Appendix B BAT Comments

between the Hill Country and the Balcones Fault Zone was determined structurally from the up-dip edge of major faults juxtaposing older Trinity Group rocks against younger Edwards Group rocks (Barker et al. 1994). Development of secondary porosity along fault planes heavily influenced the diagenetic processes occurring throughout the Cenozoic and into the Quaternary, including extensive karstification.

In areas of streams and rivers there has been some deposition of alluvial deposits, mostly silt, sand, and gravel that thinly cover the eroded limestone surface. A more detailed explanation of the regional geologic history can be found in Rose (1972), Maclay and Small (1986), and Barker et al. (1994), as well as many others.

**Groundwater and Aquifers**

Four major and two minor aquifers exist within the SEP-HCP Plan Area (Figure 4). The most significant aquifer from the standpoint of pumpage volume is the Edwards Balcones Fault Zone (BFZ) Aquifer. This karstic carbonate groundwater reserve supplies water to millions of users in Bexar, Medina, and Comal counties, and is the primary water source for the City of San Antonio. It is located within the limestone rocks of the Edwards Group, comprised of the Person and Kainer Formations.

The Edwards BFZ Aquifer is known to store and transmit large quantities of water, and is subject to very rapid recharge in the area where the aquifer is unconfined. This zone is referred to as the recharge zone (Figure 4), and is extremely sensitive to environmental impact, particularly from potential degradation to groundwater quality from anthropogenic contaminants. The Edwards BFZ Aquifer also provides the source water for many major springs in Texas, including the two largest: Comal Springs in Comal County and San Marcos Springs in Hays County. These spring systems serve as the sole known habitat for a number of federally listed aquatic species. The confined portion of the Edwards BFZ Aquifer extends to the south and southeast of the recharge zone and contains numerous very high capacity water wells.

*Edwards Aquifer Structure*

The limestone of the Edwards Group has focused recharge zones, enhanced secondary porosity, and excellent geochemical water quality conditions. These factors make the Edwards Aquifer one of the most productive groundwater reservoirs in the country (Sharp and Banner 1997). This is primarily the consequence of enhanced karstification, or dissolution of the soluble carbonate rocks, which has progressed since lithification; although, karstification processes were focused and accelerated after faulting occurred along the BFZ. The Edwards Aquifer is confined below by the Upper Glen Rose Formation and above by the Del Rio Clay. In the upthrown fault blocks to the northwest of the Plan Area, the Edwards Group rocks have been eroded away and are not present. Here, the Upper Glen Rose is exposed, and is classified as



# Summary of Comments on TITLE

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Author: jn05957 Subject: Sticky Note Date: 5/24/2011 8:10:04 AM

what are geochemical water quality conditions?

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these deeper strata area either needs to be this deeper starata area or these deeper strata areas

being the "contributing zone" to the Edwards Aquifer. On the downthrown blocks, heading to the southeast from the contributing zone, the limestone of the Edwards Group becomes exposed to the surface and is referred to as the recharge zone.
Further southeast, and down progressive fault blocks, the units above the Edwards Group become exposed at the surface and the Edwards Aquifer becomes bounded by low permeability units of the Glen Rose below and Del Rio above (Ferrill et al. 2004). This zone is referred to as the confined zone, and is where the highest capacity wells and largest springs exist (Collins and Hovorka 1997).

*Recharge and Groundwater Movement in the Edwards Aquifer*
Approximately 80 percent of recharge into the Edwards Aquifer occurs in losing streams, where surface water flows over faults, fractures, and karst features that have been solutionally enhanced (Sharp and Banner 1997). Periods of recharge are intermittent as most streams in south-central Texas are ephemeral; however, the recharge capacity of surface water into the aquifer is extremely efficient due to the karstic nature of the system. Water passing over the contributing zone (Glen Rose outcrop) and into major fault zones and exposed, heavily karstified Edwards Group limestone (recharge zone), is rapidly transferred directly to the aquifer with little or no filtration. The geologic mechanisms that form karst are complex, and many factors affect how karst is expressed in current settings. These factors control the way the groundwater flow system evolves, and ultimately how groundwater is recharged, transmitted, and naturally discharged through the aquifer system. A great deal of literature exists that presents current perspectives of karst development in the Edwards Aquifer (Sharp and Banner 1997, Hovorka et al. 1998, Schindel et al. 2008, Palmer and Palmer 2009, and many others)

Groundwater movement in the phreatic zone is generally west to east in the Plan Area, based on groundwater elevations or potentiometric surface on a regional scale (Lindgren et al. 2004). Aquifer flow models for the entire Edwards Aquifer show groundwater flowing from Uvalde and Medina Counties east-northeast eventually discharging at Comal, Hueco, and San Marcos Springs, numerous small springs, or extracted by groundwater pumping from wells (Kuniansky et al. 2001). However, recent tracer studies in northern Bexar County performed by the Edwards Aquifer Authority indicate water flowing from north to south with very rapid flow velocities (Johnson et al. 2009). These observations indicate that flow paths may be more complex than originally thought, and rapid groundwater transport is dominated by karstic conduit flow.

*Trinity Aquifer*
The Trinity Aquifer is located within older carbonate rocks than those in the Edwards Group limestone, and the Trinity Aquifer lies below the Edwards Aquifer in areas where the Edwards is present. In the southeast portion of the SEP-HCP Plan Area, the Trinity Aquifer is below the Edwards BFZ Aquifer recharge and confined zones, although water quality in these deeper strata area is generally poor (i.e., the groundwater contains a high level of total dissolved solids). North and northwest of the Edwards BFZ Aquifer recharge zone is the outcrop section of the Trinity Aquifer, which is also considered the contributing zone to the Edwards BFZ Aquifer. The Trinity Aquifer in this area is karstic, and numerous minor springs exist, primarily in areas that have been incised by surface streams. The water in this portion of the Trinity Aquifer is generally of very good quality.

# SURFACE WATER

## RESOURCE ASSESSMENT

## FOR THE SOUTHERN EDWARDS PLATEAU

## HABITAT CONSERVATION PLAN

DRAFT SEPTEMBER 16, 2010

### 1.0 INTRODUCTION

This preliminary resource assessment describes the general character of the surface waters in the Southern Edwards Plateau Habitat Conservation Plan (SEP-HCP) Plan Area. The SEP-HCP Plan Area includes Bandera, Bexar, Blanco, Comal, Kerr, Kendall, and Medina counties. The purpose of this assessment is to document the basic background information for the Habitat Conservation Plan and associated Environmental Impact Statement.

The majority of information about surface waters and related topics was generated from the National Hydrography Dataset (NHD), the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), and Texas Parks and Wildlife Department (TPWD). The NHD is a comprehensive set of digital spatial data that represents surface waters of the U.S., such as lakes, ponds, streams, rivers, and dams (Simley and Carswell 2009). The TWDB provides leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas (TWDB 2010). As the State of Texas's environmental agency, the TCEQ sets and implements surface water quality standards (TCEQ 2010). The TPWD is authorized to protect and regulate take of aquatic plant and animal species within the State of Texas, which includes participating in the designation of ecologically significant streams and rivers and initiating and supporting research to evaluate the effects of water development on wildlife (TPWD 2007a).

### 2.0 RIVER BASINS AND SUB-BASINS

The SEP-HCP Plan Area is located within the Texas-Gulf Geographic Region, which is the drainage area of a number of rivers that flow into the Gulf of Mexico and includes parts of Louisiana, New Mexico, and Texas (Seaber et al. 1987). According to the NHD, parts of four major river basins are present within the Plan Area boundaries (i.e., the Colorado, Guadalupe, Nueces, and San Antonio river basins) (Figure 1). Within the Plan Area, these four river basins are further divided into sixteen sub-basins (i.e., Atascosa, Austin-Travis Lakes, Buchanan-Lyndon B. Johnson Lakes, Cibolo, Hondo, Llano, Lower San Antonio, Medina, Middle Guadalupe, Pedernales, San Marcos, San Miguel, South Llano, Upper Frio, Upper Guadalupe, and Upper San Antonio), which are third-level classifications that encompass a more detailed area in the hierarchy of hydrologic units (Figure 1).



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Fig 1 is after fig 2

The Colorado River Basin includes the drainage area for the Colorado River, which is the largest river completely within Texas (Texas State Historical Association (TSHA) 2010). The Colorado River Basin encompasses approximately 13% of the SEP-HCP Plan Area and covers portions of Blanco, Kendall, and Kerr counties. Within the Plan Area, five sub-basins occur within the Colorado River Basin, which include the Buchanan-Lyndon B. Johnson Lakes, Austin-Travis Lakes, Llano, South Llano, and Pedernales sub-basins.

The Guadalupe River Basin encompasses approximately 30% of the SEP-HCP Plan Area and covers portions of Blanco, Comal, Kendall, and Kerr counties. Within the Guadalupe River Basin, the San Marcos, Upper Guadalupe, and Middle Guadalupe sub-basins occur within the Plan Area.

The San Antonio River Basin encompasses approximately 35% of the SEP-HCP Plan Area and covers portions of Bandera, Bexar, Comal, Kendall, Kerr, and Medina counties. Within the Plan Area, four sub-basins (the Cibolo, Upper San Antonio, Lower San Antonio, and Medina sub-basins) occur within the San Antonio River Basin.

The Nueces River Basin encompasses approximately 22% of the SEP-HCP Plan Area and occurs in portions of Bandera, Kerr, and Medina counties. Four sub-basins occur within the Nueces River Basin within the Plan Area: Upper Frio, Hondo, San Miguel, and Atascosa.

## 3.0 MAJOR RIVERS

Four major rivers (the Guadalupe, Medina, Pedernales, and San Antonio rivers) bisect the SEP-HCP Plan Area, and represent approximately 323 miles of waterway within the Plan Area. These major waterways, and the numerous streams and creeks that feed them, are valuable surface water resources for the SEP-HCP Plan Area and support wildlife, riparian habitat, recreational uses, and scenic vistas (Figure 1). Of the four major rivers within the SEP-HCP Plan area, the Guadalupe, Medina, and Pedernales are included in the Nationwide Rivers Inventory (NRI). The NRI is a database of over 3,400 free-flowing river segments in the U. S. that are believed to possess one or more remarkable natural or cultural values that have more than local or regional significance (National Park Service (NPS) 2008).

The Guadalupe River begins in western Kerr County from the North and South Fork Guadalupe Rivers and runs its course in a southeasterly direction for approximately 230 miles before emptying in San Antonio Bay (TSHA 2010). Approximately 129 miles of this waterway cross through the SEP-HCP Plan Area. It provides critical resources in the form of water and electricity to much of the area and it is also a popular tourist and recreation attraction (TSHA 2010). Principle tributaries of the Guadalupe River within the Plan Area include Johnson Creek, Goat Creek, Town Creek, Camp Meeting Creek, Quinlan Creek, Cypress Creek, and Verde Creek. Canyon Dam impounds the Guadalupe River to form Canyon Lake in Comal County. According to the NRI, the Guadalupe River from the head of Canyon Lake upstream to the headwaters near Kerrville is rated as the best recreational river within the State of Texas and the second best scenic river (NPS 2008).

