Bee Creek Cave Harvestman
(*Texella reddelli*)
5-Year Status Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
Austin, Texas
August 11, 2023

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

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional or Headquarters Office:
Vanessa Burge, Recovery Biologist, Southwest Regional Office, Albuquerque, New Mexico, vanessa_burge@fws.gov

Lead Field Office:
Michael Warriner, Supervisory Fish and Wildlife Biologist and Jenny Wilson, Fish and Wildlife Biologist, Austin Ecological Services Field Office, Austin, Texas, michael_warriner@fws.gov

Cooperating Field Office(s):
Not applicable

Cooperating Regional Office(s):
Not applicable

1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service or USFWS) is required by section 4(c)(2) of the Endangered Species ESA (ESA) to conduct a status review of each listed species once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.3 Methodology used to complete the review:

The 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 ESA (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. Data for this status review were solicited from interested parties through a *Federal Register* notice announcing this review on January

11, 2023 (88 FR 1602). We considered both new and previously existing information from federal and state agencies, municipal and county governments, non-governmental organizations, researchers, and the general public.

1.4 Background:

1.4.1 FR Notice citation announcing initiation of this review:

88 FR 1602, January 11, 2023

1.4.2 Listing history:

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

Revised Listing, if applicable
FR notice: Not applicable
Date listed: Not applicable
Entity listed: Not applicable
Classification: Not applicable

1.4.3 Associated Rulemakings:

Not applicable

1.4.4 Review History:

Status reviews for the Bee Creek Cave harvestman were conducted in 1988 for the final listing of the species (53 FR 36029), 1994 for the Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas (Service 1994, entire), and 2009 (Service 2009, entire) and 2018 (Service 2018a, entire) for 5-year reviews.

1.4.5 Species' Recovery Priority Number at start of 5-year review:

2C

1.4.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas
Date issued: 1994
Dates of previous plans/amendment or outline, if applicable: Amendment 1, 2019

2.0 REVIEW ANALYSIS

Section 4 of the ESA (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species meets the definition of "endangered species" or "threatened species." The ESA defines an "endangered species" as a species that is "in danger of extinction throughout all or a significant portion of its range," and a "threatened species" as a species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The ESA requires that we determine whether a species meets the definition of "endangered species" or "threatened species" due to any of the five factors described below.

Section 4(a) of the Act describes five factors that may lead to endangered or threatened status for a species. These include: A) the present or threatened destruction, modification, or curtailment of its habitat or range; B) overutilization for commercial, recreational, scientific, or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; or E) other natural or manmade factors affecting its continued existence.

The identification of any threat(s) does not necessarily mean that the species meets the statutory definition of an "endangered species" or a "threatened species." In assessing whether a species meets either definition, we must evaluate all identified threats by considering the expected response of the species, and the effects of the threats—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the species as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The Service recommends whether the species meets the definition of an "endangered species" or a "threatened species" only after conducting this cumulative analysis and describing the expected effect on the species now and in the foreseeable future.

2.1 Distinct Population Segment (DPS) policy (1996):

No, this species is an invertebrate, so the DPS policy does not apply.

2.2 Updated Information and Current Species Status

2.2.1 Biology and Habitat

2.2.1.1 New information on the species' biology and life history:

No new information.

2.2.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, birth rate, seed set, germination rate, age at mortality, mortality rate, etc.), or demographic trends:

No new information.

2.2.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Derkarabetian et al. (2022, entire) conducted genetic analyses of Bee Creek Cave and Bone Cave harvestman (*T. reyesi*) individuals taken from multiple caves in Travis and Williamson counties, Texas. Populations of the Bee Creek Cave harvestman south of the Colorado River are genetically divergent from populations assigned to the species in the Jollyville Plateau Karst Fauna Region, north of the Colorado River, and from sampled populations of the Bone Cave harvestman (Derkarabetian et al. 2022, pp. 408, 422, 414). Bee Creek Cave harvestman populations in the Jollyville Plateau Karst Fauna Region group with either a Bone Cave harvestman genetic clade or are associated with a genetic cluster of the latter species (Derkarabetian et al 2022, p. 414). As a result, we treat those sites as occupied by the Bone Cave harvestman.

2.2.1.4 Taxonomic classification or changes in nomenclature:

No new information.

