non-government organizations in Canada, the United States, and Mexico) hasworked to identify shared priority bird species on the continent, promote recognition of these priorities through the *Declaration of Intent for the Conservation of North American Birds and their Habitat* (signed 2005), and develop Continentally Important Proposals for conservation of shared priority species.[15] Several of these proposals intersect the CHIH and AZNM ecoregions (and are more fully discussed in the Action section of this document). While these proposals focus on priority areas for birds, these conservation actions would benefit a suite of related species as well. Habitats of special importance in this ecoregion from that effort include Chihuahuan Desert grasslands, wetlands, and some important oak habitats in Mexico which would benefit U.S. SGCN in this ecroregion.

Table 6. Shared Habitat Priorities with Adjacent State – New Mexico

Adjacent States	Ecoregions Shared with Texas	Habitat Priorities Shared with Texas *(Action Plans and the National Fish Habitat Action Plan viewer online)*
New Mexico (NM)[16]	Arizona – New Mexico Mountains Chihuahuan Desert High Plains	semi-desert grasslands and scrub/shrublands shortgrass prairie ephemeral and perennial tributaries and mainstem of the Pecos, Rio Grande/Rio Bravo, and Brazos Rivers, and associated riparian zones and floodplains springs and seeps wetlands playas TX – NM HUC 8 watersheds are all mapped at low to very low risk (although those near El Paso are mapped at high to very high risk at finer HUC 12 scale)[17]

[15] North American Bird Conservation Initiative. N.d. Continentally Important Proposals: An Introduction.

[16] New Mexico Department of Game and Fish. 2005. Comprehensive Wildlife Conservation Strategy. http://fws-nmcfwru.nmsu.edu/cwcs/New_Mexico_CWCS.htm

[17] NBII and USGS. 2011. National Fish Habitat Risk Assessment Viewer. http://www.nbii.gov/far/nfhap/

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 CHIH-AZNM Ecoregion Handbook in Table 7 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 7. Issues Affecting Conservation in the CHIH - AZNM Ecoregions

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
Invasive Species		
Non-native Plant	Salt cedar/tamarisk (*Tamarix spp*.) Cultivated and Old World grasses (e.g. Lehmann's lovegrass, King Ranch (KR) bluestem, Bermuda grass) Giant reed/river cane (*Arundo donax*) golden alga (see also *Native Problematic Species*; it is not conclusively known whether golden alga is native or non-native)	Salt cedar affects water use, monotypic stands, and outcompetes native riparian vegetation (cottonwood, sycamore) at all seral stages and canopy levels; salt cedar and *Arundo* line the banks of the Rio Grande in the Big Bend reach, armoring the banks and contributing significantly to channel incision and narrowing, which reduces the diversity and quality of habitat for aquatic species Non-native grasses either as improved pastures or naturally expansive have established in many Trans-Pecos grasslands, are a substantial threat to grassland-dependent species (e.g. grassland-obligate birds and pronghorn) 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 Toxic algal blooms in Lake Balmorhea may adversely impact Comanche Springs pupfish; also known in Pecos River
Non-native Animal	feral and/or free-ranging "pets" FERAL HOGS Introduced ungulates for hunting introduced fishes and mollusks - freshwater springs, streams and marshes	Free ranging pets are introduced predators which adversely affect small mammals, small reptiles, and birds; also contribute pathogens and diseases Feral hogs also decimate important and fragile habitats (e.g. springs, seeps, riparian areas, swale depressional wetlands), degrade instream water quality, and decrease hardwood seedling viability (rooted up, eaten) Aoudad alter and destroy habitat, compete with native small mammals and ungulates for food, and are disease vectors which can affect native ungulates and domestic livestock Within streams, nonnative species compete with natives, and are a predation risk (e.g. small mouth bass are voracious non-native predators) Bait fish releases (“minnows”) can cause problematic congeneric hybridization (e.g. *Gambusia* sp.)
Native Problematic	Native shrub (e.g. redberry juniper, creosote, tarbrush, mesquite, whitebrush) or "brush" encroachment into grassland systems Mesquite has displaced grasslands especially in areas with subsurface moisture Golden alga (see also *Non-native Invasive Species*; it is not conclusively known whether golden alga is native or non-native)	Invasive native brush/trees are a significant threat to grassland-obligate birds as well as pronghorn: 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; brush "spooks" pronghorn who need vast open spaces to feel safe from predators and brush-degraded grasslands are no longer suitable for pronghorn foraging. May reduce recharge in some areas. Toxic blooms in Lake Balmorhea may adversely impact Comanche Springs pupfish; also known in Pecos River
Pests, Parasites, Pathogens		
Pests	Pine bark beetle Cactus moth (*Cactoblastis cactorum*)	Pine bark beetle *Cactoblastis cactorum* has been used a biological control for prickly pears (*Opuntia* 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.
Parasites	*Haemonchus*	pronghorn populations devastated by this parasite; thought to be a major contributing factor to the pronghorn decline across the Trans-Pecos.
Pathogens	White-nose Syndrome (WNS)	WNS affects hibernating bats and is spread through human (we think) and bat vectors, through cave visitation. Mortality is high; prevention and overall cause is unknown.
Power Development and Transmission		
Wind Generation	See also full discussion in Statewide Handbook Competitive Renewable Energy Zones (CREZ): McCamey High ridges in west Texas highly desired dense sitings (wind "farms") Turbine operations	High ridges typically intersect raptor migration corridors (impacts to Golden Eagle, Ferruginous Hawk, Swainson's Hawk) network of maintenance and access roads typically impacts vegetation communities that occur on these ridges - grasslands, shrublands -- which causes habitat loss and contributes to invasive species deep footings may impact karst in certain areas; migratory birds and bats adversely affected through barotrauma and direct collision barotrauma in bats and birds disrupts breeding or feeding behaviors through noise or large presence on a normally open, uninterrupted landscape (pronghorn, grassland birds)