The Medina River originates from springs in northwest Bandera County and travels southeast for approximately 116 miles to its mouth at the San Antonio River in southern Bexar County (TSHA 2010). The Medina Dam impounds the Medina River to form Medina Lake in Medina County. The NRI identifies the Medina River from the head of Medina Lake upstream to the State Highway (SH) 173 bridge in Bandera as the fourth most popular river to float in Texas (NPS 2008).



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Author: jn05957 Subject: Highlight Date: 5/24/2011 9:25:16 AM

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Is this correct? Austin-Travis Lakes? I don't understand figure 1

Bandera (35 percent) and Kerr (21 percent) counties. The remaining 46 percent of the known springs within the Plan Area occur within Kendall (13 percent), Bexar (10 percent), Medina (9 percent), Blanco (7 percent), and Comal (6 percent) counties.

## 6.0 WATER QUALITY AND USE

### 6.1 WATER QUALITY

#### 6.1.1 IMPAIRED WATERS

Under the Clean Water Act, the State of Texas (through the TCEQ) has developed and enforces a comprehensive set of surface water quality standards that include chemical, physical, and biological criteria. The Texas Surface Water Quality Standards are found in the Texas Administrative Code (TAC) under Title 30, Chapter 307 and establish explicit water quality goals throughout the state for all types of surface water sources.

The state standards are set in an effort to maintain the quality of water in the state, consistent with public health and enjoyment, the protection of aquatic life, and the operation of existing industries and economic development. Surface waters are evaluated for the following five categories: aquatic life, contact recreation, public water supply, fish consumption, and general uses. Standards related to drinking water also apply to groundwater that is used as a public water supply.

Every two years, the TCEQ assesses water quality across the state and submits a report to the U.S. Environmental Protection Agency (EPA) regarding how each body of water meets the state water quality standards. This water quality inventory is the basis of the Clean Water Act 303(d) list, which identifies all "impaired" water bodies that do not meet the water quality criteria established to support designated uses. The following table lists the impaired waters in the SEP-HCP Plan Area from the 2008 Texas Water Quality Inventory and 303(d) List (Table 1) (Figure 2) (TCEQ 2008).

TABLE 1: 2008 IMPAIRED WATERS IN THE SEP-HCP PLAN AREA AND THEIR ASSOCIATED IMPAIRMENT CATEGORY.*

| Water Bodies by County | Bacteria | Impaired Fish Community | Depressed Dissolved Oxygen | Impaired Macrobenthic Community | Mercury In Edible Tissue |
|---|---|---|---|---|---|
| **Bandera** | | | | | |
| none listed | | | | | |
| **Bexar** | | | | | |
| Lower Cibolo Creek | X | X | | | |
| Lower Leon Creek | X | | X | | |
| Salado Creek | | X | | X | |
| Upper San Antonio River | | X | | | |
| Mid Cibolo Creek | X | | | | |
| **Blanco** | | | | | |
| none listed | | | | | |
| **Comal** | | | | | |



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TABLE 1: 2008 IMPAIRED WATERS IN THE SEP-HCP PLAN AREA AND THEIR ASSOCIATED IMPAIRMENT CATEGORY.*

| Water Bodies by County | Bacteria | Impaired Fish Community | Depressed Dissolved Oxygen | Impaired Macrobenthic Community | Mercury In Edible Tissue |
|---|---|---|---|---|---|
| Upper Cibolo Creek | X | | | | |
| Mid Cibolo Creek | X | | | | |
| Canyon Lake | | | | | X |
| **Kendall** | | | | | |
| Upper Cibolo Creek | X | | | | |
| **Kerr** | | | | | |
| Camp Meeting Creek | | | X | | |
| **Medina** | | | | | |
| none listed | | | | | |

*(TCEQ 2008)

### 6.1.2 ECOLOGICALLY SIGNIFICANT RIVER AND STREAM SEGMENTS

In 1997, Senate Bill 1 made water planning the responsibility of regional planning groups rather than TWDB. The TWDB was directed to create the boundaries for 16 planning regions in Texas that took into consideration river basin and aquifer delineations, water development patterns, socioeconomic characteristics, existing regional water planning areas, political subdivision boundaries, public comment, and other factors (Norris et al. 2005). The SEP-HCP Plan Area encompasses portions of three planning areas (Region J: Plateau - Kerr and Bandera counties, Region K: Lower Colorado - Blanco County, and Region L: South Central - Bexar, Comal, Kendall, and Medina counties) (Figure 2). The regional water planning groups are responsible for drafting regional water plans that identify how to conserve water supplies, meet future water supply needs, and respond to future droughts in the planning areas. The regional water planning groups must submit and update regional water plans every five years (TWDB 2010a).

Another facet to the regional water plans are recommendations for ecologically significant river and stream segments within each region. Modifications of the natural river and stream systems for water use for municipal, agricultural, industrial, and other needs and to control flooding can alter habitat diversity, reduce stream productivity, and degrade water quality (Norris et al. 2005). The regional water planning groups follow the process outlined in TAC Section 357 and Texas Water Code (TWC) Section 16.051 for designating ecologically significant river or stream segments. The criteria used to designate a stream or river segment as ecologically significant are based on biological function, hydrologic function, presence of riparian conservation areas, high water quality/exceptional aquatic life/high aesthetic value, and threatened or endangered species or unique communities (TPWD 2007, Norris et al. 2005). Official designation is a combined effort of the regional water planning groups, the TWDB, and the Texas Legislature. The designation does not protect a segment from degradation, but precludes a state agency or political subdivision of the state to finance the construction of a reservoir in an ecologically significant river or stream segment (Norris et al. 2005).

The following table identifies ecologically significant stream and river segments within the SEP-HCP Plan Area and the criteria used to award the designation (Table 2).



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change to finance to from financing

# GENERAL WILDLIFE COMMUNITIES

RESOURCE ASSESSMENT

FOR THE SOUTHERN EDWARDS PLATEAU

HABITAT CONSERVATION PLAN

DRAFT MARCH 30, 2011

## 1.0 INTRODUCTION

This preliminary resource assessment describes the general character of the ecological regions and associated wildlife communities in the Southern Edwards Plateau Habitat Conservation Plan (SEP-HCP). The SEP-HCP Plan Area includes Bexar, Medina, Bandera, Kerr, Kendall, Blanco, and Comal counties. The purpose of this assessment is to document the basic background information for the Habitat Conservation Plan and associated Environmental Impact Statement.

For the purpose of this report, general wildlife communities are defined as: Wildlife occupying the habitats that would be lost or modified as a result of activities covered for incidental take and areas protected and managed as mitigation that could be affected by the action alternatives.

## 2.0 WILDLIFE COMMUNITIES BY ASSOCIATED ECOLOGICAL REGIONS

The SEP-HCP Plan Area crosses parts of six different ecological subregions, as described by the U.S. Environmental Protection Agency (Griffith et al. 2004). These six distinct ecological subregions include the following communities: Balcones Canyonlands, Edwards Plateau Woodland, Northern Blackland Prairie, Llano Uplift, Northern Nueces Alluvial Plains, and Southern Post Oak Savanna.

- Balcones Canyonlands - This ecological subregion represents approximately 54 percent of the SEP-HCP Plan Area. The Balcones Canyonlands has rugged topography with steep-sided canyons formed by the erosion and solution of the underlying limestone bedrock by the numerous springs, streams, and rivers that flow above and below the surface. The Balcones Canyonlands subregion supports a number of endemic plant and wildlife species that are not commonly found elsewhere on the Edwards Plateau. This is the region where most of the habitat for the Covered Species occurs.

- Edwards Plateau Woodland - The Edwards Plateau Woodlands represent the central part of the Edwards Plateau (and the northern part of the SEP-HCP Plan Area). Edwards Plateau Woodland is characterized by a savanna of grasslands with scattered oak, juniper, and





Author: jn05957 Subject: Comment on Text Date: 5/27/2011 3:16:26 PM mesquite trees. Some woodlands or shrublands in this region provide habitat for the golden-cheeked warbler (GCW) or black-capped vireo (BCV).

- Northern Blackland Prairie - The Northern Blackland Prairie region represents the relatively flat southeastern end of the Plan Area. Habitat for the GCW and BCV generally does not occur in this area; although, some portions of this ecological subregion are underlain by karst geology.
- Northern Nueces Alluvial Plains - The Northern Nueces Alluvial Plains are part of the South Texas Plains ecoregion and occurs at the southern edge of the SEP-HCP Plan Area. Alluvial geology and deep soils support parkland vegetation dominated by mesquite and live oak. This region does not generally support habitat for the Covered Species.
- Southern Post Oak Savanna - The far southeastern edge of the SEP-HCP Plan Area is included within the Southern Post Oak Savanna ecological subregion. This area is a mosaic of post oak savanna, improved pasture, and rangeland. This region does not support habitat for the Covered Species.
- Llano Uplift - A very small area at the northern end of the Plan Area occurs within the Llano Uplift, which is unique because of its granite outcrops and acidic soils. This region may contain some areas of habitat for the GCW or BCV.

Wildlife communities associated with these ecological subregions are as diverse as the ecological subregions themselves. A total of approximately 520 species of amphibians, reptiles, mammals, and birds make up the various wildlife communities within the Plan Area (Dixon 2000, Schmidly 1994, Lockwood and Freeman 2004). Wildlife communities within the Balcones Canyonlands subregion are the most diverse, with approximately 95 percent of the total wildlife species within the Plan Area occurring within this region. Table 1 includes the species diversity of wildlife communities by taxon and associated ecological region within the SEP-HCP Plan Area.

Table 1. Species Diversity of Wildlife Communities by Taxon and Associated Ecological Region within the SEP-HCP Plan Area.

| | Species Diversity | | | | | | |
|---|---|---|---|---|---|---|---|
| Taxon | Plan Area | Balcones Canyonlands | Edwards Plateau Woodlands | Llano Uplift | Northern Blackland Prairies | Northern Nueces Alluvial Plains | Southern Post Oak Savanna |
| Amphibians | 33 | 33 | 25 | 22 | 30 | 21 | 28 |
| Reptiles | 79 | 77 | 65 | 63 | 76 | 72 | 74 |
| Mammals | 76 | 72 | 71 | 56 | 65 | 60 | 63 |
| Birds | 332 | 311 | 289 | 276 | 303 | 263 | 298 |
| **Total** | **520** | **493** | **450** | **417** | **474** | **416** | **463** |

A complete list of individual wildlife species by taxon, their general distribution within the Plan Area, associated ecological regions, and habitat requirements are included in Appendix A.



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Author: jn05957 Subject: Comment on Text Date: 5/27/2011 3:19:00 PM
I think that Edwards Plateau woodland is more accurately described as oaks, juniper, deciduous trees with scattered savannas and grasslands. My point is that there are more trees than there are grasslands.

Author: jn05957 Subject: Sticky Note Date: 5/24/2011 11:24:17 AM
define parkland

(such as cave-dependent bats, bobcats, forest dwelling birds, and many reptiles) would decrease as humans convert or encroach upon natural landscapes.