2.2.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, pollinator availability, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

As noted in Section 2.2.1.3, populations of the Bee Creek Cave harvestman, north of the Colorado River genetically group with the Bone Cave harvestman. In the Service's Species Status Assessment for the Bone Cave harvestman (Service 2022, p. 23), populations of the Bee Creek Cave harvestman, genetically assessed by Derkarabetian et al. (2022, entire) and others in close proximity to sampled sites, were treated as Bone Cave harvestman populations. As a result, the range of the Bee Creek Cave harvestman is no longer considered to include karst features in the Jollyville Plateau Karst Fauna Region previously assigned to the species (i.e., Jester Estates, RI-1, Spider Caves and Merkin Hole). Instead, harvestman from those caves now fall within the range of the Bone Cave harvestman.

The distribution of the Bee Creek Cave harvestman is now confined to four caves in the Rollingwood Karst Fauna Region. Along with those caves, *Texella* individuals from several surface and subsurface localities geographically distant from the region have been assigned to the Bee Creek Cave harvestman (Service 2018a, pp. 14-15. Individuals from these outlying sites have never been subject to genetic analyses and were assigned to the Bee Creek Cave harvestman based on morphological characters alone (Derkarabetian et al. 2022, p. 414). Derkarabetian et al. (2022, p. 414) postulated that genetic analysis of those populations may reveal new Bee Creek Cave harvestman clades or new *Texella* species.

For purposes of this review, the populations in the four caves morphologically and genetically identified as the Bee Creek Cave harvestman or within close proximity to those caves are included in the range of the species. Following Veni and Jones (2021, pp. 30, 43), we treat the remaining outlier populations as tentatively referable to the Bee Creek Cave harvestman but do not include them within the range of the species until additional genetic and morphological work can fully address species status.

An important consideration for this 5-year review was whether occupied caves warranted consolidation into single populations based on geographic proximity (Service 2018b, pp. 24, 49-50). Although there are no data specific to the Bee Creek Cave harvestman, research indicates that troglobitic arachnids and insects may disperse through networks of subterranean voids (e.g., mesocaverns). In central Texas, some troglobitic beetles (i.e., *Rhadine*), bristletails (i.e., *Texoredellia*), and spiders (e.g., *Cicurina* and *Tayshaneta*) have exhibited genetic connectivity among occupied caves (Avise and Selander 1972, p. 15; Paquin and Hedin 2004, p. 3250; Paquin and Hedin 2005, pp. 4-5, 14-15; Ledford et al. 2012, pp. 11, 18-23; Espinasa et al. 2016, pp. 233, 236, 238). Subterranean dispersal of troglobitic invertebrates, along with resultant gene flow in some cases, has been suggested to occur in cave systems of Australia (Moulds et al. 2007, pp. 8, 10), Brazil (Jaffé et al. 2016, pp. 11-12), and regions of the United States (i.e., Kentucky; Turanchik and Kane 1979, pp. 65- 67).

Ledford et al. (2012, pp. 11, 18-23, 51) documented significant genetic similarity (i.e., mitochondrial and nuclear DNA) among Tooth Cave spider (*Tayshaneta myopica*) populations at Gallifer, Root, Tooth Caves and Tight Pit in Travis County. Genetic similarity among Tooth Cave spiders sampled from those sites implies dispersal of individuals between caves over time through interconnected subterranean dispersal corridors such as fissures or mesocaverns (Ledford et al. 2012, pp. 11, 51). The greatest distance between genetically similar Tooth Cave spider populations at Tight Pit and Gallifer, Root, and Tooth Caves is approximately 292 meters (m) [958 feet (ft)].

For our assessment, we assumed that populations of the Bee Creek Cave harvestman, given adequate geological connectivity, are capable of subterranean dispersal and gene flow among karst features. To account for potential genetic connectivity of populations, we assigned a maximum dispersal radius of 300 m (984 ft) from each cave occupied by the species. That value is a conservative estimate that is most similar to distances exhibited by the Tooth Cave spider. Given the extent of geological connectivity surrounding caves, actual Bee Creek Cave harvestman dispersal distances may be greater or less than that value. Genetic analyses would be necessary to provide more certainty regarding actual dispersal distances. We did not apply this methodology to surface sites given the lack of detailed data on habitat conditions at these locations.

