FURTHER STUDY OF THE STATUS AND RANGE OF ENDANGERED ARTHROPODS FROM CAVES IN THE AUSTIN, TEXAS, REGION

A Report on a Study for the

U. S. Fish & Wildlife Service

Prepared by

James R. Reddell
Texas Memorial Museum
The University of Texas at Austin
Austin, Texas 78705

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TABLE OF CONTENTS

include all areas, but state why there is little or no info. available, & cite appropriate reference where info may be found (i.e., Ref. of Georgetown rep.)

List of Tables

Travis, Williamson, + Burnet counties (see p. 2, Introduction)

List of Figures

FURTHER STUDY OF THE STATUS AND RANGE OF ENDANGERED ARTHROPODS FROM CAVES IN THE AUSTIN, TEXAS, REGION

James R. Reddell

"[Many of these species possess] the distinction of no sooner becoming known than being placed upon the list of endangered species. Undoubtedly many others, known as well as unknown, are, if the truth were apparent, equally endangered and indeed exterminated: creations of incomprehensibly intricate evolutionary processes that have continued successfully for millions of years, now abruptly lost forever to the mindless surge in population density of nature's cleverest catastrophe."

Hobart M. Smith, 1973

SUMMARY

The present report includes descriptions of all new caves investigated, both as part of the present study and under separate contracts to developers, since the report by Elliott and Reddell (1989). A separate report to the City of Georgetown ~~is pending~~ distributed describes new localities for endangered species ~~will be described in detail in that report~~. The following is a summary of findings: (Reddell and Elliot, 1991).

1. The Tooth Cave ground beetle Rhadine persephone has been found in five additional localities in Travis County: Broken Arrow Cave, Gallifer Cave, Kretschmarr Double Pit, Rolling Rock Cave, and Stovepipe Cave; and five additional localities in Williamson County: Hideaway Cave; LakeLine Cave; LakeLine Well Trap No. 6; Raccoon Cave; and Testudo Tube. All are in either the Jollyville Plateau or Cedar Park areas.

2. The Tooth Cave spider Neoleptoneta myopica has been tentatively identified from Stovepipe Cave and Gallifer Cave, Travis County. Both localities are on the Jollyville Plateau. two additional caves;

3. The range of the Bee Creek Cave harvestman Texella reddelli has been extended to north of the Colorado River with discovery of a population in Jester Estates Cave, Travis County. An additional population from Cave Y in the Rollingwood Area is tentatively determined to be this species, also. has also been found in Kretschmarr Double Pit?

4. Taxonomic study has shown that the harvestman from Airman's Cave previously identified as Texella reddelli is, in fact, a new species (Texella new species 2). - cite manuscript, in press

5. The Bone Cave harvestman Texella new species 1 has been found in the following caves (a question mark indicates the record is based on immature or female specimens or awaits study by a specialist): Travis County: ?Beard Ranch Cave, Beer Bottle Cave, Cold Cave, Cotterell Cave; ?Fossil Cave; Fossil Garden Cave, Gallifer Cave; ?Hole in the Road;

McDonald Cave; McNeil Bat Cave; ?New Comanche Trail Cave; No Rent Cave; ?Root Cave; Tooth Cave; Weldon Cave; Williamson County: Beck Ranch Cave; Beck Sewer Cave; Bone Cave; Brown's Cave; ?Cat Hollow Cave; ?Elm Cave; ?Flint Wash Cave; Inner Space Cavern; LakeLine Cave; ?McNeil Quarry Cave; Man-With-A-Spear Cave; Off Campus Cave; ?Pussy Cat Cave; ?Red Crevice Cave; Sore-ped Cave; Steam Cave; ?Temples of Thor Cave; and Underline Cave.

8. The Kretschmarr Cave mold beetle Texamaurops reddelli has been found in one new locality, Stovepipe Cave in Travis County.

7. Williamson County populations of mold beetle ~~previously~~ determined as Texamaurops reddelli have ~~proven to be~~ Batrisodes (Excavodes) new species 2. No new records are known for this species.

8. Recent taxonomic revisions of Cicurina (Cicurella) spiders, pseudoscorpions, Texella harvestmen, and mold beetles have clarified the status of numerous species.

9. Since the previous study, two new species of pseudoscorpion and one new species of mold beetle have been found.

10. The distribution and zoogeographic relationships of many species have been illuminated by the discovery of several new populations of both listed and unlisted troglobites.

11. Aided by the report by Veni (1991), speculations are made regarding the likelihood of occurrence of the endangered species in particular areas.

INTRODUCTION

The previous study on the status and range of endangered arthropods in the Austin region (Elliott and Reddell, 1989; Biological Advisory Team, 1990) included descriptions and biological information on 32 caves in the area covered by the Austin Regional Habitat Conservation Plan (now the Balcones Canyonlands Conservation Plan, or BCCP). Since the publication of those reports, much additional information has accumulated on the distribution of the karst arthropods, and recent taxonomic studies have clarified the status of some populations. Table 1 lists all records for the species ~~considered to be endangered~~. Table 2 lists all species of troglobite known from Travis, Williamson, and northern Burnet Counties.

