Bee Creek Cave Harvestman
(*Texella reddelli*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
Austin, Texas

5-YEAR REVIEW
Bee Creek Cave harvestman (*Texella reddelli*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest Regional Office, Region 2
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1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act (16 U.S.C. 1531 et seq.). The Service provides notice of status reviews via the Federal Register and requests information on the status of the species. This review was conducted by Cyndee Watson from the AESFO. This status review mostly relied on information summarized and cited in Balcones Canyonlands Preserve (BCP)[1] Annual Report (BCCP 2009a)[2] and the BCP cave assessment (BCCP 2009b). We also used the draft Bexar County Karst Invertebrate Recovery Plan (Bexar RP) (Service 2008), which contains new karst invertebrate research and preserve design concepts; the Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson counties, Texas (Travis and Williamson RP) (Service 1994), and cave data contained within AESFO's files.

As a basic first step in assessing whether caves that contain the Bee Creek Cave harvestman met the downlisting recovery criteria in the Travis and Williamson RP, we compiled a list of some basic characteristics of karst preserves/recovery criteria (further described in Section 2.2.3). While the Travis and Williamson RP discusses broad concepts regarding preserve design, the draft Bexar RP has an appendix that is a compilation of research to help more specifically delineate preserve boundaries that

[1] BCP - A system of preserves permanently set aside to conserve habitat for 8 endangered species (including *T. reddelli*) and 27 species of concern as part of a joint regional 10(A)(1)(B) incidental take permit PRT 788841, held by the City of Austin and Travis County.
[2] BCCP - The incidental take permit mentioned above is also referred to as the Balcones Canyonlands Conservation Plan (BCCP).

follow those basic concepts (Service 2008). These preserve design principles and characteristics describe what is needed to protect each karst feature and its surrounding area. From the list of known locations of this species, we identified those that had the highest likelihood of meeting these characteristics. Our determinations (discussed in section 2.2.3) for each of these characteristics were based on site-specific information found in the AESFO's files and on cave location and parcel data. Unless otherwise noted, all acreage estimates were calculated using Geographic Information Systems (GIS) (2008 digital aerial photography and 2006 Travis County parcel data) and are subject to typical margins of error associated with GPS units, GIS, and transferring data from paper sources to digital media. These acreages and respective cave locations need to be ground-truthed (i.e., verified by site visits).

1.3 Background:

The Bee Cave Creek harvestman, *Texella reddelli*, is a troglobite, which is a species restricted to the subterranean environment and that typically exhibits morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment. Troglobitic habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Travis County. Karst areas commonly have few surface streams; most water moves through cavities underground. Within this habitat this species depends on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter fallen or washed in, animal droppings, and animal carcasses. It is imperative to consider that while these species spend their entire lives underground, their ecosystem is very dependent on the overlying surface habitat.

Texella reddelli was listed as endangered in 1988, based on the threats of: 1) habitat loss to development; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (i.e. the red-imported fire ant (RIFA), *Solenopsis invicta*), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; mining; quarrying (limestone); or, blasting above or in caves.

There are eight caves known to contain *T. reddelli* in Travis County, Texas. Currently, *T. reddelli* faces the same threats as it did at the time it was listed.

1.3.1
FR Notice citation announcing initiation of this review: 75 FR 20134, April 23, 2007

1.3.2 Listing history

Original Listing
FR notice: 53 FR 36029
Date listed: September 16, 1988
Entity listed: Bee Creek Cave harvestman (*Texella reddelli)*
Classification: Endangered

1.3.3 Associated rulemakings: Not applicable

1.3.4 Review History: Status reviews for the Bee Creek Cave harvestman were conducted in 1988 for the final listing of the species (53 FR 36029) and in 1994 for the Travis and Williamson RP (Service 1994).

1.3.5 Species' Recovery Priority Number at start of 5-year review: 2C

1.3.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas
Date issued: 1994

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? No, the species is an arachnid, so the DPS policy does not apply.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information: The recovery

plan only provides criteria for downlisting from endangered to threatened (Service 1994).

