FINAL REPORT

As Required by

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. E – 70-R

Endangered and Threatened Species Conservation

ASSESSING THE STATUS OF *EURYCEA* SALAMANDERS AND AQUIFER INVERTEBRATES IN NORTHERN HAYS COUNTY, TEXAS

Prepared by:

Jean Krejca

TEXAS PARKS & WILDLIFE

Robert Cook
Executive Director

Matt Wagner
Program Director, Wildlife Diversity

Mike Berger
Division Director, Wildlife

2 April 2007

INTERIM REPORT

STATE: Texas **GRANT NUMBER:** E – 70-R

PROJECT TITLE: Assessing the Status of *Eurycea* Salamanders and Aquifer Invertebrates in Northern Hays County, Texas

REPORTING PERIOD: 8/01/05 to 9/30/06

OBJECTIVE(S): The purpose of this project is to delineate the ranges and provide diversity and abundance information for salamanders and aquatic invertebrates in the northern San Marcos and southern Barton Springs segments of the Edwards Aquifer in northern Hays Co.

Objectives:

1. Caves, springs and wells will be sampled by properly permitted project personnel using drift nets, bottle traps, and mop heads, depending on well pipe diameter and flow rate.
2. Salamander specimens for genetic work will be sent to Dr. Paul Chippindale or Dr. Dave Hillis for analysis.
3. Aquatic invertebrate specimens will be deposited in the Texas Memorial Museum.

Significant Deviation:

None.

Summary Of Progress:

Please see Attachment A (.pdf document).

Location: Hays County, Texas

Cost: _____

Prepared by: Craig Farquhar **Date:** 2 April 2007

Approved by: _____ **Date:**_____
Neil (Nick) E. Carter

ZARA ENVIRONMENTAL LLC
118 W. Goforth Road
Buda, Texas 78610
www.zaraenvironmental.com

ASSESSING THE STATUS OF *Eurycea* SALAMANDERS AND AQUIFER INVERTEBRATES IN NORTHERN HAYS COUNTY, TEXAS

Prepared for:

Texas Parks and Wildlife Department
3000 S IH-35, Ste. 100
Austin, Texas 78704

Prepared by:

Andrew G. Gluesenkamp, Ph.D. and Jean K. Krejca, Ph.D.

31 March 2007

Contact information for principal investigators:

Andrew G. Gluesenkamp, Ph.D.
700 Billie Brooks Drive
Driftwood, TX, 78619
512-799-1095
andy@gluesenkamp.com

Jean K. Krejca, Ph.D.
Zara Environmental LLC
118 W. Goforth Rd.
Buda, TX, 78610
512-294-8636
jean@zaraenvironmental.com

Abstract

Twelve sites in the area of the groundwater divide between the San Marcos and Barton Springs pools of the Edwards Aquifer were sampled for groundwater fauna (Figure 1). Visual surveys and collection efforts using baited bottle traps, mop heads, and minnow traps were conducted at most sites over a period of several months. Despite repeated efforts, no groundwater organisms were encountered with the exception of a single site which yielded several amphipods (*Stygobromus russelli*). Low aquifer levels and groundwater flow rates due to ongoing drought conditions, limited access to appropriate sampling sites, and overall low detection probabilities of aquifer organisms are likely responsible for the paucity of faunal collections during this study.

Introduction

The Edwards Aquifer recharge zone in Hays and Travis counties contains six federally endangered species that rely on aquifer water and at least 41 other rare species (with less than five populations) known only from aquifer localities whose status is uncertain. Without specific knowledge regarding the distribution of these organisms, management practices have been largely based on the assumption that their ranges are limited to a handful of discrete areas. However, recent dye trace studies and syntopic water level studies conducted by the Edwards Aquifer Authority, the City of Austin, and the Barton Springs Edwards Aquifer Conservation District indicate that the groundwater divide between the Barton Springs Segment and the San Marcos Pool of the Edwards Aquifer is situated along Onion Creek, and groundwater may flow in either direction across the shallow divide depending on local conditions (Nico Hauwert and Jon Cradit, pers. comm.). The existence of ephemeral groundwater connectivity is further supported by ongoing molecular studies of *Eurycea* populations in northern Hays and southern Travis counties which have identified *Eurycea nana* alleles in salamanders from springs along Little Bear Creek, Blowing Sink Cave, Cold Springs, and even Barton Springs (approximately 6% of individuals sampled, Paul Chippindale, pers. comm.). Outside of these studies, the federally listed E. nana is known only from San Marcos Springs (Chippindale et al. 1998). In addition, several groundwater invertebrate species are known from multiple localities bracketing the area of the groundwater divide in northern Hays County. As this area becomes increasingly urbanized, it is increasingly important to document biodiversity and species abundance in a systematic and quantitative manner.