The primary purpose of the present study is to better define the range of the endangered species and to prepare recommendations for their preservation. The value and scope of this study have been greatly enhanced by private funding from developers and planners, who have given permission to include these results in the present comprehensive report. All caves visited since the 1989 report are described and maps are included. Caves covered by the previous report are listed ~~in the appropriate place~~, but only new information is presented here. Appended is a comprehensive list of all fauna known for Travis, Williamson, and that part of Burnet County covered by the BCCP. Caves studied under a separate contract with the City of Georgetown ~~will be~~ described ~~elsewhere~~.

TABLE 1. ENDANGERED CAVE INVERTEBRATES IN THE AUSTIN, TEXAS, AREA

Compiled by William R. Elliott & James R. Reddell, 20 August 1991

	CAVE NAME	QUAD	COUNTY	EAST	NORTH	EXPLEN	EXPDEP	UNITS	ELEV		MICTEX	TEXRED	TEXNSP	NEOMYO	RHAPER	TMPRED	BATNSP	FIREANTS
1	Amber Cave	Jollyville	Travis	609780	3365430	33	25	F	1041	F	X					X		1
2	Bandit Cave	Austin W	Travis	617210	3349330	440	10	F	580	F		X						0
3	Beard Ranch Cave	Jollyville	Travis	613600	3362500	18	16	F	1000	F			X					0
4	Beck Ranch Cave	Pflugerville W	Williamson	621780	3374500	2200	30	F	830	F			X					R
5	Beck Sewer Cave	Pflugerville W	Williamson	622400	3374450	1000	30	F	820	F			X					R
6	Bee Creek Cave	Austin W	Travis	616430	3353310	125	20	F	600	F		X						
7	Beer Bottle Cave	Pflugerville W	Travis	623060	3367980	100	20	F	790	F			X					
8	Bone Cave	Round Rock	Williamson	623240	3386260	74	26	F	880	F			X					3
9	Broken Arrow Cave	Leander	Travis	609360	3374720	50	25	F	1030	F					X			
10	Brown's Cave	Round Rock	Williamson	620820	3379340	117	42	F	875	F			X					
11	Cat Hollow Cave	Round Rock	Williamson	622420	3375480			F	830	F			X					
12	Cave Y	Austin W	Travis	613600	3348520	205	47	F	750	F		X						0
13	Coffin Cave	Cobbs Cavern	Williamson	626400	3402900	800	60	F	780	F							X	
14	Cold Cave	Pflugerville W	Travis	623120	3366830	80	15	F	805	F			X					
15	Cotterell Cave	Austin W	Travis	618770	3360290	40	20	F	880	F			X					R
16	Elm Cave	Round Rock	Williamson	621500	3380000	40	10	F	850	F			P					
17	Flint Wash Cave	Round Rock	Williamson	622850	3376420	100	20	F	810	F			X					1
18	Fossil Cave	Pflugerville W	Travis	621250	3365000	50	20	F	845	F			X					
19	Fossil Garden Cave	Pflugerville W	Travis	620580	3368900	95	17	F	880	F			X					X
20	Gallifer Cave	Jollyville	Travis	609950	3364380	115	24	F	1055	F			X	P	P			2
21	Good Friday Cave	Jollyville	Williamson	611280	3374200	50	25	F	980	F					X			3
22	Hideaway Cave	Jollyville	Williamson	610830	3373900	300	35	F	970	F					X			R
23	Hole-In-The-Road	Pflugerville W	Travis	622410	3367050	35	7	F	810	F			X					
24	Inner Space Cavern	Round Rock	Williamson	625800	3386650	15000	80	F	790	F			X				X	0
25	Jester Estates Cave	Jollyville	Travis	614900	3362600	30	15	F	950	F		X						0
26	Kretschmarr Cave	Jollyville	Travis	610200	3364870	48	30	F	1040	F					X	X		2
27	Kretschmarr Double Pit	Jollyville	Travis	609900	3365420	58	37	F	1045	F	P	(P) ?			P			
28	LakeLine Cave	Jollyville	Williamson	614730	3371200	69	10	F	960	F			X		X			3
29	Man-With-A-Spear Cave	Round Rock	Williamson	622670	3386310	150	30	F	890	F		not tested	X					3
30	Marigold Cave	Leander	Williamson	611800	3374720	325	89	F	950	F		in App. B			X			
31	McDonald Cave	Jollyville	Travis	609430	3367840	168	10	F	950	F			X					
32	McNeil Bat Cave	Pflugerville W	Travis	622220	3369140	150	25	F	860	F			X					
33	McNeil Quarry Cave	Pflugerville W	Williamson	623250	3370740	100	15	F	810	F			P					
34	New Comanche Trail Cave	Jollyville	Travis	608850	3362960	60	13	F	1070	F			X	X				3
35	No Rent Cave	Pflugerville W	Travis	621200	3368700	60	14	F	840	F			X					0
36	North Root Cave	Jollyville	Travis	610220	3364345	40	15	F	1047	F					X			3
37	Off Campus Cave	Round Rock	Williamson	624850	3387290	125	30	F	870	F			X				X	0
38	Pussy Cat Cave	Georgetown	Williamson	618300	3395640	108	14	F	925	F			X					0
39	Raccoon Cave	Round Rock	Williamson	615040	3372400	50	21	F	960	F					X			X
40	Red Crevice	Georgetown	Williamson	623220	3394500	30	15	F	850	F			X				(?)	3
41	Rolling Rock Cave	Jollyville	Travis	607900	3374100	50	25	F	1000	F					X			0
42	Root Cave	Jollyville	Travis	610220	3364340	10	15	F	1047	F			X	not listed in App B	(X) ?			3
43	Sierra Vista Cave	Georgetown	Williamson	624880	3387280	60	30	F	870	F			X				haven't this been positively identified?	1
44	Sore-ped Cave	Georgetown	Williamson	625340	3398400	1000	30	F	730	F			X					0
45	Spider Cave	Jollyville	Travis	612200	3362450	50	15	F	1030	F			P		P			0
46	Steam Cave	Round Rock	Williamson	625080	3386770	2000	30	F	820	F			X					
47	Stovepipe Cave	Jollyville	Travis	611300	3366500	100	20	F	1000	F	P		P	P	X	X		0
48	T.W.A.S. A Cave	Jollyville	Williamson	610670	3374180	39	41	F	990	F					X			0
49	Temples of Thor Cave	Georgetown	Williamson	623300	3394350	637	61	F	840	F			X					3
50	Testudo Tube	Jollyville	Williamson	609780	3373720	1200	25	F	1000	F					X			0
51	Tooth Cave	Jollyville	Travis	610180	3364200	166	18	F	1057	F	X		X	X	X	X		3
52	Underline Cave	Jollyville	Williamson	613780	3371520	80	12	F	960	F			X					0
53	Unemployment Cave	Georgetown	Williamson					F		F			?					?
54	Weldon Cave	Pflugerville W	Travis	621040	3369000	122	6	F	880	F			X					
55	Well Trap #6	Jollyville	Williamson	614500	3371500	0	15	F	960	F					X			1
56	Williams Cave No. 1	Georgetown	Williamson	625440	3393650	150	30	F	760	F			P					3
57	Wolf's Rattlesnake Cave	Georgetown	Williamson	622560	3388980	40	10	F	890	F			X					0