It is anticipated that approximately 241,000 acres of new land development will occur in SEP-HCP Plan Area over the next 30 years (Wendell Davis and Associates 2010). Residential development impacts natural environments in several ways, such as replacing native vegetation with buildings, pavement, and other man-made structures (e.g., direct habitat loss) (McIntyre and Hobbs 1999); decreasing the amount of continuous open-space (e.g., fragmentation); and increasing vegetational disturbance, erosion, and soil compaction (Bradley 1995). Residential development often results in the introduction of non-native vegetation through invasion or landscaping with non-native, ornamental plants (Whitney and Adams 1980, Mills et al. 1989, Bolger et al. 1997). Urbanization also can change the abundance of predators and competitors in an area (Wilcove 1985, Engels and Sexton 1994, Jokimaki and Huhta 2000) and increase disturbance from human activity (Whitcomb et al. 1981). Physical changes to the natural landscape, as well as the possible alteration in predator or competitor interactions resulting from urbanization, can have a profound impact on wildlife communities (Freisen et al. 1995).

Thus, while certain species may benefit from human activities, land development typically alters the processes that maintain balance in native wildlife communities, resulting in adverse effects to self-sustaining native wildlife communities. Therefore, projected future land development activities have the potential to adversely impact wildlife populations through habitat changes, introduction of non-native species, and other alterations to the natural balance of native wildlife species within the SEP-HCP Plan Area.

Wildlife species known to occur within the SEP-HCP Plan Area are included in Appendix A. Impacts to these species would vary based on the type of habitat impacted by development activities and the sensitivity of each species to human-induced changes to native habitats or wildlife communities. However, in general, the natural composition and stability of native wildlife communities would decline concurrently with the expansion of the human population into their habitats. Should this projected future development incorporate areas of natural green space, this anticipated decline could be minimized.

## 4.2 POTENTIAL IMPACTS FROM CONSERVATION ACTIONS

Title 5 of the Texas Parks and Wildlife Code describes laws and matters regarding forests, water district and river authority parks, Texas trails systems, wildlife and plant conservation, hunting and fishing licenses, commercial and fish farmer's licenses, the Uniform Wildlife Regulatory Act, hunting, endangered species, crustaceans and mollusks, wildlife management areas, sanctuaries, and preserves, including Federal-state agreements. The code also establishes special standards for non-game species, such as bats (Texas Parks and Wildlife Code, Title 5, Chapter 63.101).

Most urbanized animals are not seasonally hunted or treated as game, while the hunting of game animals such as white-tailed deer are restricted to specific seasons and heavily regulated. Avian species are protected by both the provisions of the Texas Parks and Wildlife Code, and the Migratory Bird Treaty Act, which prohibits the taking, killing, or possession of all migratory birds (with the exception of several non-native species). While these regulations protect wildlife to some degree, they provide no protection to the habitat required for wildlife survival.

Without the implementation of the proposed SEP-HCP, it is likely that some development on land that provides habitat for endangered species would be mitigated on a case-by-case basis and that



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# DRAFT PRELIMINARY ASSESSMENT OF RARE AMPHIBIAN SPECIES OF THE SOUTHERN EDWARDS PLATEAU HABITAT CONSERVATION PLAN

Eurycea salamanders of central Texas caves and springs

Prepared for Loomis Partners, Inc.
3101 Bee Cave Road, Suite 100
Austin, TX 78746

30 March 2011

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Author: jn05957 Subject: Sticky Note Date: 5/24/2011 2:47:50 PM
add a P

throughout the state and is a locally uncommon winter resident on the Coastal Prairies, but can be common at times along the intermediate coast, particularly near bays and estuaries (Lockwood and Freeman 2004). Like the American peregrine falcon, the arctic peregrine falcon may appear in the SEP-HCP Plan Area as a migrant (Campbell 2003). Fall migrants are noted as early as mid-July, and spring birds may linger as late as early May (Lockwood and Freeman 2004).

This species is no longer listed as threatened or endangered by the State of Texas (TPWD 2010). The falcon was removed from the Federal list of endangered and threatened wildlife in October 1994 (59 FR 50796). NatureServe identifies the conservation status of the nonbreeding population of the species within Texas as "vulnerable" due to a restricted range, relatively few populations, recent and widespread declines or other factors that make it vulnerable to extirpation (NatureServe 2009).

## 2.6 WHOOPING CRANE

The whooping crane (*Grus americana*) is a migratory bird that winters along the Texas coast. The coastal wintering grounds are dominated by salt grass (*Distichlis spicata*), saltwort (*Batis maritima*), smooth cordgrass (*Spartina alterniflora*), glasswort (*Salicornia* sp.), sea ox-eye (*Borrichia frutescens*), and Gulf cordgrass (*Spartina spartinae*) (Campbell 2003, Lewis 1995). During migration, whooping cranes are known to utilize a variety of habitat types, including freshwater marshes, wet prairies, inland lakes, upland grain fields, and riverine systems (Campbell 2003, Lewis 1995). Migration occurs across the central portion of the state to or from the central coast during October-November and again in April (Lockwood and Freeman 2004). The narrow migration corridor utilized by this species occurs in a northwesterly direction from Aransas County on the coast across central Texas (Travis, Williamson, and Burnet Counties) towards north-central Texas and the eastern portion of the Panhandle. Most of the SEP-HCP Plan Area falls to the west of this corridor, however documentation of whooping cranes just to the east and west of the migration corridor has occurred (Lockwood and Freeman 2004).

The whooping crane was federally listed as endangered in June 1970 (35 FR 8491). Critical habitat for the species was designated in May 1978 (43 FR 20938) and includes the species' wintering range in the Aransas National Wildlife Refuge and vicinity of the Texas Gulf coast. The State of Texas also lists the whooping crane as endangered. NatureServe identifies the conservation status of the species in Texas as "critically imperiled" due to extreme rarity or because of some factor(s) such as very steep declines that make it especially vulnerable to extirpation (NatureServe 2009).

Major threats for the whooping crane include habitat loss, human disturbance (particularly on the breeding grounds at Wood Buffalo National Park, Alberta), and collisions with stationary objects like power lines and poles (Lewis 1995). On March 11, 2010 The Aransas Project filed a federal lawsuit against Texas Commission on Environmental Quality (TCEQ) for illegal harm and harassment of the species at the Aransas National Wildlife Refuge leading to take in violation of Section 9 of the Endangered Species Act (The Aransas Project 2010).

## 2.7 BALD EAGLE

The bald eagle (*Haliaeetus leucocephalus*) is found year-round in Texas, and the Texas population includes both breeding populations and winter residents. Breeding populations are typically found in the eastern half of the state and along the Texas Gulf Coast. However, the species has been known to breed at some localized sites in central Texas. Most wintering populations have been observed in the Texas Panhandle and the central and eastern portions of the state. Spring and fall migrants can be found throughout the state (Campbell 2003). Bald eagle breeding and wintering habitat



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Author: jn05957 Subject: Sticky Note Date: 5/24/2011 3:17:57 PM
Add a statement re: why SEP-HCP is not addressing the whooping crane-- i.e., take will not be authorized by FWS. Also, whooping crane habitat is not found in the SEPHCP region and whooping cranes are rarely observed in the SEPHCP region.

must include bodies of open water like reservoirs and rivers. Tall trees are essential for nesting sites during the breeding season, while abundant waterfowl and fish are needed as prey items during the winter (Campbell 2003). The SEP-HCP Plan Area includes Canyon Lake (Comal County) and Medina Lake (Medina and Bandera Counties), which may provide suitable habitat for the eagle; however, breeding or wintering populations are not known from either of these locations (Campbell 2003, TPWD 2010). Campbell (2003) indicates that the species is known to winter in Kerr and Kendall counties (presumably associated with the Guadalupe River).

The bald eagle is a Texas threatened species, but it was removed from the Federal list of endangered and threatened wildlife in July 2007 (72 FR 37346). The species will be monitored by the USFWS, in cooperation with the Texas and other states for a minimum of five years after delisting. The species is still protected by the Bald and Golden Eagle Protection Act (16 USC 668-668d), which prohibits "take" of bald and golden eagles and provides a statutory definition of "take" that includes "disturb". NatureServe identifies the conservation status of the nonbreeding and breeding population of the species within Texas as "vulnerable" due to a restricted range, relatively few populations, recent and widespread declines or other factors that make it vulnerable to extirpation (NatureServe 2009).

Some of the threats that this species face are pesticide accumulation in the environment, ingestion of plastics and lead, human disturbance at nest and roost sites, and degradation of habitat (Buehler 2000).

## 2.8 WOOD STORK

The wood stork (*Mycteria americana*) is the only stork that breeds in the United States, and this species is strongly associated with shallow salt- and freshwater wetlands in the Southeast where it feeds in groups (Coulter et al. 1999). The current breeding range in the U.S. for this species is Florida, Georgia, and South Carolina; however postbreeding dispersal, from Mexican breeding colonies, occurs along the Gulf Coast with rare sightings in the eastern third of Texas (Coulter et al. 1999, Lockwood and Freeman 2004). Utilization of the SEP-HCP Plan Area by wood stork is likely to be rare due to the lack of suitable wetland habitat in this region. However, the species is rarely known to be a postbreeding wanderer to the eastern Edwards Plateau region (Lockwood 2001) and Oberholser (1974) lists a number of historical sightings of the species in Bexar, Medina, Bandera, and Kerr counties.

The breeding population of the wood stork was listed as endangered on February 28, 1984 in Alabama, Florida, Georgia, North Carolina, and South Carolina (49 FR 7332), but the species is not federally listed as threatened or endangered in Texas. The wood stork is listed as threatened by the State of Texas. Within Texas, NatureServe identifies the conservation status of the nonbreeding population as "imperiled" (due to a very restricted range, very few populations, steep declines and/or other factors that make it vulnerable to extirpation) and the breeding population of the species as "possibly extirpated" (a species or community that occurred historically in the state and there is some possibility that it may be rediscovered) (NatureServe 2009).

The wood stork faces challenges within its breeding range from habitat loss and degradation, disturbance at nest, roost, and foraging sites, and bioaccumulated toxic materials like mercury (Coulter et al. 1999).



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change face to faces

## 2.11 INTERIOR LEAST TERN

The interior least tern (*Sterna antillarum athalassos*), a subspecies of the least tern (*Sterna antillarum*), is the smallest of the North American terns. This waterbird nests on open sand, shell, and gravel beaches, sandbars, and islands that have little to no vegetation and that are typically associated with coastal areas, major riverine systems, and reservoirs (Thompson et al. 1997, NatureServe 2009, Campbell 2003). In Texas, interior least terns are found at three reservoirs along the Rio Grande River, on the Canadian River in the northern Panhandle, on the Prairie Dog Town Fork of the Red River in the eastern Panhandle, and along the Red River (Texas/Oklahoma boundary) into Arkansas (Campbell 2003). Campbell (2003) does not indicate that the species breeds or winters in any of the counties included in the SEP-HCP Plan Area. However, the migration corridor for the interior least tern may cross eastern Bexar and Comal counties of the Plan Area (Lockwood and Freeman 2004).

