Travis County FY2022
Jollyville Plateau Salamander (*Eurycea tonkawae*)
Monitoring Report



Photo: Jollyville Plateau salamander by Piers Hendrie

Travis County
Department of Transportation and Natural Resources
Natural Resources and Environmental Quality Division

October 1, 2022 – September 30, 2023

TABLE OF CONTENTS

Background …….....3

Life History…….....5

FY2023 Surveys.....8

Threats…….....8

Future Conservation Efforts…….....9

Literature Cited……...……10

TABLES AND FIGURES

Figure 1. Critical Habitat Units designated for Jollyville Plateau salamander (*Eurycea tonkawae*)… …….....4

Figure 2. Watersheds containing Jollyville Plateau salamander localities….....7

Background

On May 2, 1996, the City of Austin and Travis County were jointly issued a U.S. Fish and Wildlife Service (USFWS) regional permit referred to as the Balcones Canyonlands Conservation Plan (BCCP). This permit allows “incidental take” of eight locally occurring endangered species in compliance with Section 10(a)1(b) of the Endangered Species Act (USFWS 1996a). The thirty-year permit covers approximately 561,000 acres in western Travis County, Texas identified in the Habitat Conservation Plan and Final Environmental Impact Statement (USFWS 1996b). The permit also covers incidental take of 27 species of concern should any become listed as threatened or endangered during the life of the permit.

The Jollyville Plateau salamander (*Eurycea tonkawae*; hereafter JPS) occurs within the Balcones Canyonlands Preserve (BCP) and the overall management of Travis County preserve lands benefits the conservation of this species. Although the BCCP 10(a) permit does not cover “take” of this species or require mitigation, the BCCP partners have pledged to protect the species wherever it is located within the BCP.

On September 19, 2013, the U.S. Fish and Wildlife Service listed the JPS as threatened (USFWS 2012 and 2013) under the Endangered Species Act and designated 32 units of critical habitat (totaling 4,331 acres) in portions of Travis and Williamson Counties (Figure 1). The most significant threat is degradation of aquatic habitats, primarily in the form of reduced water quality and alteration of natural flow regimes due to extremely rapid human population growth and urbanization within this small range (USFWS 2013). About half of the total stream catchment area for the range of the JPS has been developed and studies show urbanization has a strong negative effect on density and relative abundance of JPS throughout its range (Bendik *et al.* 2014)