5 38 18

Notes: X = species known from this locality, P = tentative identification (species probably occurs), EXPLEN = explored length of cave, EXPDEP = depth of cave, EAST and NORTH are UTM coordinates, if known. MICTEX = *Microcreagris texana* pseudoscorpion, TEXRED = *Texella reddelli* harvestman, TEXNSP = *Texella* n.sp. harvestman, NEOMYO = *Neoleptoneta myopica* spider, RHAPER = *Rhadine persephone* beetle, TMPRED = *Texamaurops reddelli* beetle, BATNSP = *Batrisodes* n.sp., beetle, FIREANTS = *Solenopsis invicta* imported fire ant. For fireants, blank = unknown, 0 = no ants seen last time, 1 = ants in entrance only, 2 = moderate infestation, 3 = severe infestation, X = ants present, R = ants reported but not confirmed by us.

doesn't this species occur in 47 & more caves?

TABLE 2

Travis, Williamson, + Burnet Counties? (see p. 2, Introduction)

Troglobites of the Balcones Canyonlands Conservation Plan area

Aquatic

Flatworms:
- Kenkiidae genus and species
- **Sphalloplana kutscheri Mitchell

Snails:
- Phreatoceras taylori (Hershler and Longley)
- Phreatodrobia nugax nugax Hershler and Longley
- **Phreatodrobia punctata Hershler and Longley
- **Stygopyrgus bartonensis Hershler and Longley

Ostracods:
- **Candona probable new species
- **Prionocypris species

Amphipods:
- **Stygobromus ?new species
- Stygobromus balconis (Holsinger)
- Stygobromus bifurcatus (Holsinger)
- Stygobromus russelli (Holsinger)

Isopods:
- Asellidae genus and species
- Caecidotea reddelli Steeves

Salamanders:
- **Eurycea new species 1
- **Eurycea ?new species 2

Terrestrial

Isopods:
- **Trichoniscidae ?new genus and species
- **Miktoniscus new species

Spiders:
- **Cicurina (Cicurella) new species 1
- **Cicurina (Cicurella) new species 2
- **Cicurina (Cicurella) new species 3
- **Cicurina (Cicurella) new species 4
- **Cicurina (Cicurella) new species 5
- **Cicurina (Cicurella) new species 6
- **Cicurina (Cicurella) new species 7
- **Cicurina (Cicurella) new species 8
- *Cicurina (Cicurella) new species 9
- **Cicurina (Cicurella) new species 10
- **Cicurina (Cicurella) bugata Chamberlin and Ivie
- *Neoleptoneta anopica (Gertsch)
- **Neoleptoneta concinna (Gertsch)
- **Neoleptoneta devia (Gertsch)