The USFWS listed the interior least tern as endangered on June 27, 1985. Within Texas, the USFWS considers the interior least tern as endangered everywhere except along the coast line and a 50-mile zone inland from the coast (50 FR 21792). The species is also listed as endangered by the State of Texas. NatureServe identifies the conservation status of the breeding population of the species in Texas as "critically imperiled" due to extreme rarity or because of some factor(s) such as very steep declines that make it especially vulnerable to extirpation (NatureServe 2009).

The interior least tern faces threats from channelization, water diversions, impoundments, recreational activities on land and water, irrigation and water consumption (Thompson et al. 1997, Campbell 2003, NatureServe 2009, 50 FR 21792). However, the interior least tern may also benefit from some of the water modification projects by creating habitat and additional foraging areas (Thompson et al. 1997, Campbell 2003).



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Author: jn05957 Subject: Sticky Note Date: 5/24/2011 3:20:34 PM
Add a statement explaining why the interior least tern is not covered by the SEP-HCP: only rarely observed; little or no habitat in the Plan area.

**Introduction**

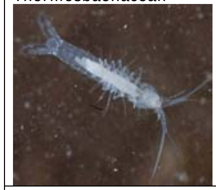
The proposed Plan Area of the Southern Edwards Plateau Habitat Conservation Plan (SEP-HCP) encompasses the following seven counties in Texas: Bexar, Bandera, Comal, Kendall, Kerr, Blanco and Medina counties. The following assessment covers rare aquifer crustacean species distributed within the Plan Area. Distribution data were collected using the Texas Memorial Museum (TMM) biological database, *TEXBIO,* and other literature sources.

Aquifer species are notoriously difficult to sample due to the inaccessibility of their habitat. Assessing their status, range and microhabitat requirements has been a subject of ongoing research for several decades, and even very recent studies are leading to the discovery of new aquifer species and assisting in defining the range of others (Zara Environmental 2009). While only one species of crustacean in the Plan Area is federally listed, other potentially rare species also occur in similar habitats and may warrant review in the SEP-HCP documents. Species included in this brief assessment include those species that are endemic to the plan area, those that are not endemic to the plan area but occur in a total of five or fewer localities, and those species on state or federal watch lists.

**Species Descriptions and Distributions**

There are twenty two rare crustacean species that occur within the range of the SEP-HCP Plan Area and are being recommended for inclusion in the plan. All of these species are aquifer dwelling, with morphological and physiological adaptations suited for the subterranean environment. These adaptations include elongated appendages, absent or reduced eyes, and lowered metabolic and reproductive rates (Culver 1982).

**Table 1.** Distribution of crustacean species within the SEP-HCP Plan Area.

| **Taxa** | **Species** | **County Range** | **Status** |
|---|---|---|---|
| Thermosbaenacean  | *Tethysbaena (=Monodella) texana* | Bexar Comal Hays Uvalde | No listing status at this time; Nature Serve Global Rank: G2 |
| Bathynellacean | *Texanobathynella bowmani* | Comal Dickens San Saba | |
| Amphipod<br><br>Amphipods are small shrimp like crustaceans | *Stygobromus dejectus* (Cascade Cave Amphipod) | Kendall Bexar | IUCN vulnerable; Nature Serve Global Rank: G1 |

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twenty-two

Author: jn05957 Subject: Sticky Note Date: 5/24/2011 3:23:22 PM
is this correct?

Author: jn05957 Subject: Highlight Date: 5/24/2011 3:22:51 PM

**Introduction**

Fishes included in this resource assessment are those species tracked by the Texas Parks and Wildlife Department (TPWD) on their County Lists of Rare Species for those counties included in the Plan Area of the Southern Edwards Plateau Habitat Conservation Plan (SEP-HCP) (TPWD 2010). Other resources reviewed to identify rare species in the Plan Area were The Texas Journal of Science- An Annotated Checklist of the Freshwater Fishes of Texas, with Keys to Identification of Species (Hubbs et al. 1991) and The Texas Natural History Collection database, accessed at www.fishesoftexas.org (2010).

The SEP-HCP Plan Area includes Bexar, Medina, Bandera, Kerr, Kendall, Blanco, and Comal counties. Species and habitat information was obtained from a variety of Internet sources and published reports. Credit for originally collecting and presenting much of this information goes to Hassan-Williams and Bonner (2010), who have studied fishes in Texas extensively.

**Edwards Plateau Shiner**

The Edwards Plateau shiner (*Cyprinella lepida*) is a small fish endemic to streams in the Nueces River basin of the Edwards Plateau, where it inhabits clear and cool spring fed waters with gravel or limestone bottoms. There is some evidence that it may also inhabit the upper reaches of the Guadalupe River Basin (Mayden 1989, Hubbs et al. 1991, Page and Burr 1991). Some taxonomic uncertainty exists for this species, as investigations by Richardson and Gold (1995) found that the Frio and Sabinal River populations were a different species than populations previous believed to be *C. lepida* from the Nueces River. TPWD lists this species as known from or potentially inhabiting Medina, Uvalde, Real, and Bandera counties. It has no formal state or federal listing status, but was described as vulnerable by Warren et al. (2000) and as critically imperiled/imperiled by (Scharpf 2005). The NatureServe Explorer database gives this species a conservation status ranking of G1/G2 (critically imperiled/imperiled) (NatureServe 2009).

Populations in the Frio and Sabinal Rivers have declined significantly over the past several decades (Richardson and Gold 1995, Edwards et al. 2004). Declines were most severe in the Sabinal River where *C. lepida* was found only in Lost Maples State Park at the headwaters of the river (Richardson and Gold 1995). Additional information on the population status, taxonomy, and ecology is needed.

**Fountain Darter**

The fountain darter (*Etheostoma fonticola*) is a small, reddish brown predatory fish found in Hays and Comal counties. Usually less than 1 inch long, it is the smallest of the darters and is known only from the San Marcos and Comal Rivers, where it prefers vegetated stream floor habitats and is often associated with mats of filamentous algae. It requires a constant flow of clear, clean water with stable temperatures, vegetation for cover, and undisturbed stream floors (U.S. Fish and Wildlife Service (USFWS) 1996). Live specimens are also kept at the San Marcos National Fish Hatchery and Technology Center. The Comal River population was extirpated in the mid 1950's when Comal Springs ran dry; however, individuals from the San Marcos population were re-introduced to the Comal River on several occasions starting in 1975 (Schenck and Whiteside 1976). It is now found throughout the Comal River to its confluence with the Guadalupe River (USFWS 1996) and the





Author: jn05957 Subject: Sticky Note Date: 5/24/2011 3:34:16 PM
Add a statement re: why an incidental take permit is not being sought even for those spp listed as federally endangered.

The proposed Plan Area of the Southern Edwards Plateau Habitat Conservation Plan (SEP-HCP) encompasses the following seven counties in Texas: Bexar, Bandera, Comal, Kendall, Kerr, Blanco and Medina counties. The following assessment covers rare insect species distributed within the Plan Area. The rare species list in this assessment was derived by accessing the Texas Parks and Wildlife's "Rare, Threatened and Endangered Species of Texas database (Texas Parks and Wildlife Department 2009). Those species were then cross checked with the NatureServe Explorer conservation database (NatureServe 2009) for global status rankings. Two species that were petitioned to the U.S. Fish and Wildlife Service for listing as federally threatened or endangered are also included (USFWS 2009).

Table 1. Distribution and status of 15 rare insect species within the SEP-HCP Plan Area.

| Common Name | Species | County Range | Regulatory Status | TPWD Rare Species List (2009) | Conservation Status Rank (NatureServe 2009) [1] |
|---|---|---|---|---|---|
| Comal Springs riffle beetle | *Heterelmis comalensis* | Comal; Hays | Federally Endangered | X | G1 |
| Comal Springs dryopid beetle | *Stygoparnus comalensis* | Comal; Hays | Federally Endangered | X | G1G2 |
| Edwards Aquifer diving beetle** | *Haideoporus texanus* | Comal; Hays | | X | G1G2 |
| Comal Springs diving beetle | *Comaldessus stygius* | Comal | | X | G1 |
| Disjunct crawling water beetle | *Haliplus nitens* | Blanco | | X | GH |
| A mayfly | *Allenhyphes michaeli* | Kendall; Bandera; Blanco; Uvalde | | X | |
| A mayfly | *Baetodes alleni* | Kendall | | X | G1G2 |
| A mayfly | *Pseudocentroptiloides morihari* | Comal | | X | G2G3 |
| A mayfly | *Plauditus futilis* | Bandera | | X | |
| Leonora's dancer damselfly | *Argia leonorae* | Medina; Bandera; Kerr; Uvalde; Kinney; Kimble; Hays | | X | G3 |



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Add a statement re: why an incidental take permit is not being sought even for those spp listed as federally endangered.

known BCV populations: the Kerr Wildlife Management Area in Kerr County, Hill County State Natural Area in Bandera County, and Rancho Diana, Freidrich Park, and Crownridge Canyon in Bexar County. However, information on the specific management and conservation obligations for the BCV on these properties is lacking (Wilkins et al. 2006 and USFWS 2009).



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Friedrich (note corrected spelling) population last 2 yrs has been 0;no BCVs at CCNA in several yrs.

Appendix C BAT Comments



typically completed by the end of July, and the species begins migration south in June or July (Ladd and Gass 1999). Most warblers have left central Texas by early to mid-August (Wahl et al. 1990).

The golden-cheeked warbler is the only bird in Texas that nests exclusively within the state's boundaries (Oberholser 1974). There are currently 27 counties that are known to support golden-cheeked warblers, including Bandera, Bell, Bexar, Blanco, Bosque, Burnet, Comal, Coryell, Edwards, Gillespie, Hays, Johnson, Kendall, Kerr, Kimble, Kinney, Lampasas, Llano, Medina, Palo Pinto, Real, San Saba, Somervell, Travis, Uvalde, Williamson, and Young counties (SWCA 2007, Groce et al. 2010). Warblers have also been recently detected in Dallas, Erath, Jack, Hamilton, Hill, Hood, McLennan, and Stephens counties (SWCA 2007, Groce et al. 2010), but additional surveys are needed to determine the extent to which the species occurs in these counties. Reliable historic records of golden-cheeked warbler occurrence are known from Eastland, Hamilton, Hood, and Stephens counties; however, the current status of the species in these six counties is uncertain (Ladd and Gass 1999). Other counties that may contain potentially suitable habitat for the golden-cheeked warbler, but for which further study is needed to determine if the species is present, include Brown, Comanche, Ellis, Guadalupe, Mason, McCulloch, Menard, Mills, Parker, and Sutton counties (Ladd and Gass 1999, SWCA 2007, Groce et al. 2010).

Figure 2 shows the 35 counties identified in the 1992 Golden-cheeked Warbler Recovery Plan (USFWS 1992) as included in the breeding range of the species. This figure also notes the other 11 counties with current records of occurrence, reliable historic records of occurrence, or potentially suitable habitat.