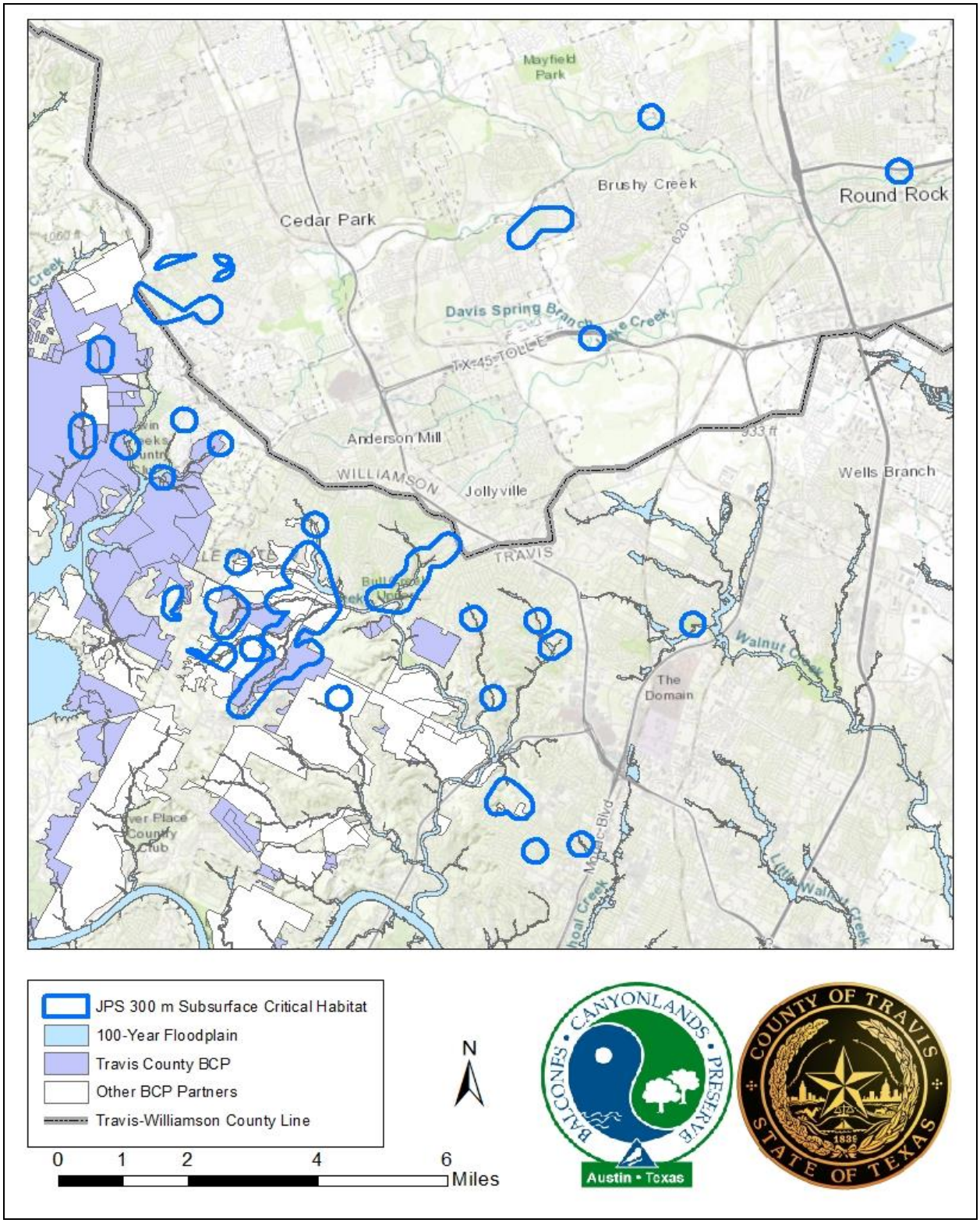

Figure 1. Critical Habitat Units designated for the Jollyville Plateau salamander in northwestern Travis and southern Williamson Counties. Surface critical habitat includes the locality buffered by 80 m of stream habitat upstream and downstream. Subsurface critical habitat includes a 984-foot (300 m) radius surrounding each spring.

Life History

The Jollyville Plateau salamander is an aquatic, neotenic salamander that is endemic to the highly urbanized area of northwestern Travis and southern Williamson counties. As a perennibrachiate, these salamanders are restricted to karst-associated habitats such as surface springs, corresponding streams, and subsurface groundwater habitats. It is a member of the Plethodontidae, a large family in the order Caudata that is characterized by the absence of lungs.

JPS found in surface springs and streams have well developed eyes, a wide head, and dark greenish-brown body. Some cave dwelling JPS exhibit reduced eyes, a flattened head, and loss of color (Chippendale *et al.* 2000). Chippendale *et al.* (2000) suggested that there might be two lineages with a taxonomic split corresponding to major geologic and topographic features: the "plateau" clade which occupies Bull, Walnut, Shoal, Brushy, South Brushy, and southeast Lake Travis watersheds, and the "peripheral" clade which is found in the Buttercup and northern Lake Travis watersheds. This finding was later confirmed with an "*E. tonkawae* (east)" group occupying Bull, Walnut, Shoal, and Brushy watersheds while an "*E. tonkawae* (west)" group occupies the Buttercup watershed as well as the Cypress and Long Hollow subwatersheds of the larger Lake Travis watershed (Devitt *et al.* 2019). This taxonomic research also shows evidence of admixture contact of these eastern and western groups at SAS Canyon and Kretschmarr Cave. These sites occur along the divide separating Cypress and Bull drainages.

The eggs of JPS are rarely found on the surface, so it is possible that they are deposited underground (O'Donnell *et al.* 2005). The skin on the ventral side of the body is translucent so that eggs are visible in gravid female individuals which are often found on the surface.

It appears from the presence of juveniles on the surface in all seasons that they reproduce year-round (Bendik 2011a, Hillis *et al*. 2001). However, juvenile abundance often increases in the spring and summer suggesting higher reproduction in the winter and early spring (Bowles *et al*. 2006). At hatching, JPS measure about 15 mm total length and reach reproductive maturity at 45-70 mm total length within six months to a year.

Their diet consists of small invertebrates, including fly larvae, amphipods, ostracods, copepods, water mites, snails, aquatic beetles, and damselfly, caddisfly, mayfly, and stonefly larvae. (COA 2001, Bendik 2011b). If flatworms are present in JPS habitat, they may be part of the diet as flatworms are a primary food source of the Barton Springs salamander (Gillespie 2013). Their underground diet is likely more restricted to stygobitic invertebrates such as amphipods and isopods.