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
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)	There are no known reservoirs for hydroelectric generation in this area, flood control and water source creation are issue	*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) Algae "farms": High amounts of water used/processed, untreated or minimally treated wastewater discharges, site conversion	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 Lowlying area and "flats" habitat loss from conversion to farming operation, groundwater pumping which contributes to lowered or drying of springs and spring-dependent aquatic systems, wastewater discharges can create unhealthy to intolerable water chemistry for SGCN
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 TX loads maintenance and operations maintaining clear right-of-way for vehicle clearance/access, prevention of line and tower danger	directly takes habitat and species during construction (loss), degrades adjacent habitat (fragmentation), and may hinder movement (daily or seasonal)
Distribution	Development to power grid and retail users: construction of new power infrastructure corridors to meet urban user needs	mowing, trimming (permanent fragmentation, erosion) herbicide application directly takes habitat and species during construction (loss), degrades adjacent habitat (fragmentation), and may hinder movement (daily or seasonal)
Oil and Natural Gas Production and Delivery		
Seismic exploration	surface and subsurface impacts - linear networked vegetation clearing and soil disturbance, vibration and "explosive" disturbance	habitat loss and fragmentation in arid lands that do not recover quickly vector for invasive species (plant) inntroductions from equipment and opportunistic colonization in wake of habitat clearing and no reclamation disruption of daily and seasonal activities for fossorial animals (small mammals, reptiles, ground-foraging and ground-nesting birds)
Traditional extraction site development and operation, including pumping and pad sites, gathering stations, transmission/delivery facilities (distribution lines, roadway	Permian Basin and Marfa Basin production fields on-site spill potential salt water injection wells road networks	limited ground and surface waters (cienegas, swale wetlands, others) highly sensitive to change/contamination are at risk from chemical, drilling material, and oil spills and groundwater contamination caused by salt water injection Extraction operations cause clearing, road networks, pad sites, and large mechanical infrastructure(s) which contribute to direct habitat loss, direct and indirect habitat fragmentation, direct mortality from vehicles and operations, and noise/light disturbance (e.g. sand dunes west of Odessa, dunes sagebrush lizard affected by these operations and road mortality; nocturnal birds and bats can be adversely impacted by the light and noise pollution; road networks, constant traffic and noise, and mechanical infrastructure interrupts seasonal and daily movements, foraging and mating behaviors of some mammals, reptiles, and birds; small geographically limited populations of desert plants fragmented or lost).
Hydraulic fracturing ("fracking") or "shale gas" extraction	http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm Barnett-Woodford and Avalon-Bone Spring shale plays Deeply injected chemical liquid which fractures substrates and releases gas for capture and delivery: potential groundwater risks, potential chemical spill risks, geologic destabilization	Groundwater and its surface expression in seeps, springs and cienegas are extremely important habitats in this ecoregion (e.g. several invertebrates, pupfish, minnows, puzzle sunflower); groundwater contamination could cause total loss of isolated aquatic populations, adversely affect vegetation that depends on water quantity and quality at springheads, seeps, riparian areas, and instream. Contamination also poses a risk to human and livestock water sources. Fracturing activities may also adversely affect the recharge capacity of porous rock layers and networked karst features.
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 soil type or vegetation; invasive species allowed to colonize or are directly planted for soil stabilization
Mining		
Sand and Gravel - upland and riverine	sand and gravel mining along and within streams and rivers	loss of riparian habitats for instream and adjacent mining, sedimentation in streams contributes to loss and degradation of instream habitats

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
Caliche	caliche - small scale on ranches, large scale for county roads	typically for road base, unreclained sites, complete/permanent loss of surface communities
Geographically isolated minerals	Bentonite, Gypsum	Terlingua Creek area mining of bentonite, limestone and/or gypsum on the Fizzle Flat lentil may adversely affect the Terlingua Creek cat's-eye, an edemic endangered plant.
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 noctural migrants including Yellow-billed Cuckoo, Painted Bunting, Summer Tanager, and other species. In rare instances kills totalling thousands of Longspurs have been found around towers.
Transportation		
road and bridge construction (new)	construction of new commercial transportation infrastructure corridors (NAFTA)	directly takes habitat and species during construction (loss), degrades adjacent habitat (fragmentation), and may hinder movement (daily or seasonal)
right of way maintenance	maintaining clear right-of-way for vehicle clearance/access, minimizing fire danger, and maintaining driver visibility	mowing, trimming (permanent fragmentation, erosion) herbicide application some rare plants are known only from sites in ROW; these are not always adequately protected as staff changes occur, management plans are filed away, information not passed through entire chain of command - needs better communication in some places
Border Protection		
	Border Fence	Barrier to daily and seasonal movements of mammals (including large mammals that need vast roaming home ranges such as black bear), reptiles, and some birds; can create a barrier to genetic diversity and fragment larger stable populations into smaller unstable populations Creates artificial roosting and resting perches for raptors, which prey on animals near the fence preferentially Removes, fragments and restricts riparian breeding habitats for several bird species: Summer Tanager, Yellow-billed Cuckoo, Gray Hawk, Common Black Hawk
	Roadways and Levees	Roadway networks, drag line networks, and levees form barriers to daily and seasonal movements for small mammals, reptiles, and some fossorial insects which cannot surmount the obstacle or avoid daily traffic; these open corridors also fragment habitat for many thick brush-dependent species and provide edge advantages for predators.
	Grading, Dragging	Clearing adjacent to and to a certain distance from the Border Fence and in sections without fencing for security observations also creates a soil erosion, vegetation loss, and water quality issue in the Rio Grande/Rio Bravo affecting several endemic and locally rare species
Land & Water Mgmt: FARM	See also Water Development section	
Lack of soil and water management and conservation practices	chemical-laden irrigation water runoff	adverse impacts to sensitive aquatic insects and other invertebrates, fishes, and amphibians
Unsustainable irrigation	Water from Lake Balmmorhea is used for irrigation Timing of water draw downs do not account for fish and wildlife needs Water-intensive and hydroponic crops grown in the most arid region least able to recover groundwater or surface water resources at the same rate they are being used See also *Groundwater Planning and Distribution*	Fluctuations in lake level can affect fish spawning and health by exposure to higher water temperature and lower dissolved oxygen
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)	Stocking practices need to be related to a balanced carrying capacity for livestock and wildlife guided by the best range science and wildlife management combined can offer; these stocking rates need to be translated for tax appraisal district use and promotion. Stocking non-native ungulates competes with not only native ungulates (deer, pronghorn), but also damages habitats for shrubland and grassland