**Neoleptoneta myopica (Gertsch)

Table 1 (continued)

**Eidmanniella reclusa Gertsch
Eidmanniella rostrata Gertsch

Pseudoscorpions:
**Aphrastochthonius new species
**"Microcreagris" reddelli Muchmore
**"Microcreagris" texana Muchmore
**Tartarocreagris new species 1
**Tartarocreagris new species 2
**Tartarocreagris new species 3
**Tartarocreagris infernalis (Muchmore)

Harvestmen:
**Texella new species 1
**Texella new species 2
Texella mulaiki Goodnight and Goodnight
**Texella reddelli Goodnight and Goodnight

Centipedes:
Theatops phanus Chamberlin

Millipedes:
Cambala speobia speobia (Chamberlin)
**Speodesmus ?new species 1
**Speodesmus new species 2
**Speodesmus bicornourus Causey

Slender springtails:
Oncopodura prietoi Bonet

Earwiglike entotrophs:
**Iapygidae new genus and species

Subterranean silverfish:
Texoreddellia texensis (Ulrich)

Ground beetles:
**Rhadine austinica Barr
*Rhadine noctivaga Barr
**Rhadine persephone Barr
**Rhadine russelli Barr
**Rhadine subterranea ?new subspecies
**Rhadine subterranea mitchelli Barr
**Rhadine subterranea subterranea (Van Dyke)

Mold beetles:
**Batrisodes (Excavodes) new species 1
**Batrisodes (Excavodes) new species 2
**Texamaurops reddelli Barr and Steeves

Notes: * = species known only from northern Williamson County but likely to occur in the BCCP area.
** = species known only from the BCCP area.

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Mr. Tom Van Zant, Hicks and Company (Dick Nichols Park)
Mr. Rick Vaughan, ECSI (Maple Run; Goat Cave Preserve)
Mr. Joe Verdoorn, Richardson Verdoorn (Hawk Tract)

RESULTS

NORTH HAYS COUNTY AREA

This area has yet to be biologically studied, but will probably prove to contain several of the species occurring in the South Travis County Area.

SOUTH TRAVIS COUNTY AREA

The only cave in this area described by Elliott and Reddell (1989) was Airman's Cave. The present report adds information on thirteen caves. The aquatic troglobites from Barton Springs and caves include an as yet undetermined flatworm of the family Kenkiidae; the snails Phreatrodrobia nugax nugax, Phreatodrobia punctata, and Stygopyrgus bartonensis; the ostracod Candona sp. nr. stagnalis; the amphipods Stygobromus balconis, Stygobromus bifurcatus, and Stygobromus russelli; the isopod Caecidotea reddelli; and the salamander Eurycea new species. The terrestrial troglobites are the isopods Trichoniscidae ?undescribed genus and species and Miktoniscus new species; the spiders Cicurina (Cicurella) new species 1, 4, and 6, Neoleptoneta concinna, and Eidmannella rostrata; the pseudoscorpion Tartarocreagris new species 3; the harvestmen Texella new species 2 and Texella mulaiki; the millipedes Cambala speobia speobia, Speodesmus new species, and Speodesmus bicornourus; the earwiglike entotroph Japygidae undescribed genus and species; the subterranean silverfish Texoreddellia texensis; and the ground beetle Rhadine austinica. Of these species the following are restricted to this area: Stygopyrgus bartonensis, Eurycea new species, Miktoniscus new species, Cicurina (Cicurella) new species 4 and 6, Tartarocreagris new species 3, Texella new species 2, and Japygidae undescribed genus and species.

App. B states that "the species may also occur in other caves in the Edwards Plateau", and that the group is "presently under study."

ROLLINGWOOD AREA

Two caves in the Rollingwood Area were described in Elliott and Reddell (1989). An additional four caves have been studied since that report. This area contains no aquatic fauna. The terrestrial troglobites include the isopod Trichoniscidae ?undescribed genus and species; the spider Cicurina (Cicurella) new species 1; the Bee Creek Cave harvestman Texella reddelli; the millipedes Cambala speobia speobia, Speodesmus new species, and Speodesmus bicornourus; the subterranean silverfish Texoreddellia texensis; and the ground beetle Rhadine austinica. None of these species are restricted to this area, but Cicurina (Cicurella) new species 1, Speodesmus new species, and Rhadine austinica are restricted to caves south of the Colorado River.

CENTRAL AUSTIN AREA

The only cave in the Central Austin Area described by Elliott and Reddell (1989) was Cotterell Cave. Few caves still remain in this area of

intense development, and the present report adds only six small caves and sinks in the immediate vicinity of Cotterell Cave. Stillhouse Springs in the same area contains the troglobitic amphipod Stygobromus ?russelli. With the exception of immature specimens of blind Cicurina (Cicurella) spiders in Outhouse Hole Sink, Three-Holer Cave, and Stoneworks Cave, troglobites are only known from Cotterell Cave. This cave houses the following eight troglobites: the isopod Trichoniscidae ?undescribed genus and species; the spiders Cicurina (Cicurella) new species 3 and 5; the Bone Cave harvestman Texella new species 1; the millipedes Cambala speobia speobia and Speodesmus bicornourus; the subterranean silverfish Texoreddellia texensis; and the ground beetle Rhadine subterranea subterranea.