Predators of JPS may include centrarchid fish (sunfish and bass), crayfish, and large insects such as dragonfly nymphs and giant waterbugs (Bowles *et al.* 2006, Cole 1995). Adult cannibalism on juveniles has also been observed in the field and in captivity but is not thought to be a significant source of predation (B. Sissel, personal observation).

Surface habitat of the JPS consists of spring outlets, associated stream reaches, and in small hillside seeps. They can generally be found in the interstitial spaces underneath or between rocks, in vegetation or in leaf litter where they are hidden from predators. Like other Central Texas *Eurycea*, JPS also inhabit underground refugia including subterranean streams and wet caves. Northwestern Travis and southern Williamson Counties encompass the nine watersheds containing known JPS localities: Brushy, Bull, Buttercup, Lake Creek, Lake Travis, Shoal, South Brushy, Walnut, and West Bull (Figure 2).

The narrow distribution of JPS has been explained by certain habitat requirements such as reliability of flow, minimal substrate siltation and calcium carbonate deposition, and availability of subsurface refugia (Dowling 1956, Rudolph 1978, Sweet 1982, Chippendale *et al.* 1993, Tumilson and Cline 1997, Bendik *et al.* 2016). Another requirement for survival and reproduction is well oxygenated groundwater with a narrow temperature range (Davis *et al.* 2001, Bowles *et al.* 2006, Bendik *et al.* 2016). Groundwater at JPS sites flow from the Northern Segment of the Edwards Aquifer and the Trinity Aquifer to local alluvial springs (Cole 1995). Groundwater in the Jollyville Plateau was characterized using water level monitoring, groundwater tracing, water chemistry and tritium dating. Results imply that the Jollyville Plateau Edwards Aquifer contains vadose zone conduits that transmit recharge water to springs and creeks with limited connection to the water table (Johns 2013).