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
	historic and/or current range-intensive livestock operations out of sync with land capacity non-native hoofstock for hunting operations	dependent birds, reptiles and insects on the SGCN list Grassland birds affected: Baird's Sparrow, Long-billed Curlew, Eastern Meadowlark, and Cassin's Sparrows
Landowner/land management incentive programs working at cross-purposes	single-objective management such as all-game, all-livestock, all-recreation Incentive programs, technical guidance, and management assistance is not always consolidated with conservation provider options (the "menu" is pre-limited for the landowner, depending on who they contact first) Landowners do not have a one-stop shop to choose best management practices for their site, for their goals	single species or single habitat management (e.g. grasslands instead of mosaic and patchy habitat values, productivity vs. diversity) Use of nonnative species in grassland restoration and farm assistance programs is counterproductive to wildlife habitat restoration and management and limits the landowner's options to optimize their use of multiple incentive programs from various sources
Fencing	netwire fencing high game fencing	Netwire fencing and most "game" fencing fragments pronghorn daily and seasonal movements, restricts their access to water and food, and increases their vulnerability to predation; their movements are interrupted by fences under which they cannot crawl (they do not jump fences). Issue causes lack of genetic diversity through inbreeding, lack of dispersal into available appropriate habitats (which means that role is unfulfilled or filled by ... instead in the system), and potentially concentrates pathogens High game fencing also adversely impacts many species of native game and non-game wildlife through genetic isolation, disease concentration, and intensive management requirements which can place a heavy fiscal burden and responsibility on the landowner to manage the public wildlife resource
Clearing and loss of important natural sites/habitats	Springs, swales altered for stock uses, domestic use	Loss of natural spring and swale habitats for aquatic and grassland species, changes vegetation community in these areas
Lack of soil management and conservation practices	inappropriate herbicide application (Spike) lack of soil conservation (vegetation conservation/restortaion) along stream courses and on grazing lands, soil erosion	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
Land ownership conversion to more urban landowners and subdivision of larger lands into smaller parcels ("ranchettes")	Intergenerational ownership changes in values and the sale of lands to non-traditional landowners (not rural or working land families, less interested in livestock production) for recreational retreats, retirement land	Land ownership changes and larger levels of subdivision are not inherently bad as these changes can create a conservation value shift which can benefit fish and wildlife resources; however, in this ecoregion, larger ranches and landscapes are generally well-managed and provide greater opportunities to concentrate landowner incentives on habitat conservation practices. Some of the detriments to SGCN and their habitats resulting from small parcel land subdivision and more intensive development than has been historically seen in this region is the loss of habitat to housing development, nonnative landscaping, and clearing in sensitive areas (need better creek setbacks and stormwater pollution/erosion prevention near creekways; loss of rare plant populations and communities), feral animal releases/mismanagement, and unregulated septic systems and wells
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)	The lack of fire and excessive grazing during drought has resulted in mesquite and cresotebush encroachment of desert grasslands. This increase in brush species and reduction in grasses may reduce recharge in certain areas from uplands into local aquifers and riparian habitats, further accentuating a reduction in surface water. .
Land & Water Mgmt: Municipal	See also Water Development section	
Lack of Zoning and Planning	Planning efforts are minimal, rarely regional	Water: Outlying areas and rural areas with water are targeted to supply municipal needs in other basins Land: Urban sprawl and little regulation on development type contributes to arid land habitat loss of many types (montane grasslands, lowland grasslands, desert shrublands), impervious cover and runoff (degradation of water quality) Continued urban expansion around El Paso (and Midland/Odessa, in the HIPL) have potential to effect prairie dogs, mountain plover, and other SGCN
Land & Water Mgmt: Conservation & Recreation		
Inadequate Management	managing wildfire (more Rx burning needed to reduce the risk of wildfires)	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 the case in Summer 2011). 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).

