A Review of the Status of Current Critical Biological and Ecological Information on the Eurycea Salamanders Located in Travis County, Texas

prepared by
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September 20, 1995

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ACKNOWLEDGEMENTS

Special thanks are due the guest speakers who participated in the information workshop. Their efforts added immeasurably to the success of this project. The outstanding efforts put forth by the ABAT members is genuinely appreciated. The assistance and expertise of Dr. Andy Price (Texas Parks and Wildlife Department) during the information meeting and field trip were of great value to the ABAT. Robert Hansen (City of Austin) and Dr. Larry McKinney (Texas Parks and Wildlife Department) demonstrated considerable patience during this often tedious process. –Ed.

INTRODUCTION

Following the decision of the United States Fish and Wildlife Service to publish rules proposing to list the Barton Springs salamander as endangered under the Federal Endangered Species Act, the City of Austin, Environmental & Conservation Services Department, and the Texas Parks and Wildlife Department, Resource Protection Division determined a desire for more information concerning neotenic Eurycea salamanders located in the Bull Creek and Barton Creek watersheds in Travis County. Subsequently, these two agencies entered into an interlocal agreement to establish an Aquatic Biological Advisory Team (ABAT) of nationally recognized experts in areas pretaining to aquatic invertebrates, stream ecology, geohydrology, amphibian ecophysiology, water quality management practices and impacts, to review the status of current critical biological and ecological information regarding the salamanders.

To the extent of their particular expertise the ABAT members were asked to review the status of critical biological and ecological information regarding neotenic Eurycea salamanders in Travis County, to possibly include:

- compiling and summarizing critical scientific data on the salamanders that may be instrumental to the development of conservation recommendations for the species.

- defining important information gaps that presently prevents development of effective factually-based conservation measures for the species.

- making specific, prioritized recommendations for short- and long-term research efforts for gathering critical missing data and to monitor the success of existing and future efforts to prevent habitat degradation.

- making recommendations to the extent practical on ecological and water quality benchmarks to strive for in order to protect the species.

- identifying existing probable or potential sources, land uses, practices, and water quality and quantity protection measures that are necessary to achieve the level of protection deemed necessary to protect the species.

- making general recommendations on ecological management practices, and water quality protection measures that are necessary to achieve the level of protection deemed necessary to protect the species;

The breadth of the ABAT members reviews were, to the extent that relevant data their expertise permitted, to encompass the following:

- the specific hydrological and hydrogeological regimes of the ecosystem which supports each salamander population.

• sensitivity of salamander populations (including salamanders in general) to variation in important water quality parameters. This should encompass both those which may have potentially catastrophic effects on the animals as well as those that may have low level chronic effects which might affect the viability of populations.

• dynamics of natural predator species that may take salamanders and of prey populations on which the salamanders may depend.

• population dynamics of the salamanders themselves and its relevance to the potential for extinction or local extirpation of populations.

• types of surface water contamination sources and controls in the recharge and contributing zones for springs supporting the salamanders.

• types of groundwater contamination sources and controls in the recharge and contributing zones for springs supporting the salamanders.

• measures to preserve existing hydrological regimes.

• protection measures in the immediate spring discharge areas that represent the salamander habitat.

The ABAT members were instructed to not review specific laws or regulations nor make recommendations regarding changes to such laws.

The ABAT was presented various reference materials in regard to the biology of Eurycea salamaders, regional geohydrology, stream ecology, water quality and quantity, and additional information on the Bull Creek and Barton Creek watersheds. The ABAT then attended an information meeting held at January 20-21, 1995 at the Wild Basin Preserve in Austin. This meeting was structured around presentations by regional experts on pertinent biological and ecological information and existing ordinances relating to the Bull Creek and Barton Creek watersheds (Appendix 1). The second day of the fact-finding meeting involved an aerial overview of the Barton Creek and Bull Creek watersheds and on-site visits to several key locations in those watersheds where salamanders occur.

Herein, is a summary of the general observations and findings of the ABAT, including their prioritized recommendations in regard to their specific taskings, and their individual reports in their entirety.