## 3.2 TERRITORIAL CHARACTERISTICS

### 3.2.1 TERRITORY BEHAVIOR AND SIZE

Male warblers announce and defend territories partly by singing high-pitched, buzzy songs loudly from conspicuous perches near the tops of trees. Females do not sing or defend territories, and have less conspicuous behavior (Ladd and Gass 1999). Golden-cheeked warblers often occupy the same territory in subsequent breeding seasons (Campbell 2003), but limited data on GCW dispersal between years report distances of up to 62 miles for adult males and up to 1.4 miles for adult females (Groce et al. 2010). Juvenile GCWs have been documented dispersing up to approximately 6.2 miles from their natal territory (Groce et al. 2010).

Male warblers are territorial during the breeding season and defend territories that typically range from approximately four to ten acres (Ladd and Gass 1999), but territory sizes of between approximately one and 57 acres have been reported (Groce et al. 2010). Campbell (2003) states that golden-cheeked warblers forage and nest in areas of habitat encompassing approximately five to 20 acres per pair.

Unpublished data from Texas Parks and Wildlife Department (TPWD) indicate varying territory sizes in Bexar County that range from approximately two to 29 acres, but average approximately five to nine acres (Richard Heilbrun, TWPD, personal communication). Golden-cheeked warbler territory sizes ~~from~~ reported from Hill Country State Natural Area and Guadalupe River State Natural Area range from approximately two to 10 acres and average approximately three to seven acres (Richard Heilbrun, TWPD, personal communication).



# Summary of Comments on Microsoft Word - Loomis_GCW_workingdraft.doc

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Average territory size on a property in far northwest Bexar County was estimated to be approximately 9.3 acres, based on the results of a presence/absence, spot-mapping survey completed by Loomis Partners in 2008 (unpublished data). Loomis Partners estimated an average territory size of approximately 17.5 acres on another Bexar County property in 2010, also based on the results of a presence/absence spot-mapping survey (Loomis Partners, unpublished data). Coldren (1998) found that territory size was inversely related to reproductive success, such that large territories may be an indicator of poor habitat quality (most likely due to reduced food availability and foraging opportunities).

### 3.2.2 TERRITORY DENSITY

Pulich (1976) estimated that 85 acres of habitat were needed to support one pair of golden-cheeked warblers in marginal habitat (1.2 pairs per 100 acres), 50 acres were needed in average habitat (2.0 pairs per 100 acres), and 20 acres were needed in excellent habitat (5.0 pairs per 100 acres). Other early studies found golden-cheeked warbler territory densities ranging between 9.5 and 20 pairs per 100 acres (USFWS 1992). Wahl et al. (1990) suggests that an approximate range-wide measure of warbler territory density in areas of suitable habitat is 6.1 territories per 100 acres (Wahl et al. 1990).

Golden-cheeked warbler territory size and territory density estimates for habitats within the SEP-HCP Plan Area are few. SWCA (2008) notes that relatively few systematic golden-cheeked warbler surveys have been conducted in the vicinity of San Antonio, which hinder attempts at developing an accurate population estimate for this area.

Wahl et al. (1990) reports golden-cheeked warbler density estimates from five sites that occur within the SEP-HCP Plan Area, based on surveys completed in 1987 and 1988 using Emlen strip census or variable circular plot survey methods. The estimated golden-cheeked warbler densities for these sites (including Guadalupe River State Park and Honey Creek State Natural Area in Comal County, Pedernales Falls State Park in Blanco County, Friedrich Park in Bexar County, and Lost Maples State Natural Area in Bandera County) range from approximately 3.2 males per 100 acres of suitable habitat to approximately 25 males per 100 acres of suitable habitat. However, the USFWS suggests estimating absolute densities of territorial birds from transect-based methods, as compared to spot-mapping methods (USFWS 1992).

Long-term golden-cheeked warbler monitoring data from Camp Bullis in Bexar County between 1991 and 2008, collected from point count surveys along transects established across the property, report an average, installation-wide, annual density estimate of approximately 4.1 singing males per 100 acres of habitat, with a range of approximately 1.5 singing males per 100 acres reported in 1993 to 8.1 singing males per 100 acres reported in 2006 (Cooksey and Edwards 2008). Surveys completed between 2002 and 2008 used similar methods, and Cooksey and Edwards (2008) show a more recent average density of 5.8 singing males per 100 acres of habitat during this 7-year period. The Camp Bullis Cibolo Creek and Lewis Creek subpopulations (which represent approximately 734 acres and 1,075 acres of relatively higher quality habitat, respectively) have shown average densities of approximately 4.9 singing males per 100 acres of habitat between 1991 and 2008, with the highest reported density of approximately 10.2 singing males per 100 acres of habitat for the Cibolo Creek subpopulation in 2001 (Cooksey and Edwards 2008). The USFWS suggests that the Camp Bullis golden-cheeked warbler density estimates derived from these point count surveys may be an underestimate of the density that could be documented using territory mapping methods (USFWS 2005).



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Author: jn05957 Subject: Highlight Date: 5/25/2011 9:47:43 AM

Author: jn05957 Subject: Sticky Note Date: 5/25/2011 10:00:05 AM
What I found in USFWS 1992 (p.20) was a reference to the "unreliability of transect methods (in comparison with spot-mapping) for estimating absolute densities of terrestrial birds." The actual statement was "Tilghman and Rusch (1981), Jolly (1981) and van Riper (1981) have pointed out the unreliability...." I think this is the opposite of the statement made in Appendix C, and, moreover, the current statement is attributed to FWS rather than the authors cited by FWS.

12 and Table 6). This analysis estimated that approximately 23,070 acres of forest cover across the Plan Area was lost between 2005 and 2010, or 2.4 percent of the total forest cover over a 5-year period (about 0.5 percent per year). . Although, some of this reported loss (located at the extreme south end of the golden-cheeked warbler range in Bexar and Medina counties; see Figure 12) occurred over an approximately 15-year time frame. Diamond et al. (2010) estimated that approximately 5,535 acres of potential golden-cheeked warbler habitat (5.7 percent of the available habitat in Bexar County, or 1.1 percent per year) was lost between 2005 and 2010 (except for the area generally between Government Canyon State Natural Area and State Highway 281, which represented a 15 year time period).

Groce et al. (2010) report that there was no evidence to indicate that the amount of golden-cheeked warbler breeding habitat is increasing or stable, due to continued habitat loss and fragmentation from human development, shifts in land use, and construction of roads and utility transmission corridors. These threats are likely to be intensified by projected increases in human populations within the breeding range of the species.

### 7.1.4 WINTERING HABITAT

Warbler wintering habitat in Central America has been affected by lumbering operations (particularly in pine and pine-oak forests), mining, firewood-cutting, and land-clearing for agriculture (Lyons 1990). Conservation efforts are being undertaken in the affected areas to prevent habitat loss (Alliance for the Conservation of Pine-Oak Forests of Mesoamerica 2008).

## 7.2 REDUCTION OF DECIDUOUS CANOPY

Golden-cheeked breeding habitat is characterized as mature, dense woodlands composed of a mix of Ashe juniper and various deciduous trees (primarily oaks). The loss or reduction of deciduous trees from juniper-oak woodlands may be threatening the relative quality of suitable golden-cheeked warbler habitat, and could reduce the carrying capacity of available habitat over time. Changes in canopy composition have been attributed to factors such as the loss of oak trees due to the oak wilt fungus and a lack of regeneration of deciduous trees from over-browsing by livestock and wildlife (USFWS 1992). Russell and Fowler (2004) indicated that ongoing browsing pressure by deer may prevent the replacement of oaks on the Edwards Plateau. Groce et al. (2010) reports that while feral hogs (*Sus scrofa*) are known to be opportunistic omnivores (including feeding on roots and mast of trees), the foraging effects of feral hogs on oak regeneration is unknown.

The extent or overall effect of any such reduction in habitat quality or carrying capacity across the Plan Area is unknown. Groce et al. (2010) reports that mortality of mature trees from oak wilt is prevalent in the golden-cheeked warbler breeding range and that browsing pressure from ungulates also contributes to a low level of oak seedling recruitment. However, Groce et al. (2010) states that the magnitude and direction of change in this threat is difficult to predict at this time.

## 7.3 NEST PARASITISM AND PREDATION

Nest parasitism by brown-headed cowbirds may also have contributed to the golden-cheeked warbler's population decline (Pulich 1976, USFWS 1992). Cowbirds, which are typically associated with livestock herds, lay eggs in the nests of other songbirds, including golden-cheeked warblers, and cause the host species to either abandon their nest or to inadvertently raise cowbird chicks in addition to (or in place of) their own young.



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Author: jn05957 Subject: Sticky Note Date: 5/25/2011 11:27:33 AM
should be mortality

## 8.0 EXISTING PROTECTIONS AND PROGRAMS

A variety of public and private lands currently receive some level of protection from future land development activities, and some of these are managed as natural areas or wildlife preserves with a focus on the protection and management of the golden-cheeked warbler. Approximately 171 conservation properties currently exist in the Plan Area, including properties under public and private ownership (not including military installations, such as Camp Bullis). These properties protect approximately 131,000 acres from the majority of future land development activities and may provide some protection for between 55,000 and 60,000 acres of potential golden-cheeked warbler habitat. See the SEP-HCP Resource Assessment for "Existing Conservation Lands" (Loomis Partners 2010b) for more detail. Groce et al. (2010) describes a variety of conservation programs and other tools that are currently available to encourage and assist landowners with actions that benefit endangered species, including habitat conservation plans, grants from the federal Cooperative Endangered Species Conservation Fund, conservation banks, the Recovery Credit system policy incentives, Safe Harbor Agreements, and a variety of other programs providing financial and/or technical assistance for land and wildlife management.

## 9.0 DATA GAPS AND UNCERTAINTIES

Few systematic surveys for the golden-cheeked warbler, such as a USFWS protocol presence/absence survey, have been conducted on the existing conservation properties in the SEP-HCP Plan Area. This lack of detailed, territory mapping data makes an accurate accounting of the currently protected population of golden-cheeked warblers difficult to determine. It is possible that the existing state of knowledge regarding golden-cheeked warbler occurrences on the vast acreage of currently protected properties underestimates the true conservation value of these tracts. Additionally, this lack of data complicates efforts to fine-tune estimates of territory density and habitat preferences particular to this region.

Other potential research needs include region-specific factors influencing habitat use and productivity. Research on the golden-cheeked warbler and its habitats is ongoing, and the results of future studies may be incorporated into the SEP-HCP via the adaptive management program.



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Author: jn05957 Subject: Highlight Date: 5/25/2011 11:39:42 AM

Author: jn05957 Subject: Sticky Note Date: 5/25/2011 11:41:57 AM
I would change "this" to the. To me "This" implies that FWS P/A surveys would give territory mapping data, and that is not necessarily the case. You can do protocol P/A surveys without mapping territories.

FIGURE 1. PHOTOGRAPHS OF MALE AND FEMALE GCWS.

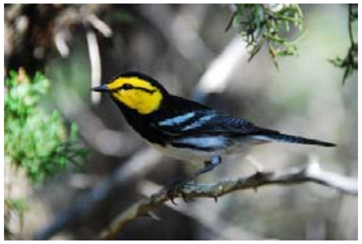

Photo 1. Male GCW in Bexar County (May 2010). Photo by J. Blair, Loomis Partners.