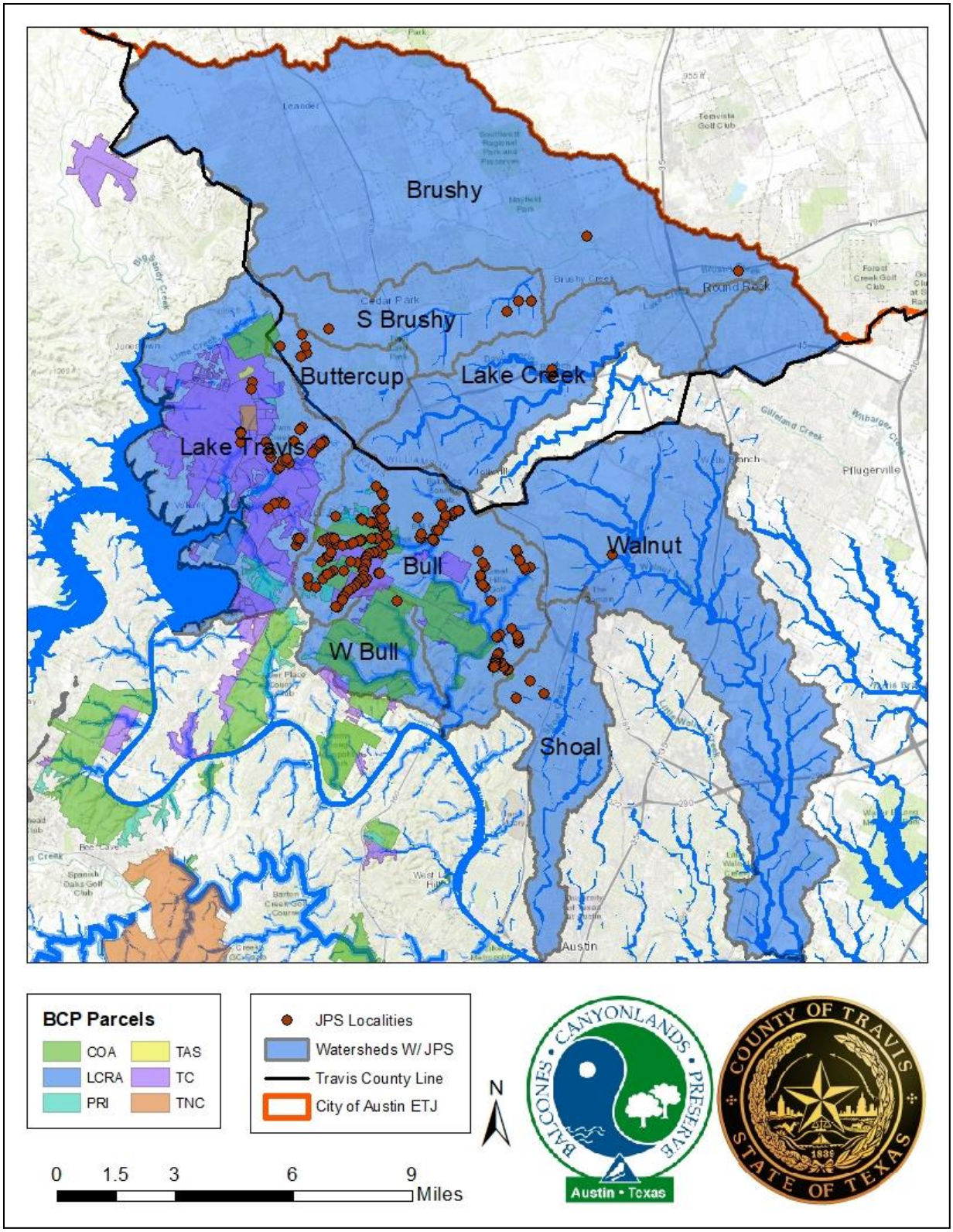

Figure 2. Nine watersheds containing JPS localities in Williamson and Travis Counties, Texas. Lake Travis watershed is shown as subdivided to a smaller catchment area that incorporates all known JPS localities.

In Travis County, most known JPS localities are found within the Bull Creek and Cypress Creek catchments. Most ecological research (Bowles *et al.* 2006, Bendik and Glusenkamp 2013, Bendik *et al.* 2013, Bendik *et al.* 2014, Gabor *et al.* 2016, Bendik 2017) focused on abundant populations at obvious springs, lending to conservation decisions based on those specific sites. After federal listing, a geographic study demonstrated that occupancy and movement of JPS in the Bull Creek drainage differed from previous assumptions and therefore challenged the current notion of conservation planning for the species (Bendik *et al.* 2016). For this reason, in 2016, a working group comprised of biologists from the City of Austin, Travis County and Texas Parks and Wildlife Department decided to focus conservation research on creek and tributary segments in terms of occupancy to further understand broader spatial distribution and habitat requirements. The working group did, however, decide to continue monitoring two specific populations at Upper Ribelin and Lower Ribelin using capture-recapture methods.

FY 2023 Surveys

No surveys were conducted in FY2023 due to extreme drought conditions leading to a lack of spring flow.

Threats

Amphibians are sensitive indicators of environmental degradation (Barinaga 1990, Blaustein *et al.* 1994, Hartwell and Ollivier 1998). Amphibians with restricted ranges in or near expanding metro areas face great risk of extinction. Of the thirteen *Eurycea* salamanders in central Texas, seven are threatened by or entirely surrounded by development (Diaz *et al.* 2020). Most known localities are at risk from urbanization due to their localized recharge areas (Chippendale *et al.* 2000, Chippendale and Price 2005, USFWS 2012). Prior research has shown that salamander densities are reduced in urbanized stream catchments (Orser and Shure 1972, Willson and Dorcas 2003). Urbanization correlates with changes to natural flow regime and degradation of surface and groundwater (Diaz *et al.* 2020). These manipulations to habitat quality may be the largest threat facing JPS and must be considered in conservation efforts (Bowles *et al.* 2006, Diaz *et al.* 2020).

The City of Austin's human population grew 277% from 1970 to 2017 (COA 2017). Bowles *et al.* (2006) found lower JPS density in developed tributaries compared to

springs in undeveloped watersheds. Developed tributaries had higher concentrations of chloride, magnesium, nitrate-nitrogen, potassium, sodium, and sulfate (Bowles *et al.* 2006). Four of nine JPS sites monitored by the City of Austin from 1996 to 2007 showed statistically significant declines in salamander abundance over ten years (O'Donnell *et al.* 2006). Analysis of count data from 1996 to 2011 reveal that JPS populations declined in areas with the largest increases in residential development over a 15-year period and furthermore, densities of JPS are negatively correlated with residential development across its range (Bendik *et al*. 2014, Bendik *et al.* 2016).