For each cave occupied by the Bee Creek Cave harvestman, we established a 300-m (984-ft) radius around individual sites in ArcGIS with the entrance as a center-point. If the respective radiuses of adjacent caves over-lapped (or caves were within 600 m (1968 ft) of each other), those sites were grouped into what we refer to as a cave cluster, and those caves were assumed to be part of the same interconnected Bee Creek Cave harvestman population. If a cave's radius did not overlap with any other cave, we labeled that site an individual cave and considered it an isolated population. Based on that methodology, we delineated Bee Creek Cave harvestman occurrences into one cave cluster and two individual caves (Table 1).

Table 1. Bee Creek Cave harvestman cave clusters and individual caves in the Rollingwood Karst Fauna Region.

Karst Fauna Region	County	Ownership
Cave Cluster(s)		
Bee Creek Cave and Little Bee Creek Cave Cluster	Travis	City of Austin/Private
Individual Caves		
Bandit Cave	Travis	Private
Little Black Hole	Travis	City of Austin

2.2.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

The population needs of the Bee Creek Cave harvestman are the factors that provide for a high probability of population persistence over the long-term at an occupied location (e.g., low degree of threats and high survival and reproduction rates). Since population estimates for the Bee Creek Cave harvestman are unavailable, nor do we know what reproductive rates sustain a healthy population, we applied measures of surface habitat elements (i.e., area of naturally vegetated open space, distance of cave entrance to nearest edge, and status of cave cricket foraging area) surrounding a cave as surrogates to assess population resiliency. For a full discussion of this methodology, see Service (2018b, pp. 31-32).

Variables related to surface land uses and native vegetation can influence cave invertebrate communities, even at some distance (i.e., 50-250 m [164-820 ft]), from a cave's entrance (Pellegrini et al. 2016, pp. 23-34). Jaffé et al. (2018, pp. 9, 11) found that anthropogenic land use in the form of agriculture within 50 m (164 ft) of a cave significantly reduced troglobitic invertebrate species richness. Those researchers partially attributed reductions to chemical contamination in the form of herbicide, pesticide, and/or fertilizer use (Jaffé et al. 2018, p. 17). Reduction of nutrients into caves, due to loss of surrounding native vegetation to agricultural conversion, was cited as another potential contributor to reduced species richness (Jaffé et al. 2018, p. 17). It is likely that urbanization may have similar impacts on cave systems (Pelligrini et al. 2016, p. 28).

Construction of development projects (e.g., single- or multi-family housing, commercial buildings, and paved roadways) often entails the partial or complete mechanical removal of natural vegetation, and potentially topsoil, from a site (Theobald et al. 1997, p. 26; Zipperer 2011, pp. 188-189) followed by replacement with built structures, impervious cover, and/or non-native, managed landscaping (McKinney 2002, pp. 884, 886; McKinney 2008, p. 168). Once completed, such urban landscape features can have long-term impacts on surrounding natural communities (Theobald et al. 1997, pp. 27-28, 31-33). Compared to some other anthropogenic drivers of species decline, including agriculture, forestry, or grazing, the impacts of urbanization on native habitats are more persistent resulting in highly modified sites with decreased potential for maintenance or reestablishment of native species (Rebele 1994, p. 177; Theobald et al. 1997, p. 33; Huxel and Hastings 1999, p. 312; Marzluff and Ewing 2001, p. 281; McKinney 2002, pp. 883-886, 889; Hansen et al. 2005, pp. 1899-1900).

For this review, we evaluated 2022 aerial imagery of areas surrounding occupied caves in ArcGIS for the following habitat elements: amount of open space with natural vegetation contiguous with a cave entrance, distance of the cave entrance to nearest edge, and status of the cave cricket foraging area (Service 2018b, p. 51). As we lack maps of every cave's footprint, cave entrances served as center-points for measurements. We assigned each cave cluster and individual cave site to one of four resiliency categories, high, moderate, low, or impaired, based on values generated for each habitat element (Service 2018b, p. 52). Finally, we noted whether a site possessed legally binding perpetual protection along with the amount of acreage protected if that information was available. We did not apply this methodology sites outside of the Rollingwood Karst Fauna Region given uncertainty regarding the taxonomic status of *Texella* population at those locations. Subsurface sites outside of Rollingwood Karst Fauna Region were not assessed either given some degree of uncertainty regarding the taxonomic status of population those locations.