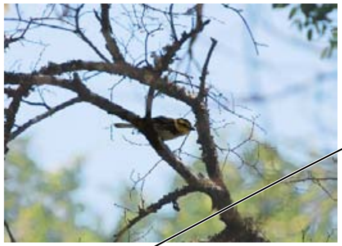

Photo 2. Female GCW. Photo by J. Blair, Loomis Partners.

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Author: jn05957 Subject: Sticky Note Date: 5/25/2011 11:43:43 AM
This photo really does not show how the female GCW looks different from the male.

TABLE 2. HISTORIC AND RECENT RANGE-WIDE ESTIMATES OF SUITABLE GCW HABITAT.

| Geographic Area | Approximate Time Period | Acres of Suitable GCW habitat | Source | Comments |
|---|---|---|---|---|
| GCW Range (specific counties undefined) | 1962 | 908,619 acres | Pulich (1976) | Based on Soil Conservation Service estimates of virgin juniper habitat. |
| GCW Range (specific counties undefined) | 1974 | 731,081 acres | Pulich (1976) | Based on Soil Conservation Service estimates of virgin juniper habitat. |
| GCW Range (specific counties undefined) | 1974 - 1981 | 835,302 acres | USFWS (1992) | Corrected estimates based on Wahl et al. (1990); habitat detected by LANDSAT imagery from 1974, 1979, and/or 1981. |
| GCW Range (specific counties undefined) | 1989 | 586,043 acres | USFWS (1992) | Corrected estimates based on Wahl et al. (1990); habitat detected by LANDSAT imagery and refined by scattered groundtruthing. |
| 33 counties in central Texas (Pulich 1976) | 1992 | 1,869,552 acres | DeBoer and Diamond (2006) | Based on 1992 NLCD forest cover types and buffered back from the edge of forest cover by 75 meters. |
| 35 counties identified in 1992 Recovery Plan | mid to late 1990's | 4,427,841 acres | Diamond (2007) | "Model C" considering percent forest/woodland within a circle of radius 200 meters, adjusted for edge. |
| 35 counties identified in 1992 Recovery Plan and limited to the Edwards Plateau and Cross Timbers Ecoregions | 2001 | 4,149,478 acres | Loomis Partners (2009) | Potential high, medium, and low quality habitat identified by a spatial analysis of 2001 NLCD Percent Canopy Cover, with additional information on probability of occuancy. |
| 43 counties currently known or expected to harbor the species | 2004 | 1,363,807 acres | SWCA (2007) | Delineated from aerial imagery based on density of woodla[illegible] relative proportions of Ashe juniper and deciduous hees, siz[illegible] of trees, woodland patch size, and land use at local and landscape scales. |
| 35 counties identified in 1992 Recovery Plan | 2005 - 2007 | 3,597,747 acres | Diamond (unpublished data) | "Model C2" modified from the original Model C by using more recent land cover data and considering stands of live oak as not representative of GCW habitat. |
| 35 counties identified in 1992 Recovery Plan and limited to the Edwards Plateau Ecoregion | 2007/2008 | 4,148,138 acres | Morrison et al. (2010) | Based on classification of satellite data as woodland having greater than 30 percent canopy cover or non-woodland. Accuracy verified by comparison to 2008 aerial imagery. |

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Author: jn05957 Subject: Sticky Note Date: 5/25/2011 12:08:55 PM
trees? instead of hees

## 3.4 NESTING BEHAVIOR

Nesting begins upon the arrival of females and continues through August. Nests are small, open-cup, hanging structures constructed in the forks of branches (USFWS 1991). Most vireo nests are constructed in very dense, deciduous foliage (most often in oak species) (Wilkins et al. 2006); although, nests have also been found in Ashe juniper (*Juniperus ashei*) and other non-juniper woody evergreen species (Balley and Thompson 2007, Wilkins et al. 2006, USFWS 1991). Nests are typically placed one to four feet from the ground. Both sexes are known to contribute to nest building (Graber 1957). Black-capped vireos may attempt up to six clutches in a single season, which typically lasts from early April through late July (USFWS 1991). A new nest is constructed for each nesting attempt (Graber 1957).

Egg laying begins the day after completion of the nest. Individual clutches contain three to four eggs (Graber 1957), with an estimated total seasonal clutch size of between 12 and 20 eggs (USFWS 1991). Male vireos aggressively guard active nests (USFWS 1991). The incubation period extends from 14 to 19 days, which is longer than most other small, open-cup nesting passerines, and duties are shared by both parents. Hatchlings stay in the nest for nine to 12 days, and are fed by both adults. Females brood newly hatched young for four to six days. Fledglings are attended by one or both parents for usually 30 to 45 days after leaving the nest (Graber 1957, USFWS 1991).

## 4.0 HABITAT DESCRIPTION

The black-capped vireo typically uses heterogeneous scrub habitat that has a patchy distribution of shrub clumps and thickets with a few scattered trees and abundant deciduous foliage to ground level (Graber 1957, 1961; USFWS 1991; Grzybowski 1995). While the habitats occupied by the vireo may differ greatly across its range, the most common and distinguishing habitat element throughout the range of the species is the presence of dense, low, deciduous foliage at ground level to approximately ten feet (USFWS 1991, Grzybowski et al. 1994, Maresh 2005). This low, dense, deciduous cover provides foraging and nesting sites, as well as protective cover from adverse weather and predators (Grzybowski et al. 1994).

Other black-capped vireo habitat variables, such as the amount of heterogeneity in vegetation structure, the degree of openness in the woody canopy, and the species composition of the habitat are highly variable throughout the range of the species and within regional areas. Due to the high degree of variation in these other habitat variables, they are thought to be less influential in comprising suitable vireo habitat than presence of low, dense, deciduous foliage (Maresh 2005).

Along the eastern edge of the Edwards Plateau (i.e., representative of the SEP-HCP Plan Area), black-capped vireos typically occupy weathered and eroded highlands and along stream corridors (but outside of floodplains) where site conditions favor the growth of suitable vegetation (Graber 1961). Campbell (2003) also describes typical black-capped vireo habitat as occurring over rocky limestone soils with shrub habitat mixed with a tree canopy that may vary from open or sparse to moderate canopy cover. Within this region, vireos were found to utilize areas with a relatively high degree of shrubby vegetative cover (regardless of whether this cover was composed of deciduous shrubs or Ashe juniper) and relatively less cactus cover (Gryzbowski et al. 1994).

Black-capped vireos may co-occur with golden-cheeked warblers (*Dendroica chrysoparia*), whereby vireos utilize the dense, deciduous foliage at the edge of warbler habitat patches (Grzybowski et al. 1994).



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variation in some of the characteristics of suitable habitat and the relatively fine-scale heterogeneity of the shrub cover used by the species. Further, suitable black-capped vireo habitat tends to be relatively short-lived, since much of the vegetation used by the species (particularly along the eastern edge of the Edwards Plateau ecoregion) is typically representative of an early successional stage following vegetation disturbance (such as a fire or mechanical brush management). The short-lived nature of this early successional vegetation stage generally results in a shifting pattern of suitable black-caped vireo habitat across the landscape over relatively short time periods (i.e., 5 to 15 years).

The best available estimates of the amount of suitable black-capped vireo habitat across Texas are reported in Wilkins et al. (2006) and are based on the results of roadside surveys conducted in the late 1990's (Maresh and Rowell 2000). These roadside surveys were conducted along two 30-mile transects in each of 53 Texas counties with known or suspected black-capped vireo breeding populations. The survey transects were located along public roads and were generally driven twice, once to assess the amount of potentially suitable habitat visible along the route and once to briefly listen for the presence of the species at 0.3-mile intervals within suitable habitat (Maresh and Rowell 2000).

In Texas, approximately 1.45 million acres of potentially suitable breeding habitat for the black-capped vireo may exist (Wilkins et al. 2006). There are no estimates of the amount of breeding habitat available in other parts of the species' breeding range. There are also no available estimates of black-capped vireo wintering habitat (Wilkins et al. 2006).

As extrapolated by Wilkins et al. (2006), these surveys estimate that approximately 181,630 acres of potentially suitable black-capped vireo habitat may occur in the 7-county SEP-HCP Plan Area (see Table 2 for more information). The geographic distribution of this potential habitat across the Plan Area is not available. Further, this habitat estimate should be interpreted with caution. Maresh and Rowell (2000) caution that their survey data are extremely limited and that: 1) the lack of black-capped vireo detections at a survey point ~~can not~~ be assumed to imply the absence of the species, since the duration of the surveys was very brief; 2) the identification of suitable habitat vs. non-habitat was highly subjective; and 3) the study lacked the statistical rigor that would be necessary to make wider inferences about the available and occupancy of black-capped vireo across the breeding range in Texas. Wilkins et al. (2006) noted that the county-wide estimates of potential vireo habitat are likely to overestimate the amount of occupied and potential suitable habitat, and cautioned that these estimates may not be reliable and are of limited utility.

TABLE 2. ESTIMATED ACRES OF SUITABLE BCV HABITAT AND KNOWN BCV POPULATION*.

| Geographic Area | Acres of Suitable Habitat | Known Males or Territories Documented Since 2000 |
|---|---|---|
| Bexar County | 47,854 | 45 |
| Medina County | 62,292 | 4 |
| Bandera County | 7,599 | 28 |
| Kerr County | 53,074 | 436 |
| Kendall County | 4,945 | - |
| Blanco County | 2,275 | 14 |
| Comal County | 3,591 | - |



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2007), and the likely abundance of potential habitat in these counties (Wilkins et al. 2006), the species is likely to occur in these two counties.

The currently known breeding population of the black-capped vireo reported in Wilkins et al. (2006) is likely to represent only a small proportion of the total breeding population because many areas of potential habitat within the breeding range have not been surveyed. Most of the range occurs on private properties that are not accessible for surveys (Wilkins et al. 2006). However, where private lands are accessible or have been systematically surveyed, the species is often found (Wilkins et al. 2006).

The Texas Natural Diversity Database element of occurrence records maintained by the Texas Parks and Wildlife Department (which is a limited dataset based on voluntary submissions of sighting records) identify 57 occurrences of the black-capped vireo in the SEP-HCP Plan Area between 1985 and 2007 (Texas Parks and Wildlife Department 2010). These data indicate that the species has been recorded from Bexar, Medina, Bandera, Kerr, and Blanco counties. Additional black-capped vireo locality data was obtained from USFWS Austin Ecological Services in September 2009 in GIS format (i.e., "HistoricBirdSurveys_Observations.mdb"). The data included point records with attribute fields for the observation year and source, notes regarding the quality of the data, and other comments. The data were compiled from the work of several different surveyors and were dated from between the years 1989 and 2003.

Generalized black-capped vireo localities available from the Texas Natural Diversity Database and the USFWS are shown on Figure 4.

## 6.0 REGULATORY STATUS AND RECOVERY CRITERIA

### 6.1 CURRENT REGULATORY STATUS

The USFWS lists the black-capped vireo as endangered. The species was first proposed for endangered status on December 12, 1986 (51 FR 44808) and was given endangered status on October 6, 1987; the rule becoming effective on November 5, 1987 (52 FR 37420). The USFWS has not designated critical habitat for the black-capped vireo.