Future Conservation Efforts

To address the conservation of JPS, Travis County will continue to manage and acquire land to protect endangered species, which will benefit JPS and general water quality. All streams within Travis County BCP tracts will be protected and if found to host JPS, will be managed to protect the species. Travis County will also collaborate in research efforts to elucidate many of the unknowns regarding JPS life history, habitat preferences, potential threats, and the mechanics of the northern segment of the Edwards Aquifer. New occupancy studies or surveys of prior sites from dry years will be conducted in FY2024 to better understand occupancy and distribution in drainages where knowledge is lacking. After discovery of additional populations, staff will return on a systematic basis to verify JPS presence at these sites.

Literature Cited

Barinaga, M. 1990. Where have all the froggies gone? Science 247: 1033-1044.

Bendik, N. F. and A. G. Gluesenkamp. 2013. Body length shrinkage in an endangered amphibian is associated with drought. Journal of Zoology 290: 35-41.

Bendik, N. F., B. N. Sissel, J. R. Fields, L. J. O'Donnell, and M. S. Sanders. 2014. Effect of urbanization on abundance of Jollyville Plateau salamanders (Eurycea tonkawae). Herpetological Conservation and Biology.

Bendik, N. F., T. A. Morrison, A. G. Glusenkamp, M. S. Sanders, L. J. O'Donnell. 2013. Computer-assisted photo identification outperforms visible implant elastomers in an endangered salamander, Eurycea tonkawae. PloS one 8: e59424.

Bendik, N. F., K. D. McEntire, and B. N. Sissel. 2016. Movement, demographics, and occupancy dynamics of a federally-threatened salamander: evaluating the adequacy of critical habitat. PeerJ, 4, e181. http://doi.org/10.7717/peerj.1817.

Bendik, N. F. 2011a. Jollyville Plateau salamander status report. City of Austin, Watershed Protection. SR-11-10

Bendik, N. 2011b. Personal communication. Jollyville Plateau Salamander (*Eurycea tonkawae*). Presentation from City of Austin Watershed Protection to U.S. Fish and Widlife Service. October 5, 2011.

Bendik N. F. 2017. Demographics, reproduction, growth, and abundance of Jollyville Plateau salamanders (*Eurycea tonkawae*). 2017. Ecology and Evolution: 10.1002/ece3.3056.

Blaustein, A. R, P. D. Hoffman, D. G. Hokit, J. M. Kiesecker, S. C. Walls, and J. B. Hays. 1994. UV repair and resistance to solar UV-B in amphibian eggs: a link to population declines? Proc. National Academy of Science 91:1791-1795

Bowles, B. D., M. S. Sanders, and R. S. Hansen. 2006. Ecology of the Jollyville Plateau salamander (*Eurycea tonkawae*: Plethodontidae) with an assessment of the potential effects of urbanization. Hydrobiologia 553:111-120.

Chippendale, P. T., A. H. Price, and D. M. Hillis. 1993. A new species of the perennibrachiate salamander (*Eurycea*; Plethodontidae) from Austin, Texas. Herpetologica 49: 248-259.

Chippendale, P. T., A. H. Price, J. J. Wiens, D. M. Hillis. 2000. Phylogenetic relationships and systematic revision of central Texas hemidactyliine plethodontid salamanders. Herpetol. Monogr. 14, 1-80.

Chippendale, P. T. and A. H. Price. 2005. Conservation of Texas spring and cave salamanders (*Eurycea*). Pages 193-197 in M. Lanoo, editor. Amphibian Declines: The Conservation Status of U. S. species. University of California Press, Berkley, California.

COA (City of Austin). 2001. Jollyville plateau water quality and salamander assessment. Water Quality Report Series COA-ERM 1999-01. Prepared by City of Austin, Watershed Protection Department, Environmental Resources Management Division, Water Resource Evaluation Section. Austin, Texas, USA, 381 pp.

City of Austin. 2017. Austin area population histories and forecasts. 1p. https://www.austintexas.gov/sites/default/files/files/Planning/Demographics/austin_forecast_2018_pub.pdf

Cole, R. A. 1995. A review of status, research and management of taxon viability for three neotenic aquatic salamanders in Travis County, Texas. In A review of the status of current critical biological and ecological information on the *Eurycea* salamanders located in Travis County, Texas. D. E. Bowles ed. Aquatic Biological assessment Team, Resource Protection Division, Texas Parks and Wildlife Department, Austin, Texas (http://www.solsdf.org).