Habitat elements at high and moderate resiliency sites provide the greatest probability for persistence of Bee Creek Cave harvestman populations and the associated karst ecosystem. However, a sites' continued status as high or moderate resiliency is dependent on the perpetuation of the needed surface and subsurface habitat elements. A cave cluster with a high or moderate resiliency designation may contain an individual cave or caves with lower resiliency, but if at least one cave in the cluster was potentially capable of supporting a high to moderate resiliency population, we assigned that higher resiliency category to the entire cluster. Low resiliency and impaired cave clusters and individual caves potentially lack habitat elements of sufficient quality to support persistent populations of Bee Creek Cave harvestman over the long-term.

Impacts to a cave's surface or subsurface drainage basin can be a significant source of stressors for Bee Creek Cave harvestman populations. To characterize habitat for a particular site, it is important to determine whether development activities are affecting drainage basins, altering either the quantity or quality of hydrologic inputs into the karst ecosystem. At this time, however, we do not have adequate assessments of drainage basins for most occupied sites. Therefore, we did not include an assessment of actual impacts to drainage basins in this evaluation. For these analyses, we assumed that larger tracts of open space were more likely to include intact drainage basins, particularly when the cave entrance was some distance from the edge. In using this approach, we recognize that drainage basin impacts may be occurring undetected even in high and moderate resiliency sites. Thus, it would be important to delineate and protect these areas in the future to ensure Bee Creek Cave harvestman populations persist.

Based on our review, only a single cave in the Rollingwood Karst Fauna Region is currently of high resiliency with potential to support Bee Creek Cave harvestman populations over the long-term (Table 2). That site, Little Bee Creek Cave, is located in a larger tract of open space and has a relatively unaltered cave cricket foraging areas. Three individual caves are impaired due to small areas of open space, potential edge effects, and degraded cave cricket foraging areas. Bee Creek Caver was categorized as moderate resiliency in the species' 2018 5-year review (Service 2018a, p. 19). In this review, that cave declined in resiliency to impaired. New information in 2020 indicated that the cave's mapped location was inaccurate and was remapped based on information from the City of Austin. That readjustment resulted in diminished values for open space, cave cricket foraging area, and an impacted drainage basin. We do not expect these sites to increase in resiliency in the future. These caves are adjacent to commercial development, single and multi-family housing, and/or roadways that are unlikely to be restored to natural or semi-natural habitats.

Table 2. Current resiliency of Bee Creek Cave harvestman sites (cave clusters and individual caves) in the Rollingwood Karst Fauna Region.

Cave Cluster or Individual Cave	Open Space Area ha (ac)	Distance of Cave to Nearest Edge m (ft)	Percent of Cave Cricket Foraging Area Impacted	Current Resiliency
Cave Cluster(s)				
Bee Creek Cave and Little Bee Creek Cave Cluster				**High**
Bee Creek Cave	3.6 (<9)	<120 (<394)	51-75%	Impaired
Little Bee Creek Cave	>40 (>100)	>120 (>394)	0	High
Individual Caves				
Bandit Cave	3.6 (<9)	<120 (<394)	76-100%	Impaired
Little Black Hole	3.6-16.0 (9-39.9)	<120 (<394)	76-100%	Impaired

2.2.1.7 Other:

No new information.

2.2.1.8 Conservation Measures:

No new information.

2.2.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

2.2.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

The range of the Bee Creek Cave harvestman in Travis County has experienced significant human population growth (Neumann and Bright 2008, pp. 8-11, 13; Potter and Hoque 2014, pp. 2, 5). During the period from 1980 to 2010, the Austin-Round Rock-Georgetown Metropolitan Area was among the fastest growing metropolitan areas in the United States (Frey 2012, p. 4). As of 2022, Texas contains five of the most populous cites (e.g., Austin, Dallas, Houston, Fort Worth, and San Antonio) in the United States and five of the nation's fastest growing cities (U.S. Census Bureau 2023a, unpaginated). The state's fastest growing cities are suburbs of adjacent major metropolitan areas (e.g., Austin-Round Rock-Georgetown and San Antonio-New Braunfels Metropolitan Areas) [U.S. Census Bureau 2023a, unpaginated). Between 1980 and 2021, the human population of Travis County grew substantially from 419,573 people to 1,305,154 people (U.S. Census Bureau 1982, p. 10; U.S. Census Bureau 2023b, unpaginated). The county's largest city, the City of Austin, grew from 345,890 people in 1980 to a projected 964,000 people in 2021 (City of Austin 2016; U.S. Census Bureau 2023b, unpaginated).