The black-capped vireo was state-listed as threatened on March 1, 1987 and endangered on December 28, 1987.

### 6.2 STATUS REVIEW AND RECOVERY CRITERIA

The USFWS includes the SEPHCP Plan Area within the black-capped vireo Recovery Region 3 – Southeast Edwards Plateau Recovery Region (USFWS 1991). A status review of the vireo by the USFWS was completed on June 19, 2007. The review assessed the current status of the species and recommended that the species be downlisted to threatened status (USFWS 2007).

The recommendation for downlisting is based on observations that the total known population of black-capped vireos in Texas is much larger than that known at the time of listing, due to an increase in the overall population size and/or increased survey efforts that identified populations at new locations (including on private lands). Given a larger known population, the magnitude of the major threats to the species may be generally less than previously suspected. However, the status review cautions that



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The 1991 Black-capped Vireo Recovery Plan is currently considered to be out-of-date and in need of revision (USFWS 2007), primarily because the known vireo population is currently much larger than the known population at the time of listing and the relative magnitude of the primary threats to the species is likely to have changed since listing. However, the recovery criteria listed in the 1991 Recovery Plan included a call for the protection of at least one viable vireo population composed of at least 500 to 1,000 breeding pairs in each of six recovery regions in Texas, Oklahoma, and Mexico.

As described in Section 5.2, many of the known black-capped vireo populations in the Plan Area occurred on public lands or designated nature preserves that are protected to some degree from future land development threats, and the size of the currently known population on these properties is approximately 420 breeding units (Wilkins et al. 2006). The Kerr Wildlife Management Area contains approximately 85 percent of these breeding units as a single population with regular habitat management.

## 7.0 THREATS AND HISTORIC TRENDS

The major threats to the black-capped vireo cited at the time the species was listed as endangered included habitat loss through conversion to other uses, heavy grazing and browsing pressure by domestic livestock and wildlife, and brood parasitism by brown-headed cowbirds (*Molothrus ater*) (USFWS 2007). Since listing, new information suggests that vegetational succession may also be a major concern for the species (USFWS 2007). The recent status review of the vireo by the USFWS states that habitat loss, grazing and browsing, brood parasitism, and vegetational succession remain the primary threats to the species, although the relative importance of each of these threats may have changed since the time of listing (USFWS 2007).

The 2007 status review found that habitat loss and fragmentation due to the conversion of rangeland to other uses has likely decreased the amount of available habitat for the black-capped vireo across Texas, particularly on the Edwards Plateau, and remains a major threat (USFWS 2007).

The status review found that fewer domestic livestock on the Edwards Plateau, particularly goats, may have decreased the overall threat from grazing and browsing. However, heavy grazing and browsing by domestic livestock may still have an important negative impact on localized vireo populations. While the density and abundance of domestic livestock on the Edwards Plateau may be decreasing, the populations of white-tailed deer (*Odocoileus virginianus*) and other exotic, browsing ungulates may have increased, which may be of concern to the species (USFWS 2007).

Brood parasitism by brown-headed cowbirds has been identified as a major factor in the low reproductive success of some black-capped vireo populations. Cowbird abundance is correlated with the number and proximity of domestic livestock feeding areas, and the relative abundance of cowbirds in Texas has generally been decreasing over the last ten years. In addition to the general decline of the abundance of cowbirds in North America, cowbird trapping and removal efforts are likely to have reduced parasitism rates on many of the managed populations. The status review states that the overall threat to the species from brood parasitism in Texas has likely decreased since the time of listing (USFWS 2007).

Vegetational succession, particularly the invasion and growth of Ashe juniper into formerly open rangelands, has limited vireo habitat across much of the range of the species. The status review identifies fire suppression, overgrazing, and drought as contributing factors to the increase of Ashe



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influx of nutrients from the surface in the forms of leaf litter, animal droppings, and animal carcasses (USFWS 2008).

General habitat characteristics for the federally listed Bexar County karst invertebrates are described below. Tables 1 and 2 summarize specific habitat variables measured for three of these species.

*Humidity and Temperature*
Troglobites require stable temperatures and high humidity approaching near saturation (Barr 1968, Culver 1982, Elliott and Reddell 1989). Generally, areas within caves that have low humidity are almost entirely devoid of cave fauna (Elliott and Reddell 1989). To sustain humid conditions, it is necessary to protect both the surface and subsurface drainage basins. This serves to maintain the supply of moisture to the cave and connected karst areas and also to insulate the karst system from extreme temperature fluctuations (USFWS 2008).

*Drainage Basins*
Water enters the karst ecosystem through both groundwater and surface drainage basins. Water is rapidly transported through cave openings, fractures, and solutionally enlarged bedding planes with little or no purification. Consequently, karst systems are highly sensitive to pollution from contaminated water traveling through the surface and subsurface drainage basins. The potential for pollutants, such as pesticides, fertilizers, and leakage from sewer lines, may be heightened in some karst areas relative to others based on local geologic features (USFWS 1994). Because of these factors, protecting caves' drainage basins is of vital importance (USFWS 2008).

*Surface Communities*
Due to insufficient and limited photosynthesis capabilities underground, the karst ecosystem relies almost entirely upon surface plant and animal communities for nutrient input. Surface plant communities provide nutrients through leaf litter that enters caves or karst voids and from root masses that may grow directly into caves (Howarth 1983). Surface plant communities also serve as a buffer against changes to moisture and temperature regimes within the karst ecosystem (Biological Advisory Team 1990, Veni 1988). Surface animals provide food for trogloxenes (i.e., animals that spend only a portion of their life cycle in the subterranean environment), such as cave crickets, bats, toads and frogs (USFWS 2008). Primary sources of nutrients in the karst ecosystem are leaf litter, cave crickets, small mammals, and other animals that defecate or die in the cave (USFWS 2003).

*Mesocavernous Habitat*
The use of interstitial zones or mesocaverns by troglobites may play an important part in these species' viability. These areas are defined as small, humanly inaccessible, solutionally enlarged voids that provide potential habitat for cave-dwelling species in the areas between caves (Veni 1994). Troglobites most likely use these areas the majority of the time, since humidity and temperature levels remain more stable than in larger caves (Howarth 1983). Use of interstitial spaces by troglobites has been observed in Japan, Hawaii, and Texas (Howarth 1983, Sprouse and Krejca 2009, Peter Sprouse pers. comm. 2010) and it is common to visit a cave several times before detecting the presence of a karst species. Krejca and Weckerly (2007) assessed the detection probabilities of three karst invertebrates, including *Rhadine exilis*, during karst faunal surveys. ~~There~~ results suggest that ten to 22 visits may be required in order to confirm presence. Furthermore, central Texas endangered karst invertebrates have been found in caves that immediately prior to sampling had no humanly accessible entrances (Horizon Environmental Services 1991, Veni 2002, Mark Sanders pers. comm. 2009).





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In order to support karst invertebrates, mesocavernous spaces should be a minimum width of five to 10 millimeters, which also corresponds to the threshold of turbulent groundwater flow that could potentially carry nutrients to karst species (Howarth 1983, Veni 1994).

In 2006, Veni and Associates quantified specific habitat characteristics for three of the listed species occurring on Camp Bullis (i.e., *Rhadine exilis*, *Rhadine infernalis*, and *Cicurina madla*). The results of this study are summarized below.

**Table 1.** Number of individuals observed within caves zones and seasons (Veni and Associates 2006).

| **Species** | **Total Individuals Observed** | **Cave Zones** | | |
|---|---|---|---|---|
| | | **Entrance Zone** | **Twilight Zone** | **Dark Zone** |
| *Rhadine exilis* | 64 | 4 | 18 | 47 |
| *Rhadine infernalis* | 23 | 6 | 10 | 7 |
| *Cicurina madla* | 75 | 0 | 3 | 72 |
| | | **Seasonal Observations** | | |
| | | **Fall** | **Spring** | **Summer** |
| *Rhadine exilis* | 64 | 12 | 37 | 15 |
| *Rhadine infernalis* | 23 | 1 | 13 | 9 |
| *Cicurina madla* | 75 | * | * | * |

*data not specified

**Table 2.** Mean temperature and humidity for recorded observations of three Bexar County endangered karst invertebrates (Veni and Associates 2006).

| **Species** | **Mean Temp (°F / °C)** | **Standard Deviation (°C)** | **Mean Humidity (%)** | **Standard Deviation** |
|---|---|---|---|---|
| *Rhadine exilis* | 21.44/ 70.59 | 1.24 | 93.5 | 3.62 |
| *Rhadine infernalis* | 22.05/71.69 | 2.62 | 90.5 | 3.44 |
| *Cicurina madla* | 20.03/68.0 | 0.82 | 94.01 | 2.24 |

**Regulatory Status**

The nine Bexar County karst invertebrates were federally listed as endangered species on December 26, 2000 (65 FR 81419). All species have a recovery priority of 2c, and critical habitat was designated on April 8, 2003 for all of the species, except the Government Canyon Bat Cave spider (Neoleptoneta microps) and Government Canyon Bat Cave meshweaver (Cicurina vespera). None of these species or their habitats receives direct protection under Texas state law, since invertebrates are not included on the Texas Parks and Wildlife Department's (TPWD) list of threatened and endangered species.





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Based on data in table, looks like the F and C be reversed so that the C is first and the F second.

**Threats and Impacts Assessment**

The primary threat to these species is habitat loss due to increased human expansion and urbanization throughout the karst terrain in Bexar County (USFWS 2003, USFWS 2008). Threats associated with increased urbanization include filling in and collapsing of caves, alteration of drainage patterns, alteration of surface plant and animal communities, contamination, and vandalism.

In addition, the continued spread of non-native, invasive species, such as the red-imported fire ant (Solenopsis invicta), poses a serious threat to karst invertebrates through direct predation and competition with native species (Taylor et. al 2003, USFWS 2008). This is a particularly important issue for listed invertebrates in central Texas because many of the caves in this region are shallow and provide refuge to red-imported fire ants during temperature extremes. Red-imported fire ants have also been directly observed attacking and carrying off cave crickets, a species that serves an integral role in the karst ecosystem (Elliott 2000, Paul Fushille pers. comm. 2010). This threat may be intensified by edge effects associated with the soil disturbance and disruption to native communities that come with urbanization (Reddell 1993).

Due to low known population densities, the rarity of encountering some species (Krejca and Weckerly 2007), and the potential for numerous confounding variables, potential impacts affecting karst invertebrates are inherently difficult to detect. Population responses may not be immediate and/or detectible (Howarth 1983, Miller and Reddell 2005).

**Uncertainties and Data Gaps**

Population estimates for any of the listed species are currently unavailable. This is mostly due to the inaccessibility of habitat, low detection probabilities, and lack of adequate sampling techniques.

Also, as previously mentioned, many features in Bexar County that could potentially have listed species have not been biologically investigated. Access to these unexplored features could contribute substantially to information on the distribution of these species.

More information on the life history of these species is needed, particularly with topics such as longevity, fecundity, reproductive cues, predator-prey relationships, and others.





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Where did these data come from, especially the vegetation data?