Methods

Eurycea robusta type locality

Surface surveys were conducted in the bed and along the banks of the Blanco River between March and June of 2006 (Figure 1). The purpose of these surveys was to pinpoint the probable location of the enlarged bedrock crevice that is the only known locality where salamanders were observed in 1951 (Potter and Sweet 1981). Excavation was conducted in June 2006, once the riverbed was completely dry and there was less risk of flooding. During June 17-19 2006, a team of eight volunteers evaluated potential features in the area of the type locality. Three candidate crevices were first excavated by hand and later with the aid of a small backhoe (Figure 2). All excavations were backfilled upon completion of site assessment.

Dowell Spring
The well is an open excavation approximately 2.5 m deep and 2 m wide and is supplied by water emanating from consolidated alluvium at the point of contact with the underlying Austin Chalk (Figure 3). No water, standing or flowing, was observed during preliminary inspection on 5 January 2007. However, a steady flow of water (2-3 gallons per minute) was observed flowing into the well on 9 January and the pool at the bottom of the excavation was approximately 0.5 m deep at 10:00 am and by 10:30 am, the level of the pool had increased by 2 cm. A backhoe was used to remove rocks and debris from the bottom of the excavation until a bedrock floor was reached at a depth of 0.75 m (Figure 4).

Open Wells
Open wells (McCoy's Well, Dowell Well, Dowell Windmill, Gregg Well, Hays Co Well #1, Hays Co Well #2, Swinney Well, and Autumn Woods Well) were sampled using mop heads, minnow traps and bottle traps, depending on well morphology. Bottle traps were constructed from 1L plastic water bottles (Figure 5) and baited with tassels of cotton mop material and dried fruit, nuts, or cat food before being lowered into accessible wells. Bottle traps were checked and re-baited at intervals ranging from 4 to 21 days for a period of 90 days. The Silberra Well was inaccessible for sampling due to an obstruction in the casing at a depth of approximately 10 m.

Results

Eurycea robusta type locality
No significant features were discovered during three days of excavation (totaling 192 person-hours of effort). Two narrow, sediment-filled features extending roughly perpendicular to the river course match the description of the historic location but neither showed evidence of significant enlargement (Figure 2). Cartographic comparison of the historic river course to the course presently followed suggests that the original crevice is likely under a large, tree-covered rocky sandbar in the riverbed. Future sampling efforts at this site should focus on drilling a series of exploratory wells above the south bank of the river. A well drilled in the same area shortly after the discovery of the type locality intersected the same water source, suggesting that interconnected water-filled cavities may extend south of the type locality. This second well no longer exists, it was backfilled in 1951.

Dowell Spring
Excavation of the spring by hand and with a backhoe (Figure 4) revealed that the hand-dug feature is of limited extent. Water emanates from the contact between Austin Chalk and consolidated alluvium just above the spring pool (Figure 3). This contact is likely the same as that seen in the nearby Dowell Windmill. Water levels were the same as in Dowell Windmill. The source of water in both cases is likely recent precipitation percolating through alluvium and flowing along the top of its contact with the Austin Chalk. No aquatic fauna were observed at this site.

Dowell Windmill
Bottle traps, mop heads, and minnow traps placed in this well were checked four times during a 70-day period. Trapping efforts at this site yielded no aquatic fauna. Given the probable source of the water in this well (see Dowell Spring), it is unlikely that aquifer organisms occur at this site.

Dowell Well
A bottle trap placed in this well (Figure 6) was sampled four times during a 70-day period. No aquatic fauna were observed at this site, despite known connectivity of the Edwards Aquifer. A partial obstruction in the well shaft at a depth of approximately 50 m may have prevented the bottle trap from reaching an optimal sampling depth.