Increased conversion of natural surface habitat to development or infrastructure has accompanied human population growth in Travis County. Based on data from the U.S. Census Bureau (2012, p. 9; 2023b, unpaginated), numbers of single and multi-family housing units in Travis County increased more than five-fold, from 100,882 units in 1970 to 593,189 units in 2021. Installation of infrastructure projects and non-residential commercial development can be expected to follow establishment of new housing units further expanding the urban, suburban, and exurban footprint (Cohen 1996 pp. 1051-1053; Brueckner 2000, pp. 166-167; Cowley and Spillette 2001, pp. 8-9; Heimlich and Anderson 2001, pp. 15, 18-19; Scheer 2001, pp. 31-35; Oguz et al. 2008, pp. 11-12; Landis 2009, pp. 157, 165).

From 2009-2015, Texas was among the states with the greatest annual loss in tree cover (8,413 ha/yr [20,790 ac/yr]) and greatest annual net increase in impervious cover (12,092 ha/yr [29,880 ac/yr]) in urbanized areas (Nowak and Greenfield 2018a, p. 37). Nowak and Greenfield (2018b, pp. 168-171) developed projections for urbanized land growth in the United States from 2010 to 2060. Texas is projected to gain the second highest amount of urbanized land in the country at 3,004,386 ha (7,424,000 ac) over that 50-year period (Nowak and Greenfield 2018b, p. 169). Percentage of urbanized land in Travis County is projected to increase from 25%-40% in 2010 to 60%-80% in 2060 (Nowak and Greenfield 2018b, p. 170).

The Bee Creek Cave harvestman, and its subterranean habitat, is reliant on functional surface ecological systems. The plant communities that overlay and surround cave systems aid in buffering subterranean ecosystems from stressors, support nutrient flow, and aid in the maintenance of microclimatic conditions (Barr 1968, pp. 47-48; Poulson and White 1969, pp. 971-972; Howarth 1983, p. 376; Culver and Pipan 2009b, p. 23; Simões et al. 2014, p. 168; Pellegrini et al. 2016, pp. 28, 32-34). As a site is developed, native plant communities are often mechanically cleared and replaced with a highly modified urban to exurban landscape (Theobald et al. 1997, p. 26; McKinney 2002, pp. 884, 886; McKinney 2008, p. 168; Zipperer 2011, pp. 188-189).

Construction activities may also modify cave entrances and other openings to the surface (Watson et al. 1997, p. 11; Veni et al. 1999, p. 55; Waltham and Lu 2007, p. 17; Frumkin 2013, pp. 61-62; Hunt et al. 2013, p. 97) which could affect climatic conditions within the cave as well as water infiltration (Pugsley 1984, pp. 403-404; Elliott and Reddell 1989, p. 7; Culver and Pipan 2009b, p. 202). The abundance and species richness of native animals may decline due to decreased foraging or sheltering habitat, increased predation, competition with non-native species, or lack of connectivity among populations (Rebele 1994, p. 177; McKinney 2002, pp. 885-886; Taylor et al 2007, pp. 2, 37, 41-44; Pellegrini et al. 2016, pp. 28, 34). Direct and collateral impacts to surface and subsurface habitat from urbanization have the potential to reduce Bee Creek Cave harvestman population viability and the species' long-term persistence. Given population and urbanized land growth projections (Texas Demographic Center 2014; Nowak and Greenfield 2018b, p. 170), it is likely that remaining surface and subsurface habitats will be impacted in the absence of management and protection.

2.2.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

No new information.

2.2.2.3 Disease or predation:

No new information.

2.2.2.4 Inadequacy of existing regulatory mechanisms:

No new information.

2.2.2.5 Other natural or manmade factors affecting its continued existence:

No new information.

2.3 Synthesis

Genetic analyses indicate that the range of the Bee Creek Caver harvestman is smaller than previously defined, with occurrences of that species in the Jollyville Plateau Karst Fauna Region now referable to the Bone Cave harvestman (Derkarabetian et al 2022, pp. 408, 412, 414). As a result, the only karst fauna region to contain the species is the Rollingwood Karst Fauna Region. The taxonomic status of several geographically distant locations assigned to the Bee Creek Cave harvestman is uncertain (Derkarabetian et al. 2022, p. 414). Genetic assessment of individuals from those sites could prove to constitute new Bee Creek Cave harvestman clades or distinct *Texella* species (Derkarabetian et al. 2022, p. 414).