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
Inappropriate Recreational Uses	ORV use in sensitive areas (stream beds, dunes on private sites)	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.
Not all "public" or "managed" lands are "conservation" lands	Whle most public lands in this region are managed for recreation compatible with wildlife and fisheries resources, some improvements could be made to trails and recreation facilities to prevent soil erosion, vegetation loss	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 the arid conditions in this ecoregion.
Lack of connectivity between public lands managed for conservation	A great deal has been done in the last 20 years to network international sites (*parques*) with Big Bend National Park, and to connect BBNP with Big Bend Ranch State Park, TNC preserves, and TPWD Wildlife Management Areas; however there are some disconnected landscapes and resources in other areas of the region which need attention to enhance ecological function	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. Needs more focus beyond the BBRSP, BBNP complex throughout the ecoregion.
Water Development, Management and Distribution	SEE ALSO STATEWIDE HANDBOOK	
Surface Water Planning	Natural resources not well-defined or required as a "constraint" in Regional Water Planning (RWP) processes; natural resource professionals are not consistently involved in RWP processes Large municipalities' demands are the primary driving force in surface and groundwater planning Overallocation and dewatering of region's principle rivers New water line construction not considered in planning or operational impacts/costs to resources Although the Trans-Pecos is not experiencing the sprawling urban/suburban growth that many other areas of Texas are, water is a scarce and precious resource. Groundwater withdrawals and surface water diversions deplete the amount of water available for wildlife.	Both surface water and groundwater use for agriculture and municipalities in the U.S. and Mexico (Rio Conchos) has reduced the amount of water present in rivers, creeks, and springs. Altered flooding regime (timing, periodicity, amounts) in the Rio Grande/Rio Bravo and its tributaries due to upstream withdrawals and impoundments on even small second and third order tributaries, all of which adversely affects flood-dependent riparian and aquatic systems Lack of consideration/coordination with groundwater planning in this ecoregion during surface water planning processes – most of the permanent water in this ecoregion is groundwater-sourced (springfed) See also other sections: Other Water Source Developments and Technologies: Interbasin Transfers Reservoir Construction and Operation Groundwater Planning and Distribution
Reservoir Construction and Operation	Timing/Periodicity/Intensity of Water Releases releases are unnaturally intense and short duration in the "wrong" season to mimic natural flooding processes; Rio Grande/Bravo and Pecos River	Unnatural hydrograph scours instream and stream-adjacent habitats, shifts vegetation communities out of sync with other riparian communities where flooding is more "natural", vegetation communities and instream animal (invert, fishes, etc.) cannot "rely" on the seasonal changes under which they evolved.
Groundwater Planning and Distribution	Not all aquifers have groundwater districts; groundwater districts are political subdivisions, not aligned necessarily with aquifer boundaries Extraction: groundwater pumping without full accounting for natural resources as a "use"	Inconsistency in districting across the landscape creates conflict and natural resources do not fare well; also, groundwater planning processes do not coordinate well with surface water planning processes Physical changes to karst, springs, cienegas (water amount and quality) adversely impact some species' thresholds for survival and/or sustainable life history (reproduction, foraging, resting) Subirrigated and instream aquatic habitats which rely on springflow through decreased 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 water conditions such as temperature, oxygen availability, and other nutrient and chemical factors (such as the age of water source that comes from the aquifer) Decreased and degraded aquifer recharge capacity ("drying out the sponge or seive" at certain levels within the aquifer can affect the flow quantity and quality into the aquifer from recharge events)
Other Water Source Developments and Technologies	Interbasin Transfers (Surface and Groundwater) Municipal demands on water and potential for well field development for commercial export out of the region or to the largest municipalities	This is a key issue in this ecoregion; however, it is a statewide issue and addressed in the Statewide/Multiregion Handbook
	Desalination and Chloride Removal Operations Proposed desalination plant near Dell City Water Treatment Wetlands: Presidio	may adversely affect sensitive species (e.g. gypsum scalebroom, mountain plover) - appropriate siting, waste discharge, and monitoring will be important to avoid, minimize or mitigate effects
Lack of Information &		

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
Resources		
Lack of Data/Information for Monitoring Progress and Making Conservation Decisions	Lack of Data (amount, type)this tied to "Lack of Processing Existing Data" lack of bird monitoring data for riparian and montane ecosystems Lack of information on the population/distribution/etc on numerous SGCN is a significant problem Climate change models, GIS analysis of land conversion and change overtime, species specific information, community-specific information – see also CLIMATE CHANGE SECTION in Statewide handbook and below	It is possble given the nature of the ownership landscape - large and privately held in west Texas - that populations and communities of conservation need occur on private lands. Lack of access to those sites prevents a complete understanding of just how rare or not rare a species may be, and limits cooperative stewardship and best management practices. Species-specific monitoring needs: all breeding birds of riparian and montane ecosystems, including Montezuma Quail, Common Black-Hawk, Gray Hawk, Yellow-billed Cuckoo, Spotted Owl, Colima Warbler, Summer Tanager; Sprague's pipit and mountain plover; mountain lion movements, effects on natural and ranching resources, population distribution and stability See Climate Change section in Statewide Handbook and below
Perception of Management Needs More Information	Predator control without biological standards or supporting management	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. Predator trapping and/or baiting has an adverse effect on non-target species including black bears and smaller mammals such as hooded skunks, foxes
Lack of Data/Information Synthesis	Lack of Processing *Existing* Data this tied to "Lack of Information (amount, type)	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.
Lack of Best Management Practices	Inadequate understanding of available or widely-accepted conservation Best Management Practices	habitat senescence in areas where natural processes (fire, flood, weather patterns) have been interrupted and not replaced through human intervention or active management
Lack of Targeted Outreach	This portion of Texas, along with other border ecoregions, has a very diverse bilingual or Spanish-speaking population. Conservation outreach messaging and incentives generally have not been crafted to influence and understand Hispanic and Latino/a audiences.	With such a large percentage of the population which also uses and influences the resources not targeted for conservation messaging, effectiveness is highly variable and lower than it could be, especially in border urban areas where Rio Grande/Rio Bravo water quality and quantity, riparian habitats, other water features (resacas, canals, wetlands) and certain brush and grassland communities are very important to SGCN.
Inadequate Policies, Rules, Enforcement		
Poaching, Permitting Avoidance and Violations	insufficient law enforcement for non-game issues	Counties are large and game wardens are few; resources are stretched thin – large landscapes, inaccessible areas, and the complications of border issues (human traffic, legal and illegal) complicate efforts for wildlife and fisheries 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 *Perception of Management Needs More Information* 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 in jeopardy; additionally, the disconnect between surface and ground water management is especially significant in this ecoregion – influencing springs and seeps which are directly connected to SGCN freshwater fishes and invertebrate health.
Other Cross-Cutting Issues	*Lack of Conservation Funding is an issue in this section; however, it's in the Statewide/Multiregion Handbook	
Climate Change	isolated habitats are more at risk than others: sky islands, montane grasslands and forests, cienegas Other arid-land wetland and water-dependent features such as riparian and instream habitats In general, unknown longterm effects, needs	highly localized and intrinsically rare species associated with specific geologic features – 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. Climate change models, GIS analysis of land conversion and change overtime, species specific information, community-specific information – see CLIMATE CHANGE SECTION in Statewide handbook