McCoy's Well
This well experiences dramatic changes in water level (+/- 35 m, Brian Hunt, pers. comm.) and is subject to turbulent flow. The first bottle trap set in this well was lost two weeks later during heavy flow conditions. Subsequent traps were checked bi-weekly yet no aquatic fauna were encountered. Trapping continues at this promising site.

Hays Co Well #1
Bottle traps and mop heads placed in this shallow well (< 5 m) yielded no aquatic fauna, and trapping was suspended after six weeks of bi-weekly sampling.

Hays Co Well #2 (Figure 7)
Bottle traps and mop heads placed in this shallow well (< 5 m) yielded no aquatic fauna. The source of water in this well is likely precipitation seeping through overlying sediments. A small stock pond nearby maintained the same water level as the well during six weeks of bi-weekly sampling.

Swinney Well
Bottle traps placed in this well and checked bi-weekly for a 70-day period yielded no aquatic fauna. Although the well is deep and intersects both Edwards Aquifer water and a "bad water" zone, it's placement in a flood-prone drainage area has resulted in much debris washing under the cap and down the shaft. Following heavy rains in January 2007, traps were fouled with sediment and vegetation washed in from the surface.

Silberra Well
This well's depth location made it a promising site for faunal sampling. Unfortunately, a partial obstruction at a depth of approximately 10 m prevented adequate sampling. Following rainfall events in December, January, and February 2007, the water level in the well rose significantly. However, removal of leaf litter and debris that had collected above the obstruction revealed that apparent the apparent rise in water level was due to perched rainwater, not rising groundwater. Repeated efforts to remove the partial obstruction using steel chain, cable, and heavy hooked weights were unsuccessful.

Gregg Well (Figure 8)
Bottle traps and tassels of mop head placed in this well and checked bi-weekly for over three months yielded no aquatic fauna. However, the depth and location of this well make it an excellent candidate for faunal sampling and collecting efforts continue.

Buda Monitoring Well
Bottle traps and tassels of mop head placed in this well and checked bi-weekly for over three months yielded no aquatic fauna. Sampling in this well is hampered by its narrow diameter and the rusty condition of the casing. A partial obstruction at approximately 75 m depth may prevent traps from reaching optimal sampling depth. Sampling efforts in this well continue.

Autumn Woods Well
Bottle traps placed in this well over the past several years regularly yield large numbers of amphipods (William Russell, pers. comm.). A pair of bottle traps set in March of 2007 and checked four days later yielded six *Stygobromus russelli*. This is a blind stygobitic amphipod known from Bexar County north to Fort Hood in Bell and Coryell counties and west to Bandera County (James Reddell, pers. comm.). A restriction at approximately 25 m depth may restrict the size of organisms that enter the upper portion of the water column in the well. Trapping efforts continue in this well.

Discussion

While very little fauna was found during this study, important progress was made towards understanding this region of the Edwards Aquifer. First, this study demonstrates that it is possible to obtain permission for biological sampling of wells and to use traps to successfully capture aquifer fauna from these wells. This is particularly important considering that so many rare species are known only from caves and springs, and important management decisions (e.g. critical habitat designation) are based on small buffers around these discreet localities. The real extent of the habitat for these fauna is not known, but hydrology predicts that they may be widespread between the known localities. Wells offer a small window into this habitat that is extremely difficult to sample and monitor. With more extensive effort, even a single well locality that yields rare species would have utmost conservation value: to sample DNA and species morphology, measure habitat parameters (water chemistry, flow), estimate the true range of the species, and monitor populations and contamination events.

Second, data on the wells sampled herein represents a baseline for the type of wells and geologic areas that may provide habitat for groundwater fauna. The Dowell Spring and Windmill were shallow, with recharge from alluvium on the top of the Austin Chalk. Hays County Well # 2 was similar. Future efforts should focus on deeper sites with known Edwards Aquifer connections.