Recovery Criteria: Each species will be considered for reclassification from endangered to threatened when:

(1) Three karst fauna areas (KFA) (if at least three exist) within each karst fauna region (KFR) in each species' range are protected in perpetuity. If fewer than three KFAs exist within a given KFR, then all KFAs within that region should be protected. If the entire range of a given species contains less than three KFAs, then they should all be protected for that species to be considered for downlisting.

(2) Criterion (1) has been maintained for at least five consecutive years with assurances that these areas will remain protected in perpetuity.

There are seven KFRs (adapted from the karst fauna areas in Figure 19 of Veni & Associates' 1992 report and reproduced in Figure 2 of the Travis and Williamson RP) in Travis and Williamson Counties that are known to contain listed karst invertebrate species. These regions are delineated based on geologic continuity, hydrology, and the distribution of rare troglobites.

Within each KFR, established karst preserves may be considered a KFA if they meet recovery criteria. For the purposes of the recovery plan, a KFA is an area known to support one or more locations of a listed species and is distinct in that it acts as a system that is separated from other KFAs by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna. Karst fauna areas should be far enough apart so that if a catastrophic event (for example, contamination of the water supply, flooding, disease) were to destroy one of the areas, that event would not likely destroy any other area occupied by that species. To be considered "protected", a KFA must be sufficiently large to maintain the integrity of the karst ecosystem on which the species depends. In addition, these areas must also provide protection from threats such as red-imported fire ants (*Solenopsis invicta*) (RIFA), habitat destruction, and contaminants.

Brief summary of preserve design principles:
Much of the conservation and recovery of this rare and cryptic species is dependent upon the long-term preservation of its habitat. Because most endangered karst invertebrates are difficult to detect during in-cave faunal surveys, their conservation strategies focus on the delineation, study, and management of occupied KFAs. Regarding size and configuration of KFAs, the Travis and Williamson RP provides some conceptual guidelines on habitat conditions that are important to karst invertebrates, including maintaining humid conditions, air flow, and stable temperatures in the air-filled voids. Also necessary are maintaining adequate nutrient supply; preventing contamination from the surface and groundwater entering the karst ecosystem; controlling the invasion of exotic species, e.g., RIFA; and allowing for movement of karst fauna and nutrients through voids between karst features (Service 1994). Additional scientific information

and karst preserve design guidelines are presented in the draft Bexar RP and help to further define a protected KFA (Service 2008). According to these preserve design guidelines, KFAs should include the following: 1) surface and subsurface drainage basins of at least one occupied karst feature (i.e. cave); 2) ideally a minimum of 24 to 36 hectares (ha) (59 to 89 acres(ac)) of contiguous, unfragmented, undisturbed land to maintain native plant and animal communities around the feature and protect the subsurface karst community; 3) 105 meter (m) (345 foot (ft)) radius, undisturbed, from each cave entrance for cave cricket foraging; and 4) at least 100 m (328 ft), undisturbed, from the cave footprint to the edge of the preserve to minimize deleterious edge effects (Service 2008). The Bexar RP also recognizes various qualities of KFAs. A medium quality KFA is 16 to 24 ha (40 to 60 ac) and a high quality KFA is 24 to 36 ha (60 to 90 ac). Any karst preserve less than 16 ha (40 ac) will not count toward meeting the minimum Bexar County recovery criteria. The quality of KFAs is defined based on the probability of long-term survival of the species in that area and the amount of active management necessary to maintain those species. High quality KFAs tend to be larger, require less active management, and have a higher probability of long-term species survival. Medium quality KFAs have some compromised characteristics of a high quality preserve, but still have potential for reasonable remediation. Additionally, the Bexar RP outlines perpetual management, maintenance, and monitoring necessary for ensuring a high probability of species survival at each site (Service 2008). At a minimum, these activities should include: 1) controlling RIFA; 2) installing and maintaining fencing; 3) installing, if necessary, and maintaining cave gates; and 4) monitoring of karst invertebrates and the ecosystem upon which they depend (Service 2008).