Six of these species are comparatively widespread. One of the spiders, however, is known only from Cotterell Cave. This is the only known case of sympatry in Cicurina (Cicurella).

MCNEIL AREA

Elliott and Reddell (1989) described four caves in the McNeil Area. The present study adds eleven caves to those studied in this area. The only aquatic troglobite from the area is the widespread amphipod Stygobromus russelli in Balcones Sink. Terrestrial troglobites are the spider Cicurina (Cicurella) new species 5, the harvestman Texella new species 1, the millipedes Cambala speobia speobia and Speodesmus bicornourus, the subterranean silverfish Texoreddellia texensis, and the ground beetle Rhadine subterranea subterranea. All of these species have fairly wide distributions in the BCCP region.

ROUND ROCK AREA

No caves were described for the Round Rock Area in Elliott and Reddell (1989). The present report includes descriptions of two caves in this area. The Bone Cave harvestman Texella new species 1 is known from Beck Ranch Cave, Beck Sewer Cave, and possibly Cat Hollow Cave. The area contains no identified aquatic troglobites, but flatworms and asellid isopods have been observed in Beck Ranch Cave. The terrestrial fauna includes a rich troglobitic fauna, including the spider Cicurina (Cicurella) new species 5, the pseudoscorpion "Microcreagris" reddelli, the Bone Cave harvestman Texella new species 1, the millipedes Cambala speobia speobia and Speodesmus bicornourus, and the ground beetle Rhadine subterranea subterranea. None of these species is endemic to this area.

GEORGETOWN AREA

Elliott and Reddell (1989) described four caves in this area. Recent studies for the City of Georgetown have included visits to several additional caves. These results ~~will be~~ presented elsewhere but do not significantly modify the analysis presented here.

The Georgetown Area contains a rich fauna, with three aquatic and 11 terrestrial species recorded. The only aquatic species are the snail Phreatoceras taylori and the amphipod Stygobromus ?new species from springs, and the amphipod Stygobromus bifurcatus from Great Mud Cave. The terrestrial fauna includes the isopod Trichoniscidae ?undescribed genus and species; the spider Cicurina (Cicurella new species 2; the pseudoscorpion Tartarocreagris infernalis; the Bone Cave harvestman Texella new species 1; the centipede Theatops phanus; the millipedes Cambala speobia speobia and Speodesmus bicornourus; the slender springtail Oncopodura prietoi; the subterranean silverfish Texoreddellia texensis; the ground beetle Rhadine subterranea mitchelli; and the Coffin Cave mold beetle Batrisodes (Excavodes) new species 2. Two of these species, Cicurina (Cicurella) new species 2 and Tartarocreagris infernalis, are known only from this area. The remaining species occur in other areas.

CEDAR PARK AREA

Twelve caves in the Cedar Park area were described by Elliott and Reddell (1989). Eleven additional caves are added to the list of those biologically studied in this area. It is possible that some of the peripheral caves (Adobe Springs Cave and Grove Sinks Cave north of Volente and Ceiling Slot Cave and Moss Pit south of Leander near Nameless Road) should not be considered part of this area.

The fauna is generally shared by other areas, but it remains one of the less studied parts of the BCCP region because of difficulty in obtaining access to the larger caves. The aquatic fauna remains largely unknown but includes three troglobites: flatworms of the family Kenkiidae; the amphipod Stygobromus russelli, and salamanders of the genus Eurycea. The terrestrial fauna includes nine troglobites: isopods of the family Trichoniscidae; the spider Cicurina (Cicurella) new species 5; the pseudoscorpion Microcreagris reddelli; the harvestman Texella new species 1; the millipedes Cambala speobia speobia and Speodesmus bicornourus; the subterranean silverfish Texoreddellia texensis; and the ground beetles Rhadine persephone and Rhadine ?subterranea.

JOLLYVILLE PLATEAU AREA

Elliott and Reddell (1989) included data on nine caves on the Jollyville Plateau. Others were discussed by Reddell (1984) and Veni and Associates (1988a, 1988b). Since that time our knowledge of the caves and fauna of this area has been improved by the discovery of a number of caves in areas not previously known to contain significant karst features and by further study in some of the previously known caves. Descriptions are provided below for an additional eleven caves in this area which have been biologically investigated.