Finally, these results should be interpreted in light of low aquifer levels and low population densities for aquifer species. The wells that were sampled are all open and not artesian, meaning the actual quantity of groundwater that the odor of the bait infiltrated and the trap was exposed to may have been on the order of a handful of m^3, or tens of m^3 at most. In contrast, the San Antonio aquifer dwelling catfish *Satan eurystomus* and *Trogloglanis pattersoni* occurred at rates of one per every 130,000 m^3 and 65,000 m^3 of water (Karnei 1978). Most well records for aquifer species are from flowing artesian wells that are covered with nets to capture fauna, which is analogous to sampling a much larger area of habitat, undoubtedly increasing chances of encountering rare fauna. Our own observations at localities outside of this study show that traps are effective for capturing salamanders but may yield many negative results before and after a single hit. As groundwater use is increasingly regulated and wastage is prohibited, the potential to sample thousands of m^3 of water using nets is increasingly rare.

The Edwards Aquifer between the San Marcos and Barton Springs pools is under extreme development pressure, and this area is probably a pathway between two biological and socioeconomic jewels of Texas. The results of this study are the beginning of an increasing effort to understand the fauna there.

Acknowledgements

Assistance in the field was provided by Marion Cuvier, Dante Fenolio, Randy Gibson, Leah Gluesenkamp, Brian Hunt, Colin Peden, Corey Roelke, William Russell, Mark Sanders, and Lily Verdone. Jon Cradit (EAA), Nico Hauwert (CoA), Brian Hunt (BSCEAD), and William Russell provided critical assistance in locating wells, obtaining landowner contacts, and background information on individual wells. Landowners and land managers who generously provided sampling access include Cliff Alexander, Caroline Dowell, Ray Silberra and Bill Swinney. Funding was provided by Texas Parks and Wildlife through the Endangered Species Act Section 6 grant program of the U.S. Fish and Wildlife Service. In particular, Craig Farquhar (TPWD) did an outstanding job taking care of the administration of these funds.

Literature Cited

Chippendale, P. T., A. H. Price, and D. M. Hillis, 1998. Systematic status of the San Marcos Salamander, *Eurycea nana* (Caudata:Plethodontidae). Copeia 1998: 1046-1049.

Karnei, H. S. 1978. A Survey of the Subterranean Aquatic Fauna of Bexar County, Texas. M. S. Thesis, Southwest Texas State University. 118 pages.

Potter, F. E. and S. S. Sweet, 1981. Generic boundaries in Texas cave salamanders, and a redescription of *Typhlomolge robusta* (Amphibia: Plethodontidae). Copeia 1981: 64-75.

Table 1. Coordinates of wells sampled during this study. ID = Identification numbers; TWDB = Texas Water Development Board; BSEACD = Barton Springs Edwards Aquifer Conservation District; UTM = Universal Transverse Mercator.

Well Name	**TWDB/BSEACD ID**	**Location (UTM NAD27CONUS)**
Autumn Woods Well	NA	14R 606679E 3335418N
Buda Monitoring Well	58-50-101	14R 611557E 3328408N
Dowell Spring	58-50-8DS	14R 614460E 3334755N
Dowell Well	58-50-801	14R 614568E 3335006N
Dowell Windmill	5850-802	14R 614362E 3334858N
Eurycea robusta type locality	NA	14R 606193E 3309644N
Gregg Well	58-57-902	14R 606573E 3320082N
Hays Co Well #1	NA	14R 613435E 3325633N
Hays Co Well #2	NA	14R 614146E 3327506N
McCoy's Well	58-50-707	14R 611851E 3334917N
Silberra Well	67-013-04	14R 608435E 3317397N
Swinney Well	58-58-4BS	14R 612492E 3324929N