Analysis regarding whether downlisting criteria have been met:
Eight known caves in Travis County, Texas, have confirmed presence of the Bee Creek Cave harvestman (Table 1). These caves are within the Jollyville Plateau, Rollingwood, and McNeil/Round Rock KFRs with three caves, four caves, and one cave respectively (Map 1). The preserve design principles and perpetual management, maintenance, and monitoring guidelines listed above were applied to each cave containing this species to determine its possibility as being considered a protected KFA. Based on a review of available data, none of these caves currently meet this definition; however, with some additional data gathering and/or confirmation/implementation of certain activities, there is potential for two areas (with caves) in the Jollyville Plateau KFR to meet protected KFA status. In particular, more research is needed to delineate the subsurface drainage basin for caves in both of these areas. These two areas and a description of how they have the potential to meet KFA status are discussed below.

Jollyville Plateau KFR:
Spider Cave – The City of Austin owns this cave which is in a 464-ha (1,148-ac) tract[3] referred to as West Park and is considered part of the BCP (BCCP 2009b). The cave entrance and cave footprint are more than 105 m (345 ft) from an edge (i.e., disturbance e.g. road or a development) (ZARA 2006). The surface drainage basin for this cave is included in this tract (BCCP 2009b); however, the subsurface drainage basin has not been

[3] Tract – refers to a contiguous undeveloped piece of land.

delineated so we are not sure if it is in this tract. As part of perpetual management for the cave, the City of Austin maintains the perimeter fence, conducts quarterly site visits looking for human intrusion and RIFA (including RIFA treatment), and surveys the cave fauna annually (BCCP 2009a, b).