General Issue	Ecoregion Issue Identified in Workshops (2010) and Surveys (2011)	Description of Adverse Effects Identified in Workshops (2010), Surveys (2011), and expert input
Population Growth	Urbanization - Additional Human Population with additional infrastructure needs; sprawl development directly takes habitat and species during construction (loss), degrades adjacent habitat (fragmentation), and may hinder movement (daily or seasonal) 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)	In this ecoregion, urbanization is primarily associated with large (El Paso/Juarez) to small (Presidio/Ojinaga) border areas, highly desirable communities such as Fort Davis and Alpine, and large crossroads communities like Fort Stockton which is a provisioning and jumping off point for many industrial operations. Many of these areas have large expanses of flat, open space, prime for building and the local culture values and appreciates “room to breathe,” so high density development and in-fill are not favored unless economically necessary.
Economics	Ranch	Landowner incentives cannotcompete currently with market forces – acres are being pulled out of NRCS and Farm Service Agency conservation programs back into livestock and agricultural production markets – perpetual conservation incentives are unavailable through traditional venues. Market forces in some areas cannot support continued large ranch ownership – production prices and hunting revenues are too low to maintain large ranches in multiple family ownership as a single source of income, in some instances.

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 CHIH-AZNM Ecoregion (Table 8) 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 managment.

[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] 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

Table 8. CHIH-AZNM Ecoregion 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
Begin a coordinated "Headwaters to Rio Grande/Rio Bravo" approach with regional conservation service providers, regional Texas Master Naturalist chapters, and local volunteer groups in watersheds which have high ecological significance (see Tables 6 and 7, Riverine Habitats) for invasive riparian species (e.g. *Tamarisk*, *Arundo donax*) removal through targeted landowner incentive programs and priority activities on public lands; document progress with an ecoregional invasive species management team and spatially-explicit website to track the progress of eradication – success and failures, to modify approaches as needed.
Document and map golden algal blooms across water bodies in west Texas, especially where SGCN fishes are known to occur (Pecos River, Balmorhea), along with conditions which may be related; encourage contribution by citizen scientists to a golden algal bloom tracking network
Prioritize landowner incentives for restoration ofnative grasslands, including conversion of non-native grasses to native, where feasible and where landowner can commit to longterm conversion practices and success. Promote the use of site-appropriate native grasses only in landowner incentive programs for livestock or wildlife recommendations.
Target angler education to prevent baitfish releases especially where they may compete with or hybridize with rare native SGCN fishes.
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 aquatics of springfed rivers and streams in this ecoregion.
Provide site appropriate brush removal advice and project implementation to restore native grasslands (focus on pronghorn, grassland breeding birds, SGCN insects); retain intact riparian areas, and protect wetlands, karst, slope and outcrops. 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 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 *site-specific* SGCN and rare communities.
Promote aggressive aoudad, feral hog and other nonnative ungulate control
Intensify outreach and public education efforts especially near boat ramps and high-traffic fishing tournament areas (e.g. Amistad) to reduce or eliminate the introduction of aquatic invasives – plants, mollusks and baitfishes. Highly isolated and vulnerable aquatic SGCN in this region would be severely threatened (moreso than they are currently) by such introductions.
Pests Parasites Pathogens
Intensify private landowner outreach in karst-prone areas, especially those sites with traversable caves, to promote appropriate precautionary protocols in equipment use and cleaning to help prevent the introduction of White-Nose Syndrome in caves and karst roosts in this region. Also, post protocols near cavern entrances for public and commercial caves with known roost areas, even if those roosts are only seasonal. Texas needs a documentation protocol and clearinghouse for suspected observances, verification, and reporting structure to the Western Bats Working Group and the USFWS WNS working group.
Monitor *Cactoblastus* distribution in Texas and document in a public resource (published journal, centralized website, Wildflower Center database?) in order to determine threats to native *Opuntia* sp.
Sample and monitor *Haemonchus* distribution in pronghorn populations and determine source of vulnerabilities, spread, and avenues for containment and recovery if needed.
Monitor infestation centers of *Ips* sp. beetles in various species of Ponderosa pine in the region and western pine beetles (*Dendroctonus brevicomis*) in the Davis Mtns to determine factors which increase their potential activity, possible expansion or contraction with climate change, and management recommendations.
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 in addition to pronghorn herds 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 mapper for developers to use to avoid areas of highest ecological significance.
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.
Oil and Gas Production and Delivery