This area is perhaps the most important in the BCCP region for cave fauna. Four aquatic troglobites occur in the area: the hydrobiid snail Phreatodrobia nugax; the amphipods Stygobromus bifurcatus and Stygobromus

russelli, and as yet undetermined isopods of the family Asellidae. None are endemic to this area. The terrestrial troglobite fauna is quite remarkable and includes the following species: terrestrial isopods of the family Trichoniscidae; the spiders Cicurina (Cicurella) new species 5, 7 and 9, Neoleptoneta myopica (the Tooth Cave spider), Eidmannella reclusa, and Eidmannella rostrata; the pseudoscorpions Aphrastochthonius new species, Microcreagris reddelli, Microcreagris texana, and Tartarocreagris new species 2; the harvestmen Texella new species 1 and Texella reddelli; the millipedes Cambala speobia speobia and Speodesmus bicornourus; the subterranean silverfish Texoreddellia texensis; the ground beetles Rhadine persephone (Tooth Cave ground beetle) and Rhadine subterranea mitchelli; and the Kretschmarr Cave mold beetle Texamaurops reddelli. The presence of 18 terrestrial troglobites in this limited area is unparalleled in the BCCP area and probably in Texas as well. The area contains five of the seven species currently considered endangered. Five additional species are limited to this area, and three other species have limited distribution. The area also contains the Category 2 amphipod Stygobromus bifurcatus. (also occurs in S. Travis & Georgetown areas)

which ones?

NORTH WILLIAMSON COUNTY AREA

With the exception of North Hays County, this is the most poorly studied area in the region under consideration. Elliott and Reddell (1989) described only Coffin Cave in this area. A few additional caves have been found during studies for the City of Georgetown. These will be described elsewhere. (where?)

The only aquatic troglobites in the area are amphipods and asellid isopods. This material remains under study. The terrestrial troglobites include the following: the spiders Cicurina (Cicurella new species 8 and Neoleptoneta anopica; the Bone Cave harvestman Texella new species 1; the millipedes Cambala speobia speobia and Speodesmus bicornourus; the subterranean silverfish Texoreddellia texensis; the ground beetle Rhadine noctivaga; and the Coffin Cave mold beetle Batrisodes (Excavodes) new species 2. Three of these species, Cicurina (Cicurella) new species 8, Neoleptoneta anopica, and Rhadine noctivaga are restricted to this area. The remaining species range into other areas.

POST OAK RIDGE AREA

Prior to 1989 only two caves, Lunsford Cave and Jack's Joint, had been biologically investigated in the Post Oak Ridge area, neither of which were adequately sampled. Elliott and Reddell (1989) included information on six small caves in Burnet County (Eckhardt and Taylor Ranches). Field work in 1990 and 1991 has resulted in study of 20 additional caves in this area. Fourteen of these caves are on the W.B. Simons Ranch (now Lester Ranch), 2 on the Gainer Ranch, 2 on the Gene Taylor Ranch, 1 on the Jimmy Youngquist Ranch, and 1 on the Eckhardt Ranch. Most of the caves are quite small, but Simons Water Cave has 1806 ft. of mapped passage, with the possibility of additional passage beyond a narrow opening that will require enlargement.

The fauna of Post Oak Ridge is limited, but no cave has been adequately studied and almost all of the studies have been made during one season. Four aquatic troglobites are known from the area: an undetermined species of triclad flatworm of the family Kenkiidae, the amphipods Stygobromus bifurcatus and Stygobromus russelli, and the asellid isopod Caecidotea reddelli. Amphipods and isopods from two other caves, Armadillo Ranch Sink and Simons Water Cave, await study. Terrestrial troglobites are the following: the spider Cicurina (Cicurella) probable new species; the pseudoscorpion Tartarocreagris new species 1; the millipedes Cambala speobia speobia, Speodesmus probable new species, and Speodesmus bicornourus; the ground beetle Rhadine russelli, and the mold beetle Batrisodes (Excavodes) new species 1. The pseudoscorpion, the apparent undescribed species of Speodesmus millipede, and Rhadine russelli are known only from Post Oak Ridge. The Cicurina (Cicurella) spider will also probably be determined to be endemic to this area, but adults have yet to be found. It will be surprising if additional terrestrial troglobites are not found in this area. No endangered species have been found in this area, and it is unlikely that they occur here. Stygobromus bifurcatus is listed by the U.S. Fish & Wildlife Service as a Category 2 species.

CONCLUSIONS

Based on new data and on Veni's (1991) study of factors affecting distribution, I have reached the following conclusions about the distribution of the fauna:

1. The Tooth Cave ground beetle Rhadine persephone has been found only in the Jollyville Plateau and Cedar Park areas. It is not likely that this species will be found outside of these areas.

2. Although not yet positively identified, the Tooth Cave spider Neoleptoneta myopica probably occurs in Gallifer and Stovepipe Caves. Gallifer Cave is only a few hundred yards from Tooth Cave, but the Stovepipe Cave population, if verified to be this species, extends the range of the species about two miles to the north. This species probably occurs only in the southern part of the Jollyville Plateau. A separate species, Neoleptoneta devia Gertsch, is found in McDonald Cave, or a "peninsula" of the Jollyville Plateau.