APPENDIX 5

Report of Dr. Mark D. Schram

COMMENTS AND RECOMMENDATIONS FOR SALAMANDER CONSERVATION IN THE TRAVIS COUNTY AREA

Mark D. Schram

OVERVIEW

The Edwards Plateau area of central Texas is unique in that it possesses a multitude of springs, streams, and rivers that originate from aquifers deep within the karst topography. The aquatic biota of the region is rich and includes many taxa that are endemic; some of which face possible extinction (Bowles and Arsuffi, 1993 and others). Protection of these natural environments, including water quality, fauna and flora is of paramount importance. It not only insures sustaining of our natural heritage, but also will provide for a quality environment for residents in the region as well as future residents due to urban expansion.

The charge put forth to the Aquatic Biological Team (ABT) was to 'review the status of the critical biological and ecological information regarding three neotenic Eurycea salamanders in Travis County' (northwest Edwards and Jollyville Plateaus) and to make recommendations that will insure the protection of these species. The scope of this report focuses on the general aquatic biology and ecology of surface waters (Barton and Bull Creeks) occurring in Travis County and immediately adjacent areas.

Although the focus of this contracted work was to assess critical data and to make recommendations for the preservation of salamanders in the Travis county, other biotic and abiotic factors should be considered. Biotic and abiotic interactions (including salamander populations) cannot be disconnected. Interruption or deletion of any component of the trophic structure (i.e. food chain) of these ecosystems could have a catastrophic cascading effect that would threaten the existence of salamander populations. Additionally, numerous other rare and endemic species, both plant and animal, are known to occur in these highly sensitive areas (Bowles and Arsuffi, 1993; and others). They should also be considered in any preservation plan. Any attempt to conserve salamander populations in the Travis county area, or any area for that matter, must be viewed in a holistic manner and an ecosystem approach utilized.

Recommendation:

- when applicable evaluate environmental issues using an ecosystem approach.

Numerous documents/reports were submitted to me for evaluation and analysis. In a great many cases these reports were not comparable. For example, the Intensive Survey of Bull Creek (1982) lists macroinvertebrate fauna. No subsequent data on macroinvertebrates were available to me, and therefore, a comparison of community structure and analysis of community change was impossible to complete. Additionally, sampling stations in many instances were not the same (USGS vs. USFW vs. TDWR) making interpretations difficult in many instances. Intensive survey data are very useful, but do not provide the sensitivity needed to evaluate environmental changes that can occur seasonally or detect changes that are associated with storm events.

Recommendations:

- select environmental sample stations that can be used by all agencies in monitoring water quality. Standardize monitoring efforts.

- coordinate efforts to establish long-term data bases to clearly delineate seasonal and meterological influences on water quality.

- search and compile a list of all water quality studies and reports and establish a central/master file of these documents for future reference.

TAXONOMIC AND GEOGRAPHICAL STATUS OF NEOTENIC SALAMANDERS IN THE TRAVIS COUNTY AREA

Little information exists on taxonomic status of plethodontid salamanders of the genus Eurycea in central Texas (Chippendale et al., 1993). The once known Eurycea neotenes appears to be a polyphyletic group comprising many species in a closely related complex. A recently described species, Eurycea sosorum, has been reported from only single locality, Barton Springs at Zilker Park. This salamander was noted as having the smallest range of any vertebrate in North America (Chippendale et al., 1993). Moreover, other plethodontid salamanders, including the Jollyville Plateau Salamander, are considered to be endemic with highly restricted ranges in Travis and adjacent Williamson counties (Price et al., 1995). It is apparent that little, if any, information exist concerning the life-histories, life-cycles, reproduction, physiology, habitat preference and distribution of these species.

Recommendations:

- continue efforts in the identification of salamander species.

- document specific habitat localities and ranges for each species.

- compile pertinent information regarding life-histories, life-cycles, reproduction, physiology and habitat preferences of these species.

BULL CREEK WATERSHED

Bull Creek and it's tributaries drain a portion of the Jollyville plateau, an area

encompassing approx. 22.3 square miles north and northwest of downtown Austin. The upstream reaches are characterized as intermittent, the lower as possessing steady flow due to impoundments in down stream segments. The origin of water for this system is primarily from a series of springs located at the head of many tributaries. Springs are fed by a series of underground conduits typical of karst areas. Substrate type varies from bedrock in the upper reaches to silt in the lower reaches. Major developments occur north of the main stem of Bull Creek and in a smaller area just north of Lake Austin off of Loop 360 to the west (Map 1993). Jollyville Plateau salamanders have been reported from 13 sites within this watershed (Comments and Recommendations Regarding Salamanders and the BCCP).