Conservation Action
Continue to work with the oil and gas industry to find creative avoidance, minimization and mitigation solutions to industry impacts to listed species while addressing *indirect and cumulative potential effects*. Small fossorial and limited range mammals and reptiles and rare plants are most potentially affected. Review recovery potential of listed species and find intersections for cooperation, high-conservation-value mitigation, and incentives. For non-listed, candidate species potentially affected by this industry, review thresholds and concentrate on Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances incentives for private landowners to prevent listing, where possible.
Mining
Identify areas where Terlingua Creek cat's-eye, an edemic endangered plant, are potentially adversely affected by local mining and concentrate outreach efforts on prevention of impacts.
Develop a short list of best management practices for water quality protection and aquatic feature adjacent vegetation protection for mining operations in west Texas. Provide conservation outreach to mining company operators, especially those in the sand and gravel field, to inform them of the new regulations requiring a TCEQ permit for river and stream 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).
Communications
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), adjacency to pronghorn herd patterns -- and potential areas to concentrate mitigation dollars and projects in the event avoidance is not feasible or prudent. Identify non-compliant communications towers work collaboratively to bring into compliance (lighting, height); outreach to communications companies about the local hazards of communiation towers and recommendations to improve practice to improve conditions for all
Transportation
Form a cross-border multi-disciplinary ecological working group to work directly with TXDOT Regional Engineers and FHWA to identify areas of high ecological significance to avoid or minimize impacts during development of priority Interstate highway improvements and/or any proposed NAFTA transportation corridors. Study, identify, and include areas for focused bridge and culvert design to accommodate migratory and daily movement for wide-ranging species (jaguarondi, black bear) and bats; identify and suggest protective measures for water quality at important crossings at and upstream of aquatic SGCN populations; and identify significant riparian corridors for conservation.
Border Management/Fence
Form a working group of conservation practitioners and landowners adjacent to the border fence and potential border fence areas to review the recent Texas and other border states' findings about wildlife and fisheries impacts (see, among others, *Lasky, J.R., W. Jetz, and T.H. Keitt. 2011. Conservation biogeography of the US–Mexico border: a transcontinental risk assessment of barriers to animal dispersal. Diversity and Distributions 17(4): 673–687, July 2011*), identify targeted areas where wildlife crossings are particularly important/significant, craft avoidance and mitigation objectives for riparian habitats and aquatic impacts (bank disturbance, soil loss, water quality impacts, stormwater pollution prevention). Convey these objectives and projects through the TPWD Borderlands liaison, conservation NGOs operating in Mexico along the border (e.g. Pronatura, CONABIO), Mexico's National Commission for the Knowledge and Use of Biodiversity and the Mexico program of the Nature Conservancy, local officials and Homeland Security regional directors in Texas. Document whether recommendations were or will be implemented; document successes and barriers to success in conservation practice journals (Communications); share lessons learned with other border states.
Land and Water Management: FARM
Work with willing landowners *especially adjacent to and in corridors between* well-managed public lands to restore and manage grassland and riparian communities in large single-ownership or smaller acreage cooperatives – opportunities to connect/improve historically fragmented management
Provide incentives for water conservation measures and equipment where irrigation is needed, conversion to low water crops, and water trust (like land trust) participation
Identify key areas to promote netwire fencing replacement (with strand barbed wire) for pronghorn benefits. Monitor pronghorn use of these areas to determine if this fencing program is an effective conservation technique or whether it should be coupled with other strategies (what other strategies)
Identify areas in windrows, crop corners and fenceline habitats where management could benefit grassland or shrubland dependent birds, contribute to riparian conservation through streamside buffers and conserve rare plants and communities.
Work with private landowners and conservation partners to minimize feral hog populations through aerial shooting, hunting, and trapping. Provide technical guidance and educational programs about the impact and management of feral hogs to benefit ground nesting birds, small mammals, aquatic species
Land and Water Management: RANCH
Promote incentive programs which encourage landowners to protect desert springs and cienegas from livestock access, restore surrounding wetland fringe vegetation, and contribute data about the location and condition of these incredibly important and sensitive resources.
Work with local landowners and planning partners to identify and designate Important Bird Areas, primarily for grasslands
Work with willing landowners *especially adjacent to and in corridors between* well-managed public lands to restore and manage grassland and riparian communities in large single-ownership or smaller acreage cooperatives – opportunities to connect/improve historically fragmented management