**Analysis of Proposed Critical Habitat Units for Potential Karst Preserve Opportunities**

DRAFT March 31, 2011

| PROPOSED CHU NUMBER | KNOWN OCCUPIED CAVES | LAND OWNERSHIP TYPE | LISTED SPECIES IN UNIT | KNOWN TO BE OCCUPIED AT TIME OF LISTING | CURRENTLY OCCUPIED | TOTAL ACREAGE | NATURAL VEGETATION ACRES | NATURAL VEGETATION % | INVASIVE VEGETATION ACRES | INVASIVE VEGETATION % | DISTURBED/NON-NATIVE VEGETATION ACRES | DISTURBED/NON-NATIVE VEGETATION % | URBAN ACRES | URBAN % | NO DATA ACRES | NO DATA % | Current Possible KFA Status | Future KFA Opportunity | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1a | Bone Pile Cave<br>Surprise Sink | State | *R. infernalis*<br>*C. madla* | Yes | Yes | 237.9 | 235 | 99% | 0 | - | 0 | - | 0 | - | 3 | 1% | H+ | H+ | |
| 1b | Government Canyon<br>Bat Cave | State | *C. vespera*<br>*N. microps*<br>*R. exilis*<br>*R. infernalis* | Yes | Yes | 178.2 | 176 | 99% | 0 | - | 0 | - | 0 | - | 3 | 2% | H+ | H+ | |
| 1c | Lost Pothole | State | *C. madla* | Yes | Yes | 178.2 | 174 | 98% | 0 | - | 0 | - | 0 | - | 3 | 2% | H+ | H+ | |
| 1d | Dancing Rattler Cave<br>Lithic Ridge Cave<br>Hackberry Sink | State | *C. madla*<br>*R. exilis*<br>*R. infernalis* | Yes | Yes | 348.8 | 341 | 98% | 0 | - | 0 | - | 0 | - | 9 | 3% | H+ | H+ | |
| 1e | Canyon Ranch Pit*<br>Continental Park Cave<br>Creek Bank Cave<br>Fat Man's Nightmare Cave*<br>Pig Cave<br>San Antonio Ranch Pit<br>Scenic Overlook Cave*<br>Tight Cave | State<br>City<br>Private | *R. infernalis*<br>*R. exilis*<br>*B. venyivi*<br>*C. madla* | No | Yes | 690.2 | 674.2 | 98% | 1 | - | 0 | - | 1 | - | 16 | 2% | H+ | H+ | |
| 1f | 10K Cave | State | *R. infernalis* | No | Yes | 178.2 | 175 | 98% | 0 | - | 0 | - | 0 | - | 3 | 2% | H+ | H+ | |
| 2 | Logan's Cave<br>Madla's Drop Cave | Private | *C. madla*<br>*R. exilis*<br>*R. infernalis* | Yes | Yes | 251.7 | 237 | 94% | 0.2 | - | 0.5 | - | 10 | 4% | 4 | 2% | | H- | |
| 3 | Helotes Blowhole*<br>Helotes Hilltop Cave* | Private | *R. exilis*<br>*R. infernalis* | Yes | Yes | 125.1 | 96.7 | 77% | 1 | 1% | 1 | 1% | 24 | 19% | 2 | 2% | | H- | |
| 4 | Kamikazi Cricket Cave<br>Mattke Cave<br>Scorpion Cave | Private | *R. exilis*<br>*R. infernalis* | Yes | Yes | 254.6 | 205.8 | 81% | 1 | - | 0 | - | 43 | 17% | 4 | 2% | | H- | |
| 5 | Christmas Cave | Private | *C. madla*<br>*R. exilis*<br>*R. infernalis*<br>*B. venyivi* | Yes | Yes | 117.3 | 109 | 93% | 0 | - | 0 | - | 8 | 7% | 1 | 1% | | H- | |
| 6 | John Wagner Ranch Cave No. 3* | Private<br>City | *C. madla*<br>*R. exilis*<br>*R. infernalis* | Yes | Yes | 105.1 | 103 | 98% | 0 | - | 0 | - | 1 | 1% | 1 | 1% | H+ | H+ | |
| 7 | Young Cave No. 1 | Private | *R. exilis* | Yes | Yes | 157.9 | 151 | 96% | 0 | - | 0 | - | 3 | 2% | 4 | 3% | | H+ | |
| 8 | Three Fingers Cave<br>Hills and Dales Pit*<br>Robber's Cave | Private<br>City | *C. madla*<br>*R. infernalis*<br>*R. exilis* | Yes | Yes | 470.6 | 326.3 | 69% | 0 | - | 27 | 6% | 116 | 25% | 1 | - | H+ | M- | CAVE ON COSA LAND COULD BE CURRENT HIGH; CAVES ON PRIVATE LAND COULD BE MEDIUM |
| 9 | Mastodon Pit<br>Feature No. 50<br>La Cantera Cave No.1<br>La Cantera Cave No. 2 | State<br>Private | *C. madla*<br>*R. exilis* | Yes | Yes | 286.2 | 135 | 47% | 11 | 4% | 47 | 16% | 95 | 33% | 0 | - | | M- | MIGHT BE ABLE TO CREATE A MEDIUM PRESERVE ON SOUTH SIDE OF ROAD |
| 10a | Low Priority Cave [1] | City<br>Private | *R. infernalis* | Yes | Yes | 66.8 | 65.7 | 98% | 0 | - | 0 | - | 0 | - | 1 | 1% | H+ | H+ | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 10b | Flying Buzzworm Cave [1] | City | *R. infernalis* | Yes | Yes | 65.6 | 65 | 99% | 1 | 2% | 0 | - | 0 | - | 0.1 | - | H+ | H+ | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 11a | Up The Creek Cave[1] | Private | *R. exilis* | Yes | Yes | 20.5 | 19.8 | 97% | 0 | - | 0 | - | 0 | - | 0.3 | 1% | H+ | H+ | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 11b | Bunny Hole[1] | Private | *R. exilis* | Yes | Yes | 15.5 | 14 | 90% | 0 | - | 0 | - | 2 | 13% | 0 | - | H- | H- | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 11c | Poor Boy Baculum Cave [1] | Private | *R. exilis* | Yes | Yes | 21.2 | 5 | 24% | 1 | 5% | 0 | - | 15 | 71% | 0 | - | H- | H- | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 11d | Root Toupee Cave[1] | Private | *R. exilis* | No | Yes | 52.5 | 7.3 | 14% | 0.3 | 1% | 2 | 4% | 42 | 80% | 0 | - | H- | H- | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 11e | Blanco Cave | Private | *R. exilis* | No | Yes | 102.1 | 23 | 23% | 3 | 3% | 1 | 1% | 75 | 73% | 0 | - | M- | M- | ANALYSIS INCLUDES REVIEW OF ADJACENT AREA ON CAMP BULLIS |
| 12 | Hairy Tooth Cave<br>Ragin' Cajun Cave | Private | *R. exilis* | Yes | Yes | 370.9 | 185.4 | 50% | 0 | - | 14 | 4% | 173 | 47% | 0.2 | - | | NONE | CAVES LOCATED IN A PREDOMINENTLY URBAN AREA |
| 13 | Black Cat Cave | Private | *R. exilis* | Yes | Yes | 187.2 | 86.8 | 46% | 23 | 12% | 0 | - | 77 | 41% | 0 | - | | M- | |

# Appendix E & F BAT Comments

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why only mechanical-- isn't prescribed fire less expensive and have additional ecological benefits?



## Appendix F. Estimated SEP-HCP Implementation Costs

| Plan Year: | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| Deer Population Control Equipment (GCW & BCV)<br>Equipment costs include one deer feeder and one ground blind for each 500 acres of preserve. Assumes 35 50-lb bags of deer corn per feeder during 8 week WTD hunting season plus two weeks of pre-season baiting. Equipment can be used either by a staff-operated deer population control program or by contract services. Assumptions stated in 2011 dollars and costs inflated annually by 3%. | $ 1,397 | $ 1,439 | $ 1,483 | $ 1,527 | $ 3,936 | $ 2,432 | $ 2,505 | $ 2,581 | $ 2,659 | $ 5,477 |
| Feral Hog Control - Equipment Only<br>Assumes purchase of 1 corral trap/2,000 acres of preserve and 1 box trap per 3,000 acres of preserve. Cost of corral trap estimated at $665/trap and cost of box trap estimated at $400/trap. Does not include replacement or operations (bait) costs. Equipment can be used either by a staff-operated feral hog control program or by contract services. Assumptions stated in 2011 dollars and costs inflated annually by 3%. | $ 1,520 | $ 977 | $ [illegible] | $ 1,036 | $ - | $ 1,761 | $ - | $ 1,868 | $ 1,201 | $ - |
| Fire Ant Control (BCV)<br>Estimated at one pallet of fire ant bait (Spinosad) per 1,000 acres of BCV preserve. Cost is approximately $4800 (in 2011 dollars) per pallet. First purchase scheduled for year 2 of the Permit. Costs inflate annually by 3%. Preserve staff to apply as an individual mound treatment as needed. | $ - | $ 7,048 | $ - | $ - | $ - | $ - | $ - | $ 8,415 | $ - | $ - |
| Fire Ant Control (Karst)<br>Estimated cost of materials needed to treat fire ant mounds twice per year with boiling water within 165 feet of cave entrance is $220/80 acres of preserve. Materials include rain collection barrels at each cave, fuel to heat water, and a hot water pressure washer for applying boiling water for $5,000 (purchased in Year 3 of the Plan and replaced every 15 years). Assumptions stated in 2011 dollars and costs inflate annually by 3%. Assumes labor completed by staff. | $ 613 | $ 661 | $ 711 | $ 764 | $ 9,182 | $ 1,223 | $ 1,293 | $ 1,368 | $ 1,445 | $ 1,525 |
| Vireo Habitat Restoration and Management - Mechanical<br>Estimated at $530/acre of BCV preserve (in 2011 dollars) and repeated every 15 years. Includes contract services for operator, transport, and fuel. First purchase occurs in year 2 of the Permit. Costs inflate annually by 3%. | $ 126,197 | $ 129,983 | $ 133,882 | $ 137,898 | $ 142,035 | $ 292,592 | $ 301,370 | $ 310,412 | $ 319,724 | $ 329,316 |
| General Vegetation Management - Equipment and Materials<br>Estimated costs are for equipment and materials for general vegetation management on all preserves, such as herbicides, chainsaws, safety equipment, and related items. Costs estimated at $650 for each 3,000 acres of total preserve. Assumes labor completed by staff. Assumptions stated in 2011 dollars and costs inflated annually by 3%. | $ - | $ - | $ 984 | $ - | $ 1,044 | $ - | $ 1,107 | $ - | $ - | $ 1,209 |
| Vegetation Enhancement (Karst - 2,400 acre preserve)<br>Estimated at $40/year for each 80 acres of preserve (in 2011 dollars) and the management activity is repeated every 5 years. Costs are for native seed mixes that will contribute to the overall health and diversity of native vegetation within 345 feet of cave entrance. The first purchase occurs in year 2 of the Permit. Costs inflate annually by 3%. | $ 162 | $ 168 | $ 174 | $ 180 | $ 248 | $ 256 | $ 264 | $ 272 | $ 280 | $ 360 |