The Texas Department of Water Resources conducted an intensive survey of Bull Creek during February 1981 and submitted a report in December of 1982. The general conclusions of this document were that the water quality of Bull Creek was excellent, there were no point source discharges to Bull creek, but non-point source problems existed in the downstream reaches along Loop 360. By comparison (USGS, Multiple Station Analyses during 1992 and 1993 at loop 360) major changes have occurred in physical and chemical features of the Bull Creek watershed over the course of the decade and a half. Comparisons here were between Station C (TDWR, 1982), and loop 360 data (USGS, 1992 & 1993). Observed changes include increases in: discharge, total nitrogen, nitrate nitrogen, nitrite nitrogen, total phosphorus, orthophosphate and total organic carbon. Increase in nutrient load is likely to be a product of development (i.e. increase in surface fertilizer application, septic leaching, etc.). There are insufficient data available for assessment of aquatic flora and fauna occurring in Bull Creek. The TDWR report (1982) includes a flora/fauna list from three sites on Bull Creek quite typical of a undisturbed system with high water quality. No information was available (at least not to me at the time of drafting this report) on the composition of aquatic flora and fauna from Bull creek after 1982.

The City of Austin's summary report on the Cumulative Impacts of Development on Water Quality and Endangered Species in Bull and West Bull Creek Watersheds (1993) clearly describes differences in water quality between developed and undeveloped tributaries. They report 'higher ambient concentrations in base flow at the developed site for TDS, total nitrogen, total phosphorus, TSS and bacteria; and higher concentrations in flow after storms at the developed site for total nitrogen, total phosphorus and bacteria.' These data support the comparative increase in certain nutrients in the loop 360 segment of Bull Creek over the course decade and a half.

<u>Recommendations</u>:

- establish a monitoring program to include a headwater and mainstream sites to document changes in nutrient/chemical as well as physical components of the Bull Creek system.

- continue to monitor for comparison between developed and undeveloped areas.

The recharge area for Bull Creek and it's tributaries is limited to the drainage basin in which it occurs. The addition of impervious cover to this region will result in a decrease recharge to this aquifer, and ultimately spring flow will cease eliminating critical habitat for the Jollyville Plateau salamander, and other aquatic flora and fauna. Increase in impervious cover would result in the channelization surface runoff from storm events directly into Bull Creek at various points. As development continues, surface runoff will carry with it increased nutrients (fertilizers), pesticides, herbicides, various pollutants and debris that normally would not occur in an undisturbed system. The result would be a change in the trophic structure of the ecosystem from the point of entrance to the Colorado River. Diversion of storm water directly into Bull Creek would also result in significant changes in the flow dynamics of the system. Raging water levels during storm events would increase the likelihood of area flooding, erosion, scouring of creek basin and physical disruption of the flora and fauna along the entire length of Bull Creek. Indications of the effects of diverted storm water were observed at the three sites visited in January 1995 (Still House Springs, Balcones District Park and a site on Spicewood Springs Road) that include: erosion, deposition of organic matter, pollutants, and wastes such as plastics, paper, bottles and cans.

Recommendations:

- restrict the development of impervious cover to insure the maintenance of spring flows.

- if development is inevitable then avoid the channelization of surface runoff directly in to critical spring habitats, especially from paved road surfaces. Construct storm sewers to route surface runoff from these areas.

The I-360 corridor adjacent to the lower reaches of Bull Creek and the Colorado River is heavily travel by tanker trucks carrying petroleum products, pesticides, herbicides and various industrial chemicals (many references here to potential spills). These aquatic habitats are extremely vulnerable to toxic spills occurring along I-360. A single incident could have catastrophic effects on the general water quality of Bull Creek and the Colorado River as well as destruction of habitat, flora and fauna that may be irreversible. Accidents are bound to occur in the future and eventually will have a catastrophic impact on the surrounding area.

Recommendations:

- development and maintenance of containment features along overpasses and roadways which border critical habitats.

- development and maintenance of effective clean-up measures that can become operative on short notice.