Conservation Action
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.
Identify key areas to promote netwire fencing replacement (with strand barbed wire) for pronghorn benefits. Monitor pronghorn use of these areas to determine if this fencing program is an effective conservation technique or whether it should be coupled with other strategies (what other strategies)
Work with private landowners and conservation partners to minimize feral hog populations through aerial shooting, hunting, and trapping. Provide technical guidance and educational programs about the impact and management of feral hogs to benefit ground nesting birds, small mammals, aquatic species
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.
Identify the barriers to RX fire application to significant grassland restoration areas. Make management recommendations (timing, season, periodicity) to overcome barriers AND match more natural fire episode timing. Craft TARGETD outreach plans to overcome these barriers and work with landowners in core grassland restoration and recovery areas to benefit pronghorn, grassland birds, and small mammals and reptiles. Select a few keystone species for monitoring in these areas – see above.
Where wildlife and fisheries management are not the primary objective and where livestock production is the primary objective, refer landowners to partners who can assist them with best management practices for rotational and site-appropriate grazing management
Land and Water Management: MUNICIPAL
Work with the planners of the City of El Paso, Ciudad Juarez, El Paso County, Fort Bliss Military Installation, and Grant County (New Mexico) to reduce the human-induced pollution risks and increase water conservation in the following at-risk watersheds: Avispa Canyon – Rio Grande, Mulberry Dam – Rio Grande, McKelligon Canyon, Ascarate Lake – Rio Grande (National Fish Habitat Action Plan, high to very high risk HUC 12 watersheds); 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 and suburban planners in developing and developed areas focused on the significance of shortgrass prairie, riparian habitat, sensitive geologic features which host SGCN rare plants and communities, streamside buffers and water quality, drainage way protection, and water conservation to SGCN *specific to their community*. Include information on programs available to them for guidance, conservation incentives, and restoration (e.g. FEMA floodplain buyouts). Monitor the targeted outreach effectiveness and determine if the approach could be successfully implemented in other areas (e.g. adjacent ecoregions with similar issues).
Land and Water Management: CONSERVATION and RECREATION LAND
Evaluate trail impacts to SGCN rare plants and plant communities, and water quality, on public lands (local, state, federal) where SGCN are directly affected and work with TPWD Recreation and Trails coordinator to identify rehabilitation opportunities.
Voluntary conservation easements and landowner incentive programs are the best instruments for landowner participation in conservation solutions in this region. Landowners with intact grasslands (especially those within priority grassland areas identified by the Rio Grande Joint Venture, The Nature Conservancy, Alamito Creek and Terlingua Creek drainages; grasslands with restoration potential for little investment, willing to change to pronghorn-sensitive fencing, riparian corridors along Ecologically Significant Stream Segments (and to their headwaters), and/or cienegas or springs should be first-eligible. Monitoring of key species (to be identified) must be a part of these projects. Information about methods, short and longterm success (or failure) need to be shared through conservation networks (see Statewide/Multi-region Issues handbook – Information Actions section).
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. Monitor Bairds sparrow, Cassin Sparrow, Long-billed Curlew, Eastern Meadowlark to determine effectiveness of the applied practices
Form multi-partner working group(s) to establish scientifically sound best management practices for **chemical/mechanical brush control** for the ecoregion and specific watersheds
Form multi-partner working group(s) to establish scientifically sound best management practices for **riparian restoration** (cottonwood, sycamore, other?), 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)
Review conservation measures and recovery plans for Aplomado Falcon; determine next best steps to engage partners in accepted measures