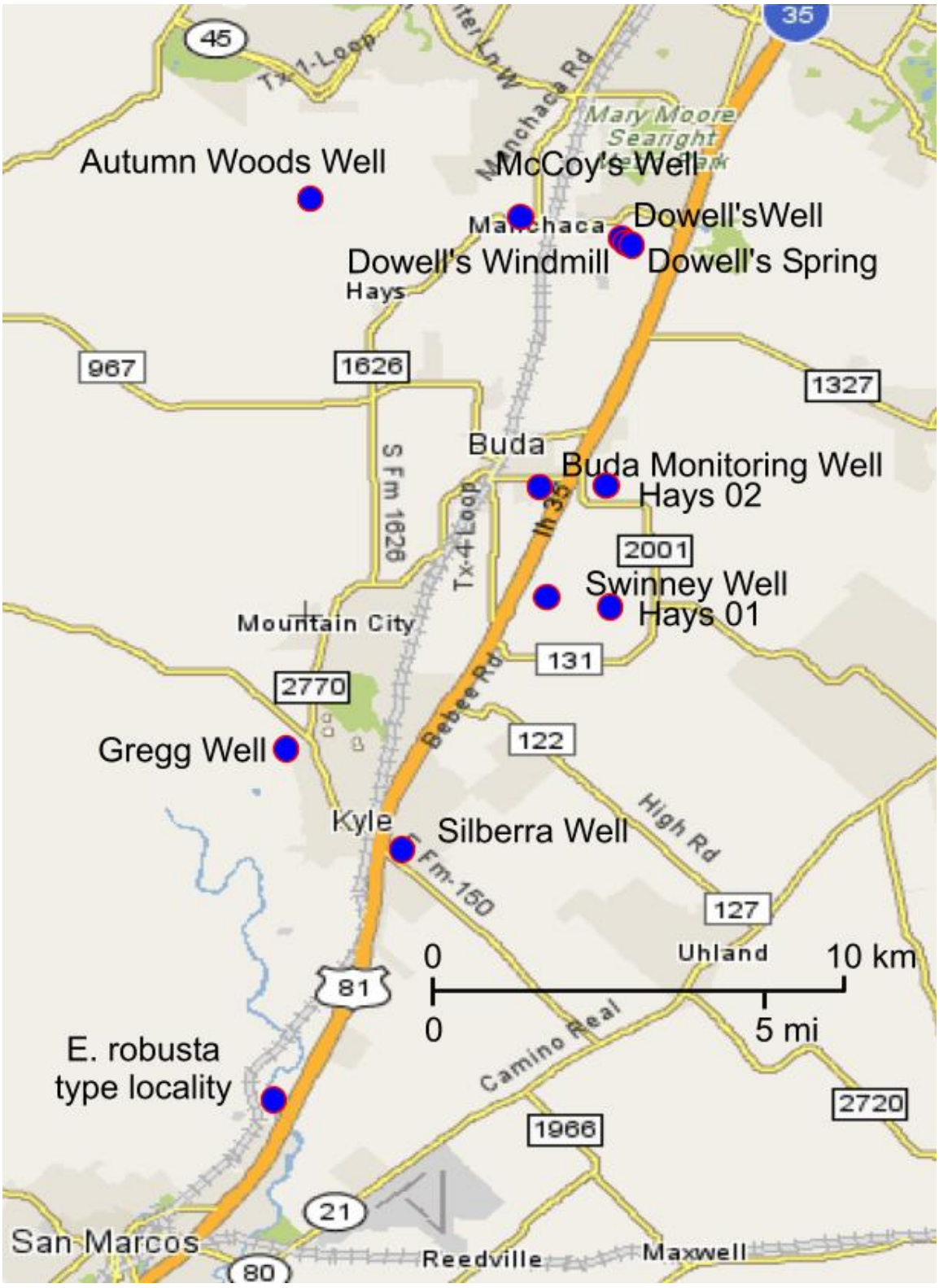

Figure 1. Localities sampled during this study. TWDB and BSCEAD Well ID numbers and GPS coordinates are listed in Appendix I.

Figure 2. William Russell and Colin Peden excavate a fissure in the bed of the Blanco River near the type locality of *Eurycea robusta*. Features were excavated by hand and, in some cases, further excavation was conducted using heavy machinery (Marion Cuvier can be seen working on another feature in the background).

Figure 3. Dowell Spring, located immediately north of Onion Creek in Manchaca, Texas. The spring was completely dry 24 hours before this photo was taken.

Figure 4. Excavation of Dowell Spring using a backhoe. The backhoe encountered a solid bedrock bottom approximately 0.75 m below the surface of the water.

Figure 5. Bottle trap designed for open hole well sampling. This design has proven highly effective for sampling wells up to 300 feet deep.

Figure 6. Dowell Well (TWDB ID # 58-50-801) located just north of Onion Creek in Manchaca, Texas. Note bottle trap and mop head in foreground.

Figure 7. Leah Gluesenkamp at Hays Co Well #2, east of Buda, Texas.

Figure 8. Gregg Well, west of Kyle, Texas.

Figure 9. Blind amphipods (*Stygobromus russelli*) from Autumn Woods Well, Manchaca, Texas.