BARTON CREEK AND BARTON SPRINGS WATERSHED

Barton Creek runs approximately 50 miles from its headwaters in Hays County to the Colorado River in Austin. Barton Creek is characterized as a low flow lotic environment that can become intermittent during periods of low flow. The underlying Edwards Aquifer is the areas primary water supply and is heavily utilized for domestic and agricultural purposes. The recharge of this aquifer differs from that in the Bull Creek watershed, in that, surface water infiltrates at specific recharge zones along surface waterways.

A report by the Texas Water Commission (1986), Intensive Survey of Barton Creek Segment 1430 May 20-24, 1985, describes Barton Creek as in excellent condition for physical, chemical and biological attributes of this system. They specifically point out that the low nutrient levels were limiting to algal growth. They report high counts of fecal coliform bacteria following rain events at sample site along loop 360, a highly populated area.

USGS Multiple Station Analyses data for 1991, 1992 and 1993 show increases in contaminants and nutrients at the three station sampled on many if not most of the dates sampled. Considerably higher concentrations of fecal coliform bacteria, streptococcus bacteria, total nitrate and total phosphorus were reported for Barton Creek at State High, Barton Creek at Lost Creek, and Barton Creek at Loop 360. High nutrient concentrations would be indicative to algal production. By contrast with the 1985 data, I observed significant blue-green algal growth during the fly-over as well as during site visits.

The Barton Springs/Edwards Aquifer Conservation District (1994) reported on the water quality of the Barton Springs segment of the Edwards Aquifer. Samples were taken from 37 wells and springs from 1990 to 1994. Water samples were characterized based on concentrations of strontium, sodium, chloride, and sulfate. Their general conclusion was that the level of measured water-quality parameters were well within the drinking water standard for the Barton Springs segment of the aquifer. However, specific wells and springs showed elevated levels of bacteria, arsenic, lead, aluminum, and petroleum hydrocarbons. They list possible source of this contanimation to include concentrated urban runoff, construction, septic tanks, other leaking wastewater systems, and petroleum storage tank releases.

Benthic macroinvertebrate data were presented in two reports by the Texas Water Commission in 1986 and 1992. None of the collections were made at the same sites; therefore, direct comparisons cannot be made without detailed information on stream morphology, aquatic vegetation and meteorological data.

Recommendations:

- as for the Bull Creek watershed.

Barton Springs (Zilker Park) are disconnected from the main flow of Barton Creek by bypass conduits within the framework of the recreational area. This area, a major recreational

area and tourist attraction, receives heavy usage during summer months.

In a comparison of Barton Spring and Creek water, 1983 - 1993, significantly higher concentrations of TDS and nitrite+nitrate were recorded for the spring site (Barton Springs Watershed Study, 1994). Moreover, significant differences were reported for fecal coliforms, nitrite+nitrate, TDS and TOC were recorded in the spring but vary with flow conditions. Of these four, fecal coliform concentrations and TOC were significantly higher during runoff conditions. These findings suggest that nutrients and other constituents in the Barton Springs segment of the Edwards Aquifer may be originating from sources other than the recharge zone of Barton Creek, or by processes within the aquifer itself. Clearly storm events and subsequent surface water runoff have pronounced effects on the quality of Barton Springs water.

Recommendations:

- continue monitoring for changes in water quality.

- continue and upgrade pool maintenance procedures to insure habitat recovery and stabilization.

- examine other recharge zones for potential addition of nutrients and sources of contamination.

GROUNDWATER AND FLOW IN EPIGEAN AQUATIC ECOSYSTEMS

Within the karst substrate of the Edwards and Jollyville plateaus lie enormous aquifers that serve as a source of water for springs and lotic ecosystems in the area. In addition water pumped from these aquifers is utilized as the primary source of water for drinking, agriculture, and industry. The annual recharge for the Edwards aquifer is approximately 600,000 acre feet, and by the year 2000, due to urban expansion, it has been estimated that the same volume will be withdrawn by pumping alone (Bowles and Arsuffi, 1993; and others). Over pumping and the subsequent loss of hydraulic pressure will result in the reduction of surface discharge. Maintaining the integrity of these aquifers (i.e. recharge) is crucial for maintaining base flow in aquatic ecosystems. Hundreds of springs in central Texas have dried up; likely due to enormous demands on the aquifers by pumping, the addition of impervious cover, and divergence of surface run-off destined for recharge. Specific conduits of these aquifers which supply water to habitats which harbor salamanders and other endemic fauna are unknown (cited in numerous documents). Knowledge of groundwater flow in the areas adjacent to sensitive spring habitats would prove invaluable for proper planning of urban developments to insure that groundwater flow to springs is not altered.