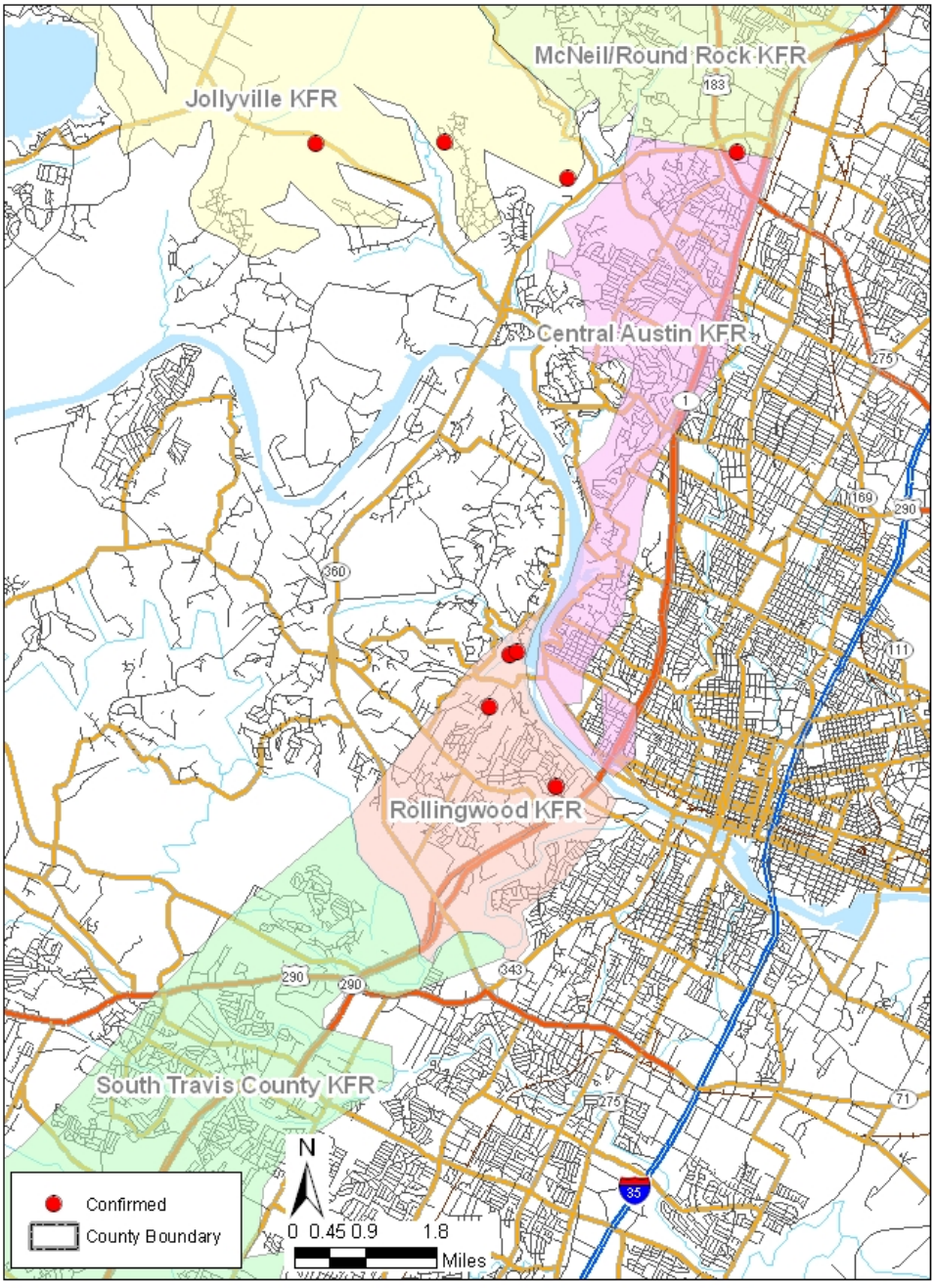
Jest John Cave[4] – This cave is owned by the BCP and is located in a >1,695-ha (4,189-ac) tract (BCCP 2009b). The cave entrance and footprint are more than 365 m (1,200 ft) from the nearest edge (i.e., disturbance e.g. road or a development) (Elliott 1997, BCCP 2009b). The surface drainage basin for this cave is included in this tract (BCCP 2009b); however, the subsurface drainage basin has not been delineated so we are not sure if it is in this tract. The City of Austin conducts biannual surface monitoring of this cave and cave cricket exit counts (BCCP 2009b); however, due to rugged terrain and its remote location, it has not been treated for RIFA. Quarterly faunal surveys have also not been conducted because during surveys, several cave crickets are crushed as this is a narrow cave (M. Sanders, City of Austin, pers. comm. 2009).

[4] Ubick and Briggs (2004) state that *T. reyesi* (not *T. reddelli*) occurs in Jest John Cave; however, the BCP lists *T. reddelli* in this cave. Ubick and Briggs (2004) states that *T. reddelli* does occur in Jester Estates Cave which is only 1.5 miles away from Jest John Cave and in the same KFR. Until genetic research is conducted to reconcile this discrepancy we are considering that *T. reddelli* occurs in Jest John Cave.

Table 1. *T. reddelli* Distribution

Cave name	Size of tract (acres)**	Notes
Jollyville Plateau KFR		
Spider Cave	1,148	Within the BCP and has quarterly site visits and RIFA treatment with boiling water.
Jest John Cave	4,189	Within the BCP and has regular site inspections
Jester Estates Cave	<1	Privately owned near subdivision. In 2008, BCP staff found that a neighbor's pool was leaking, much of the preserve was saturated including the cave, uncertain what impacts this had on the cave fauna.
Rollingwood KFR		
Little Black Hole	17*	BCP owned cave; very close to houses
Little Bee Creek Cave	17	BCP owned and receives regular site inspections
Bee Creek Cave	<1	Privately owned; appears to be receiving human visitation
Bandit Cave	<1	Privately owned; landowner does not allow entry into the cave
McNeil/Round Rock KFR		
Stark's North Mine Cave	>1?	Privately owned; located near a shopping center

Acreage was estimated in GIS and/or verified with BCCP 2009b.
*Not included in BCCP 2009b.
**Unless otherwise noted all acreage estimates were calculated using Geographic Information Systems (GIS) (2008 digital aerial photography and 2006 Travis County parcel data), and data from BCCP 2009b and are subject to typical margins of error associated with GPS units, GIS, and transferring data from paper sources to digital media. These acreages and respective cave locations need to be ground-truthed (i.e., verified by site visits).