Davis, B., R. Hansen, D. Johns, M. Turner. 2001. Jollyville Plateau water quality and salamander assessment. City of Austin, Austin, Texas.

Devitt, T. J., A. M. Wright, D. C. Cannatella, and D. M. Hillis. 2019. Species delimitation in endangered groundwater salamanders: Implications for aquifer management and biodiversity conservation. PNAS 10.1073. https://doi.org/10.1073/pnas.1815014116.

Diaz, P. H., E. L. Orsak, F. W. Weckerly, M. A. Montagne, D. A. Alverez. 2020. Urban Stream Syndrome and Contaminant Uptake in Salamanders of Central Texas.
Urban Stream Syndrome and Contaminant Uptake in Salamanders of Central Texas. Journal of Fish and Wildlife Management (2020) 11 (1): 287–299.

Dowling, H. G. 1956. Geographic relations of Ozarkian amphibians and reptiles. Southwestern Naturalist 1: 174-189.

Gabor, C. R., K. C. Zabierek, D. S. Kim, L. A. Barbiano, M. J. Mondolli, N. F. Bendik, D. R. Davis. 2016. A non-invasive water-borne assay of stress hormones in aquatic salamanders. Copeia 104: 172-181.

Gillespie, J. H. 2013. Application of stable isotope analysis to study temporal changes in foraging ecology in a highly endangered amphibian. PLoS ONE 8(1): e53041. Doi:10.1371/journal.pone.0053041

Hartwell H. W. Jr. and L. M. Ollivier 1998. Stream Amphibians as indicators of ecosystem stress: a case study from California's redwoods. Ecological Applications 8:1118–1132.

Hillis, D. M., D. A. Chamberlain, T. P. Wilcox, and P. T. Chippendale. 2001. A new species of subterranean blind salamander (Plethodontidae: Hemidactyliini: Eurycea: Typhlomolge) from Austin, Texas, and nomenclature of the major clades of central Texas paedomorphic salamanders. Herpetologica 53: 266-280.

Johns, D. A. 2013. Surprises in groundwater characterization in karst areas of the Jolllyville Plateau, Austin, Texas. National Groundwater Association Summit.

O'Donnell, L., M. Turner, E. Geismar, and M. Sanders. 2005. Summary of Jollyville Plateau salamander data (1997-2006) and status. Water Resource Evaluation. Watershed Protection and Development Review Department. City of Austin. Austin, Texas.

O'Donnell, L., M. Turner, M. Sanders, E. Geismar, S. Heilman, and L. Zebehazy. 2006. Summary of Jollyville Plateau salamander data (1997-2006). Water Resource Evaluation Short Reports SR-07-02. City of Austin. Austin, Texas.

Orser, P. N. and D. J. Shure. 1972. Effects of urbanization on the salamander *Desmognathus fuscus fuscus*. Ecology 53: 1148-1154.

Rudolph, D. C. 1978. Aspects of larval ecology of five plethodontid salamanders of the western Ozarks. American Midland Naturalist 100: 141-159.

Sweet, S. S. 1982. A distributional analysis of epigean populations of *Eurycea neotenes* in central Texas, with comments on the origin of troglobitic populations. Herpetologica 34: 101-108.

Tumilson, R. and G. R. Cline. 1997. Further notes on the habitat of the Oklahoma salamander (*Eurycea tynerensis*). Proceedings of the Oklahoma Academy of Sciences 77: 103-106.

U. S. Fish and Wildlife Service. 1996a. Federal Fish and Wildlife Permit PRT788841.

U. S. Fish and Wildlife Service (USFWS). 1996b. Final Environmental Impact Statement / Habitat
Conservation Plan for Proposed Issuance of a Permit to Allow Incidental Take of the Golden-cheeked Warbler, Black-capped Vireo, and six karst invertebrates in Travis County, Texas.

U. S. Fish and Wildlife Service. 2012. Endangered status for four central Texas salamanders and designation of Critical Habitat; proposed rule. *Federal Register* 77: 163 (22 August 2012) pp. 50769 - 50854.

U. S. Fish and Wildlife Service. 2013. Threatened and endangered wildlife and plants; determination of endangered species status for the Austin blind salamander and threatened status for the Jollyville Plateau salamander throughout their ranges; final rule. *Federal Register* 78: 161 (20 August 2013) pp. 51277 - 51326.

Willson, J. D. and M. E. Dorcas. 2003. Effects of habitat disturbance on stream salamanders. Implications for buffer zones and watershed management. Conservation Biology 17: 763-771.