3. The Bee Creek Cave harvestman Texella reddelli has been tentatively identified from Cave Y just north of Barton Creek and about two miles SSW of Bandit Cave, but in a continuous band of Edwards Limestone that also connects these caves with Bee Creek Cave. Of great interest is the discovery of this species in Jester Estates Cave on the Jollyville Plateau. Since T. reddelli is a comparatively recent troglobite still retaining the retina, this distribution is best explained by assuming that these represent one or more invasions in comparatively recent times and that divergence of the now-isolated cave populations on both sides of the river is not advanced enough to consider them different species. The presence of ~~an undescribed species of~~ Texella, also with the retina, in Airman's Cave just south of Barton Creek implies that T. reddelli may not occur south of Barton Creek. A population of what may be T. reddelli has also been found

in Kretschmarr Double Pit about 1 mi. N of Tooth Cave, indicating that this species may be found in other caves on the Jollyville Plateau.

4. The Bone Cave harvestman Texella new species 1 has been found in numerous additional localities north of the Colorado River with the northernmost locality being Sore-ped Cave, north of Georgetown. Whether this represents the northernmost limit of the species is unknown in the absence of studies in northern Williamson County. The presence of a species of ground beetle in northern Williamson County distinct from that in the Georgetown area implies that Texella new species 1 may be at or near the northern limit of the species. There is clinal variation in this species with the northern populations being more troglomorphic than the southern. It is important to save populations throughout the range of the species in order to preserve the genetic diversity within the species. It is also possible that with further study some populations may be shown to be distinct undescribed species.

5. The Tooth Cave pseudoscorpion "Microcreagris" texana has been tentatively identified from two new caves on the Jollyville Plateau. The distribution of this species likely will be limited to the southern Jollyville Plateau since, as in the Neoleptoneta spiders, a second species of pseudoscorpion, "Microcreagris" reddelli, occurs in McDonald Cave.

6. The Kretschmarr Cave mold beetle Texamaurops reddelli has been found in Stovepipe Cave about 1 mi. NE of Amber Cave. This species is almost certainly restricted to the Jollyville Plateau Area.

7. The Coffin Cave mold beetle Batrisodes (Excavodes) new species 2 was not found during the course of the present study. It will almost certainly be limited to the Georgetown and North Williamson County Areas.

8. A revision of Cicurina (Cicurella) spiders has demonstrated the presence of 11 troglobitic species in Travis and Williamson Counties (Gertsch, in press). Ten of these are new species. All have extremely limited distributions and are as likely candidates for endangered species status as those presently listed.

9. A revision of the harvestman genus Texella has clarified the status of the species of this group. The arrangement of these species in Elliott and Reddell (1989) has been modified somewhat (Ubick and Briggs, in press). The harvestman species in South Travis County is Texella mulaiki, which is also known from the San Marcos area in Hays County. The Airman's Cave population belongs to an undescribed species rather than to T. reddelli, and (with the exception of the Jester Estates Cave population) all populations north of the Colorado River belong to a single undescribed species. All of these species probably should be considered for endangered species listing.

10. Restudy of the mold beetles (Pselaphidae) of Texas caves has demonstrated that the Williamson County populations previously considered to be Texamaurops reddelli are in fact an undescribed species of Batrisodes (Excavodes) which is highly convergent in external morphology with T. reddelli (Chandler, in press). A new species of Batrisodes (Excavodes) from caves in the western Cedar Park area and Post Oak Ridge may be a suitable candidate for endangered species listing.

11. Study of the pseudoscorpions has revealed the presence of two undescribed species of Tartarocreagris in Travis County. One species is

restricted to Airman's Cave and a second to New Comanche Trail Cave (Muchmore, in press). These, together with the two previously described (but unlisted) species presently placed in Microcreagris, all should be considered for endangered species listing. Recent collections have revealed the presence of an undescribed species of Aphrastochthonius in Stovepipe Cave, Travis County, and of Tartarocreagris in caves on Post Oak Ridge. These species are also likely candidates for endangered species status.

RECOMMENDATIONS

In general the recommendations in Elliott and Reddell (1989), Biological Advisory Team (1990), and The Butler/EH&A Team (1991) should be followed. I would emphasize that prior to finalization of any buffer zone around a cave, a hydrogeological survey should be conducted to define the boundaries of the specific preserve. Also, despite extensive additional field work, new localities will continue to be found for some if not all of the endangered species. Some of the newly discovered caves may be more significant than those presently known to contain the listed fauna. This has been well demonstrated by the discovery of Stovepipe Cave, which probably contains five of the protected species as well as an undescribed species of pseudoscorpion deserving of protection.

Ubick and Briggs (in press) in their revision of the harvestman genus Texella have demonstrated genetic diversity between different caves or cave clusters. This fact combined with the high degree of endemicity in the spider genera Cicurina and Neoleptoneta and the pseudoscorpion genus Tartarocreagris, makes it essential that at least the more significant caves in all regions be preserved. Small caves with limited habitat and few troglobites could be filled, but it is recommended that even in these cases the entrance be left open to determine the effect of urbanization on these caves. This could be done with a very limited area around the cave entrance. The idea of one or a few large preserves for the cave fauna with the remainder of the caves destroyed essentially creates a zoo-type situation that destroys the genetic diversity in the species. Any future information on the evolution and zoogeographic relationships of the species as a whole will thus be impossible to obtain.