Recommendations:

- maintain limits for pumping from aquifer systems. This may prove difficult as the

population of the area grows as anticipated

- it also will be difficult for residents to live without an adequate water supply.

- tracer studies to identify specific conduits which feed springs containing salamanders and other endemic fauna. Knowledge of groundwater pathways in sensitive areas would insure protection of critical spring habitats.

Groundwater sources should be viewed as extremely sensitive with regard to the potential for contamination. Extreme care should be taken in the development/alteration of surface environments near or at major recharge zones. The Barton and Bull Creek watersheds have totally different recharge patterns and the effects of development will likely result in two completely different scenarios. Aquifer recharge in the Jollyville plateau area (Bull Creek) is primarily by infiltration through surface soils (Comments and Recommendations Regarding Salamanders and the BCCP). Therefore, development of this region is more likely have a initial negative effect on aquifer discharge that .will eliminate many spring and spring run habitats which harbor salamanders and other flora and fauna. At least one site is known to have dried up completely. Nutrification (nitrogen and phosphorus), increased bacteria (septic, landfills), and contamination by petroleum products of Jollyville aquifer water due to urbanization is not likely to occur in the short term because of the infiltration pattern of recharge in this area. However, long term increase of these substances is inevitable and depends solely on the extent and type of development patterns that occur in the area. The quality of Bull Creek surface water is extremely sensitive to immediate change due to urban runoff.

Groundwater recharge in the Barton Creek watershed differs from Bull Creek in the primary source of recharge is by input from surface water tributaries - Barton Creek, Onion Creek, Slaughter Creek, Williamson Creek, and Bear Creek. Over development of any of these watersheds or improper developmental plans could result in a significant effect on the quality of groundwater in a relatively short time frame. Surface waters containing higher concentrations of nutrients, bacteria, and pollutants from urban runoff would have a more direct path into groundwater systems in the area. Groundwater in The Sunset Valley and Barton Springs area show elevated levels of sediment, bacteria, arsenic, lead, aluminum, and petroleum hydrocarbons (Barton Springs/Edwards Aquifer, Hydrogeology and Groundwater Quality, 1994). Continued development of these areas will likely result in continued deterioration of groundwater quality. Moreover, as water demands continue to increase so will pumping to meet these demands. Concentrations of pollutants will also continue to increase in ground waters because of lowered aquifer volumes - simply, if you remove water you remove the potential for dilution.

Recommendation:

- continue monitoring groundwater for increases inconcentrations of pollutants and detection of potential new sources of contamination.

CONCLUSIONS

Water quantity and quality (surface and groundwater) in the Travis County area has declined over the past decade and a half. Decreases in aquifer volume and development of residential areas in these watersheds have resulted in lower discharge of springs and creek runs. Increases in nutrient loads into these systems has already altered the trophic structure at the primary producer level. This certainly will have an effect on higher trophic levels in the near future. Potential for contamination by various pollutants is high (e.g. various ions, bacteria, lead and petroleum hydrocarbons). Any increase of these pollutants, especially in groundwater, should be of major concern.

Recommendations: (overall)

- continued monitoring of surface and groundwater quality from selected long-term sites. Select parameters and maintain them to produce comparable data on water quality. Establish a central depository for all facets water quality data for future reference.

- perform selected tracer studies to delineate major groundwater conduits and recharge zones which contribute significantly to critical habitats and human consumption.

- continue to document flora and fauna in the area, especially salamander populations. Include life-history, ecology and distribution for rare and endemic organisms.

- establish a long-term conservation plan and policies to insure that no continued deterioration of water quality occurs.

- restrict development in critical areas until the above mentioned recommendations have been implemented and produce data that clearly defends that continued development will have no further effect on water quality.

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ATTACHMENT 6

Report of Dr. Joe C. Yelderman, Jr.