There are currently one high resiliency and three impaired individual caves that contain the Bee Creek Cave harvestman in the Rollingwood Karst Fauna Region. A large tract of natural open space surrounds the high resiliency cave, providing higher quality cave cricket foraging habitat and greater potential for connectivity among karst features to support cricket populations. Persistence of Bee Creek Cave harvestman populations at this site is dependent upon management and perpetual protection that maintains adequate open space, sufficient buffering from edge effects, intact foraging areas for cave crickets, and sufficient quantity and quality of water from intact drainage basins. The resiliency of outlying populations of the species were not evaluated for resiliency given taxonomic uncertainty regarding the species-status of *Texella* at those locations.

Recovery criterion (1) in Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas (Service 1994, pp. 86-88; Service 2019, pp. 6-7) states that three karst fauna areas within each karst fauna region should be protected if a species occupies more than one region. If a species only occurs within a single karst fauna region, six karst fauna regions should be protected. Protection is defined as an area sufficiently large to maintain the integrity of the karst ecosystem on which the species depends. These areas must also provide protection from threats such as habitat destruction, red-imported fire ants, and contaminants. Recovery criterion (2) requires at least five consecutive years of a cave meeting karst fauna area status and that perpetual protection of these areas is in place.

The Balcones Canyonlands Preserve contributes to the high resiliency of Little Bee Creek Cave. The protections provided by the preserve, and open space provided by the nearby City of Austin's Ulrich Water Treatment Plant, have maintained some open space surrounding the cave and the integrity of cave cricket foraging habitat. However, for Little Bee Creek Cave to be recognized as a karst fauna area, sufficient open space surrounding the cave and its drainage basins would need to be protected.

3.0 RESULTS

3.1 Recommended Classification:

No change is needed.

3.2 New Recovery Priority Number (indicate if no change; see 48 FR 43098):

No change is need.

Brief Rationale:

The range of the Bee Creek Cave harvestman is now much reduced from the species' 2018 5-year review (Service 2018a, pp. 14-16). At that time, the species was thought to inhabit caves in both the Jollyville Plateau and Rollingwood Karst Fauna Regions. Genetic analyses now indicate that the Bee Creek Cave harvestman does not occur north of the Colorado River into the Jollyville Plateau Karst Fauna Region (Derkarabetian et al 2022, pp. 408, 412, 414). Several of the caves in that region were of high resiliency and protected within the Balcones Canyonlands Preserve (Service 2018a, pp. 19, 24). Assignment of the caves to the Bone Cave harvestman limits recovery potential of the Bee Creek Cave harvestman. The only region to host the species is now the Rollingwood Karst Fauna Region and only a cave there is of high resiliency.

The occurrence of Bee Creek Cave harvestman outside of currently delineated karst fauna regions requires examination. We also need detailed information on surface collection sites of the Bee Creek Cave harvestman, specifically the surface and/or subsurface microhabitats the species may rely upon. At present, recovery criteria for the Bee Creek Cave harvestman have not been achieved. No karst fauna areas exist for this species in any occupied karst fauna region. In Travis County, threats from increasing development due to rapidly growing human populations are projected to continue. At this time, we do not recommend a change in listing status for the Bee Creek Cave harvestman given the lack of protected karst fauna areas.

3.3 Listing and Reclassification Priority Number, if reclassification is recommended (see 48 FR 43098):

Reclassification (from Threatened to Endangered) Priority Number: Not applicable
Reclassification (from Endangered to Threatened) Priority Number: Not applicable
Delisting (Removal from list regardless of current classification) Priority Number: Not applicable

Brief Rationale:

Not applicable

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Obtain information for Little Bee Creek Cave within the Balcones Canyonlands Preserve to include surface and subsurface drainage basins, potential development impacts, tract acreage, management, and perpetual protection mechanisms among others. Review information to determine the potential for the site to be recognized as a karst fauna area.

- Conduct a robust and intensive genetic and morphological investigation of all surface and subsurface outlying populations of the *Texella* assigned to the Bee Creek Cave harvestman based on morphology.

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U.S. FISH AND WILDLIFE SERVICE

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable: Not applicable

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas

Approve KAREN MYERS Digitally signed by KAREN MYERS Date: 2023.08.11 09:08:34 -05'00'