Given the likelihood that additional species in the BCCP area will be petitioned for listing because of their extremely limited ranges and ~~proposed~~ urbanization, it is recommended that each cave in the area be ~~considered individually~~ prior to destruction, whether it contains the presently listed species or not.

The greatest threats to the cavernicole fauna of this area are urbanization and invasion by fire ants. Elliott (1991) reports that at 12 endangered-species caves are invaded by fire ants. ~~This means that at least 1/4 of the 48 populations are threatened~~. Since many caves have not been recently investigated, this number is probably much higher. The preserve system will go far to protect the fauna from development. Protection from fire ants is a far more difficult process in many respects. It cannot be urged too strongly that a controlled fire ant study be initiated immediately. In a few cases, such as LakeLine Cave, the caves of the Four-

Points cluster (Tooth Cave, Kretschmarr Cave, Gallifer Cave, Kretschmarr Double Pit), and others, the impact of fire ants is so great that it is recommended that fire ant control be initiated at once. In these instances ~~it is felt that~~ the impact of fire ants may be so great that even if fire ant control might harm the cave cricket population it will have a less immediate effect than the fire ants. In the long term, however, this is not a satisfactory solution. Careful monitoring of all endangered-species caves should be initiated to determine if fire ants are invading the caves.

A comprehensive monitoring program for each cave containing endangered species should be conducted for an indefinite period of time. Such a program, however, should be minimally invasive and the type of monitoring program should be adapted for each cave. In areas of intensive urbanization it may be desirable in a few caves to monitor the caves each month for at least one year. In the smaller caves this is probably excessive and it is probably preferable to visit the caves once every three months. Monitoring should not include any attempt to count every organism or to turn over rocks on every occasion. Careful thought should be given to disturbing the caves as little as possible. Larger caves with extensive faunas and floor areas may be suitable for population estimates and density and dispersion studies.

The following recommendations are made with respect to each specific area covered by this report:

1. North Hays County and South Travis County Areas. Additional field work is needed in the entire area to determine if the Bee Creek Cave harvestman Texella reddelli extends south of Barton Creek.

2. Rollingwood Area. Attempts should be made to obtain male Texella from Cave Y and Bandit Cave to verify the presence of Texella reddelli in these caves.

3. Central Austin Area. Very little habitat in this area remains undeveloped, and Cotterell Cave may be the only cave containing endangered species. The proposed preserve around Cotterell Cave should be adequate to protect the cave.

4. McNeil and Round Rock Areas. In addition to the Bone Cave harvestman Texella new species 1, several other species, both described and undescribed, are prime candidates for listing. Numerous new localities for troglobites await discovery in these areas if permission can be obtained from several land owners. A full assessment of the preserve needs in this region can only be made with more field work. As a result it is recommended that all known localities for the endangered species be preserved. The recommendations for cave clusters in The Butler & EH&A Team (1991) should be accepted with modifications based on hydrogeological studies. As new caves in these areas are found, they may need to be included in future preserve systems, either as adjuncts to the recommended preserves or as separate preserves.

5. Georgetown and North Williamson County Areas. These areas are ~~currently being studied under~~ a separate ~~contract with~~ the City of Georgetown. The recommendations of Elliott and Reddell (1989) and The Butler/EPH&A Team (1991) are adequate, but additional preserves may be recommended in the report to the City of Georgetown.

6. Cedar Park Area. Several additional localities for the endangered

Tooth Cave ground beetle have been found in this area. Because of the rarity of this species it is recommended that all localities be preserved. It is also urged that the Buttercup Creek karst region be further investigated, with special emphasis on a hydrogeological study. The likelihood that the stream systems contain a new species of blind salamander of the genus Eurycea and that the caves constitute one enormous hydrological network make this one of the more important areas in the entire (BCCP) region to protect. Further study is needed in the area to the north along Nameless Road to determine if the Tooth Cave ground beetle extends into this somewhat isolated area. If it does not, the Nameless Road area may constitute an entirely separate zoogeographic region deserving of separate consideration.

7. Jollyville Plateau Area. The single preserve for the Four Points cave cluster is probably not adequate to protect the remarkable fauna of the Jollyville Plateau. Additional preserves ~~of some size~~ should be developed around Stovepipe Cave, Jester Estates Cave, and Beard Ranch Cave. Newly discovered caves on the H. Ross Perot Four Points Development should be biologically studied. There is essentially no doubt but that these caves contain one or more of the endangered species.

8. Post Oak Ridge Area. The proposed ~~Balcones Canyonlands~~ Wildlife Refuge should preserve most of the caves in this area. It is urged that a comprehensive karst feature survey be conducted on the entire refuge to provide for adequate future management guidelines.

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