Map 1. *T. reddelli* Distribution

Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC) (2007) "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007). It is very likely that over the past 50 years cold days, cold nights, and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). It is likely that heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007). To date, these changes do not appear to have had a negative impact on *T. reddelli*.

The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely larger than those observed during the 20th century. For the next two decades a warming of about 0.2°C (0.4°F) per decade is projected (IPCC 2007). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007). Various emissions scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007). Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007). The IPCC says it is very likely hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007). There is also high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to climate change (IPCC 2007). Milly et al. (2005) project a 10–30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

Although climate change was not identified as a threat to *T. reddelli* in the original listing document or in the recovery plan, the harvestman's dependence on stable temperature and humidity open the possibility of climatic change impacting the species. While it appears reasonable to assume that *T. reddelli* may be affected, we lack sufficient certainty to know how climate change will affect the species.

2.3 Synthesis

According to recovery criterion (1) in the Travis and Williamson RP, three KFAs within each KFR should be protected. Protection is defined as an area sufficiently large to maintain the integrity of the karst ecosystem upon which the species depends. These areas must also provide protection from threats such as RIFA, habitat destruction, and contaminants. Recovery criterion (2) requires at least five consecutive years of criterion (1) being met and that perpetual protection of these areas is in place. Since this species was listed in 1988, there have been significant steps toward protecting caves in which it occurs and meeting the downlisting criteria.

Within the Jollyville KFR, there are currently two caves (Spider Cave and Jest John Cave) that have potential for meeting the definition of a KFA. With some additional research on the subsurface drainage basins of both caves and/or implementation of certain management activities, we should be able to make this determination. In total, there could be two KFAs for this species within the Jollyville KFR.

If a cave is determined to be a KFA, then information relating to recovery criterion (2) should be gathered and/or implemented to meet downlisting criteria; however, there does not appear to be enough potential KFAs per KFR to meet downlisting criteria. Until such time, we do not recommend a change in listing status for this species.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ **No change is needed**

3.2 New Recovery Priority Number: No change

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS – THESE ARE THE HIGHEST PRIORITY ACTIONS FOR THE NEXT 5 YEARS -

- Determine the subsurface drainage basins for Jest John Cave and Spider Cave.
- Confirm and/or implement RIFA control at Jest John Cave and Spider Cave.
- Find more *T. reddelli* locations that could meet KFA status and protect them to meet downlisting criteria.
- Considering the geographic distance between northern (Jollyville and McNeil/Round Rock KFRs) and southern (Rollingwood KFR) caves where this species occurs, the fact that they are separated by a major hydrologic divide (Colorado River), and that the northern caves occur within the range of the closely related Bone Cave harvestman (*Texella reyesi*), genetic analyses to confirm the presence of the Bee Creek Cave harvestman are needed.

5.0 REFERENCES

BCCP (Balcones Canyonlands Conservation Plan). 2009a. Balcones Canyonlands Conservation Plan 2007 annual report (October 2006-September 2007). USFWS Regional section 10(a)(1)(B) Permit No. PRT-788841, Travis County and City of Austin. Karst report tab, 110 pp.

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FISH AND WILDLIFE SERVICE
5-YEAR REVIEW for the Bee Creek Cave Harvestman (*Texella reddelli*)

Current Classification: endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__x__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: n/a

Review Conducted By: Cyndee Watson, Austin Ecological Services Office, Austin, Texas

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 6/26/09

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Region 2

Signature Nancy G Gloman Date 12-4-09