Conservation Action
Concentrate grassland conservation in and adjacent to the Marfa Grasslands, a high priority grassland identified in the Commission for Environmental Cooperation's (CEC) *North American Environmental Atlas* recently updated priority grasslands to better reflect public and protected lands and critical habitat for grassland bird species. Grasslands Priority Conservation Areas (GPCAs) are defined as areas of trinational importance due to their ecological significance and threatened nature. Originally published in 2005, the CEC's North American GPCA map data have been updated by the results of two important grasslands bird population studies to show: • The diversity of bird species in GPCAs, particularly in Canada and the US, and projections of the rates at which critical bird habitats are being lost; • Extensive monitoring data from 2007–2010 on bird population densities in northern Mexican and southwest Texas grassland sites; • Proximity of GPCAs throughout North America to public and protected lands; and • Evaluations by local, regional and national experts from Canada, Mexico, and the US. For this extensive update, the Rocky Mountain Bird Observatory (RMBO), the *Universidad Autónoma de Nuevo León* and other partners collected data from various sources. The detailed changes to each GPCA and the specific data used can be found in Assessment and Revisions of North American Grassland Priority Conservation Areas. See map at http://www.cec.org/newsletter/images/NA_GrasslandPCAs2010.jpg
Species Restoration: ▪ Pronghorn populations (not just individuals) coincidental with conservation easements to connect disjunct populations, *native* grassland improvement, fence replacement, restocking to enhance genetic diversity and sustainability, Haemonchus research and solutions ▪ Black-tailed prairie dog – burrowing owl – black-footed ferret shortgrass prairie systems: conservation easements and incentives to restore functional colonies, experimental introductions, shortgrass prairie native grassland restoration, and management recommendations for compatible land uses ▪ Monitoring and continued improvement of reestablished Rio Grande silvery minnow to the Big Bend reach of the Rio Grande
From the NABCI Continentally Important Proposals - Support these important proposals by networking important grasslands and wetlands in this ecoregion and providing technical assistance for the following proposals: CHIHUAHUAN DESERT GRASSLANDS, MEXICO – PRAIRIE POTHOLE JOINT VENTURE, UNITED STATES – PRAIRIE HABITAT JOINT VENTURE, CANADA The Chihuahuan Desert grasslands are the most important wintering area in the U.S. for grassland species, the fastest declining group of birds in the country. Conservation activities include protection of the last remaining tracts of intact grassland on the continent's Great Plains; habitat management on privately, publicly, and communally owned areas; and increasing local interest and respect for this important ecosystem. Other objectives include regional alliance coordination and monitoring and inventory. CHIAPAS, MEXICO – PACIFIC COAST JOINT VENTURE, UNITED STATES AND CANADA This proposal will ensure the health of the 390 bird species of Chiapas, where a diversity of habitats supports high concentrations of many of these migratory and endemic birds. Although the species abundance for breeding birds that winter in Chiapas is concentrated in the east, the proposal supports an international collaboration for the conservation of high concern Gary Oak habitats and associated bird species in the U.S. and Canadian Pacific Northwest. Objectives include habitat management and acquisition, monitoring and GIS capacity building, and consolidation of a critical regional alliance in Chiapas. (this project is included as several ecologists from this ecoregion are well-positioned to assist in these efforts in Chiapas and these efforts would build alliances, support for migratory bird habitats, and leverage conservation in this ecoregion in the future) MARISMAS NACIONALES, MEXICO - UTAH, UNITED STATES – SASKATCHEWAN, CANADA This proposal presents projects that will strengthen range-wide conservation of birds along a migratory path that extends from the Chaplin and Quill Lakes of Saskatchewan, through the Great Salt Lake in Utah, and ends in the Marismas Nacionales of Sinaloa and Nayarit, Mexico. The coastal wetlands of Marismas Nacionales support one of the largest wintering concentrations of U.S. breeding wetland birds on earth. Objectives include development of population and habitat objectives, technical assistance with surveys and adaptive monitoring, environmental education, and ecotourism.
Water Development, Management and Distribution
River rehabilitation in/adjacent to identified stretches of the Rio Grande/Rio Bravo from Rio Conchos to Amistad: use recommendations for environmental flows to include water for natural resources and human uses, identify quality thresholds ("not to exceeds" at various monitoring stations) and recommend flood intensity management parameters to mimic natural flood conditions periodically for riverine and riparian health; work with regional ecologists to identify a list of appropriate riparian restoration species and native sources, techniques adapted for arid lands restoration (SeeStotz, N.G. 2000. *Historic Reconstruction of the Ecology of the Rio Grande/Río Bravo Channel and Floodplain in the Chihuahuan Desert*. Prepared for the World Wildlife Foundation Chihuahuan Desert Program); and, specifically work to increase riparian corridor and flow resiliency to climate change (increase buffers, provide incentives to landowners for less management and livestock in buffers)
Monitor groundwater and surface water expressions of groundwater (spring, seep, cienegas, and spring-fed river) water quality and quantity to determine and document the effects of several practices, alleged to be detrimental to groundwater resources on which SGCN depend: fracking, algal farms, unmonitored residential development, other high water-intensive agricultural uses. Publish findings and advise groundwater and surface water management processes to find collaborative water quality improvement and water quantity conservation solutions to these issues.
Form a local ecologists' working group to evaluate instream flow studies' recommendations and craft/deliver specific environmental water flow recommendations and rationale that connect ground and surface water issues for the following Water Planning Groups: Surface Water Regions E and F; Ground Water Management Areas 3 (Pecos Valley), 5 (Hueco Mesilla Bolsons), 7 (Edwards Trinity Plateau); and Groundwater Conservation Districts 9, 21, 39, 41, 58, and 73.
Lack of Information and 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: • monitoring the status of key suite of grassland birds for short grass and mid grass prairies to determine overall effects of applied conservation incentives; • effects of isolated pronghorn populations on their longterm self-sustaining survival with management and conservation recommendations to reconnect isolated populations; • longterm monitoring of the Summer 2011 Wildfire to document vegetation community and animal assemblage recovery, timing, compared to areas which have not been burned in 5, 10, 15 years; • 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; • effects of harmful algal blooms and related water chemistry threshold changes to SGCN freshwater fishes (especially those dependent on spring or spring-fed systems) • Research on effects of managed flows (dam releases) on the Rio Grande and Pecos Rivers, including sediment dynamics and water quality, and their effects on SGCN pupfish, minnows, and aquatic invertebrates. • Specific levels of impact of groundwater withdrawals on spring and cienega habitats that support rare and endemic species (e.g. Phantom Lake, Diamond Y, Balmorhea, others); 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. Many SGCN in this region lack distribution and POPULATION status information. This lack of information can contribute to "false rarity" determinations; 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. Priorities include breeding native grassland, montane and riparian birds (Montezuma Quail, Common Black-Hawk, Gray Hawk, Yellow-billed Cuckoo, Spotted Owl, Colima Warbler, Summer Tanager), pronghorn, mountain lion, black bear, sprague's pipit, mountain plover, wintering grassland birds
Identify a host website to share ecoregional professional practitioner cross-training opportunities for prescribed fire, stream rehabilitation, reintroductions, brush management, GIS and corridor identification
Work with private landowners and conservation partners to minimize feral hog populations through aerial shooting, hunting, and trapping. Provide technical guidance and educational programs about the impact and management of feral hogs to benefit ground nesting birds, small mammals, aquatic species
Inadequate Policies, Rules, Enforcement
Provide annual workshops for regional law enforcement related to updates in nongame collection, possession and sale regulations; include identification section in curricula; create a voluntary monitoring program to determine effectiveness of the technical guidance/training related to the efficacy of nongame enforcement, decrease in adverse SGCN population impacts (especially to resources on public lands)
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, and swift fox). 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
Climate Change
Climate change models and effects on isolated habitats, riparian areas, and springs/groundwater resources
See also Information Needed section above and the State Handbook
Population Growth
Work with El Paso Metropolitan Planning Organization and the Texas/Mexico Border Housing Forum (Texas Comptrollers Office) to work conservation of SGCN habitats into urban, suburban and rural development along the border to protect floodways, water quality, riparian areas, grasslands, and other priority habitats. Provide them with a list of contacts including TXNDD, TPWD Habitat Assessment, local land and water trusts, local conservation land and open space planning resources to help them identify areas for perpetual conservation and appropriate development envelopes during the planning timeframe.
Economy
Evaluate market forces affecting large ranchlands with conservation potential and determine incentive *packages* and tools which could help the landowner conserve the site and its features for future generations. Concentrate on areas near established conservation lands, land trusts and water trusts, and public lands.

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