MEMORANDUM

TO: Parks and Recreation Board

FROM: Michael J. Heitz, AIA, Director
Parks and Recreation Department

DATE: January 19, 1995

SUBJECT: Construction of Boat Docks and Retaining Walls
5600 Craggy Point, Boat Dock - File# SP-94-0421DS
4805 Precipice Cove, Boat Dock - File# SP-94-0497DS
3201 Rivercrest Drive, Retaining Wall - File# SP-95-0006DS
1407 N Weston Lane, Boat Dock - File# SP-94-0418DS

Requests have been received for approval to construct the following:

Helen Ludeman, 5600 Craggy Point, single-slip boat dock
Bill Coleman, 4805 Precipice Cove, single-slip boat dock
Conrad Bohn, 3201 Rivercrest Drive, concrete retaining wall
Ellen Paull, 1407 N Weston Lane, single-slip boat dock and concrete retaining wall

The Ludeman and Coleman boat docks are part of the Cliffs over Lake Austin clustered boat docks that were approved by the Board in 1980. Another four docks, that will be constructed at the same time as these, were approved by the Board in October 1994.

Parks and Recreation Department staff have reviewed these requests and the site plans meet the requirements of Article VI, Division 4, Part E (Requirements for the Construction Of Boat Docks) of the Land Development Code (including all amendments), with the exception of the Paull boat dock that requires a navigation light station.

The Navigation Committee has also reviewed these requests and recommends approval, subject to the conditions listed below.

Recommendation

I recommend approval of the requests to construct the following facilities, in accordance with the Site Plans listed:

5600 Craggy Point, Boat Dock - File# SP-94-0421DS
4805 Precipice Cove, Boat Dock - File# SP-94-0497DS
3201 Rivercrest Drive, Retaining Wall - File# SP-95-0006DS
1407 N Weston Lane, Boat Dock - File# SP-94-0418DS (Condition: Navigation light stations be provided in accordance with City Code)

If I can provide you with any additional information, please let me know.

Jesus M. Olivares

for, Michael J. Heitz, AIA, Director
Parks and Recreation Department

MH:PM

D I S T R I B U T I O N   M E M O R A N D U M   20-DEC-1994

TO: COMMENT DUE DATE: 27-DEC-1994
FROM: SITE PLAN REVIEW DIVISION/PLANNING DEPT
SUBJECT: DEVELOPMENT PERMIT ONLY SP-94-0497DS

PROJECT: BILL COLEMAN BOAT DOCK

4805 PRECIPICE COVE

CASE MANAGER: SELFRIDGE, KEVIN 499-2706

APPLICATION DATE: 20-DEC-1994

ZIP: 78731 FULL PURPOSE
WATERSHED: Lake Austin RURAL WATER SUPPLY

OWNER: COLEMAN, BILLY M. (214)931-5924
6031 AINSDALE COURT DALLAS, TX 75252
CONTACT: BILLY M. COLLEMAN
ENGIN: SIGNOR ENTERPRISES, INC. (512)327-6064
5523 W. BEE CAVES ROAD K-5 AUSTIN, TX 78746
CONTACT: BRIAN RENNAKER
AGENT: LOFLIN, CHARLES E. (512)467-8680
5608 CRAGGY POINT AUSTIN, TX 78731
CONTACT: CHARLES E. LOFLIN

SITE PLAN AREA: 0.009 ACRES (377 SQ FT)
UTILITY OR STORM SEWER LENGTH: 0 LINEAR FEET

EXISTING ZONING:
EXISTING USE:

TRACT	ACRES/SQ FT	PROPOSED USE
	0.000/ 0	BOAT DOCK

RELATED CASE NUMBERS (IF ANY): SPC-94-0437AS

OTHER PROVISIONS:
QUALIFIES AS A SMALL PROJECT
TIA IS NOT REQUIRED
FEE RECEIPT #: 1580385

SUBD NAME: CLIFF OVER LAKE AUSTIN
BLOCK/LOT: BLOCK B, LOT 50
PLAT BOOK/PAGE: 80 PAGES 33-34

PARCEL #:

D I S T R I B U T I O N   M E M O R A N D U M   8-NOV-1994

TO: COMMENT DUE DATE: 14-NOV-1994
FROM: SITE PLAN REVIEW DIVISION/PLANNING DEPT
SUBJECT: DEVELOPMENT PERMIT ONLY SP-94-0421DS

PROJECT: HELEN LUDEMAN BOAT DOCK

5600 CRAGGY PT

CASE MANAGER: SELFRIDGE, KEVIN 499-2706

APPLICATION DATE: 7-NOV-1994

ZIP: 78731 FULL PURPOSE
WATERSHED: Lake Austin RURAL WATER SUPPLY

OWNER: LUDEMAN, HELEN K. (512)345-3312
7524 STONECLIFF DRIVE AUSTIN, TX 78731
CONTACT: HELEN K. LUDEMAN
ENGIN: SIGNOR ENTERPRISES, INC. (512)327-6064
5523 W. BEE CAVES ROAD K-5 AUSTIN, TX 78746
CONTACT: BRIAN RENNAKER
AGENT: DOFLIN, CHARLES E. (512)467-8680
5608 CRAGGY POINT AUSTIN, TX 78731
CONTACT: CHARLES E. DOFLIN

SITE PLAN AREA: 0.009 ACRES (377 SQ FT)
UTILITY OR STORM SEWER LENGTH: 0 LINEAR FEET

EXISTING ZONING: SF
EXISTING USE:

TRACT	ACRES/SQ FT	PROPOSED USE
	0.009/ 377	BOAT DOCK

RELATED CASE NUMBERS (IF ANY):

OTHER PROVISIONS:
QUALIFIES AS A SMALL PROJECT
TIA IS NOT REQUIRED
FEE RECEIPT #: 1521043

SUBD NAME: CLIFF OVER LAKE AUSTIN II
BLOCK/LOT: BLOCK B, LOT 41
PLAT BOOK/PAGE: 80 PAGES 33-34
PARCEL #:

Charles E .Loflin
5608 Craggy Point
Austin, TX 78731
(512) 467-8680

December 19, 1994

To: City of Austin, Department of Planning and Development

Subject: SITE DEVELOPMENT SUMMARY LETTER for:

Project: Billy Coleman Boat Dock
5605 Craggy Point
Lot 50, Block B, The Cliff over Lake Austin
Travis County, Austin, Texas

Dear Sir or Madam:

This request is for permission to construct a single family boat dock as an addition to and part of a previously approved 18 slip boat facility for the Cliff over Lake Austin Development (see atchs 1 and 2).

There are currently 9 of the approved 18 docks in place. This dock is one of six that will be constructed at the same time. Each of the six docks to be built is individually owned by homeowners in the Cliff over Lake Austin development. As required by the April 22, 1980 amended approval by the Parks and Recreation Department to construct these docks, each permit application is being submitted separately.

For reference the names of the six projects are:

Dock number 10: Pat Howard Boat Dock, SP-94-0378DS

Dock number 11: Charles Loflin Boat Dock, SP-94-0377DS

Dock number 12: Emilio Gutierrez Boat Dock, SP-94-0379DS

Dock number 13: William Barbour Boat Dock, SP-94-0380DS

Dock number 14: Helen Ludeman Boat Dock, SP-94-0421DS

Dock number 15: Billy Coleman Boat Dock

This is a single submission for dock number 15. Requests for approval for the other five docks were submitted separately and are currently going through the approval process.

These docks will be constructed using a water based crane and pile driver by:

Signor Enterprises. Inc.
5524 Bee Caves Rd. Ste K-5
Austin. TX 78746

The following applies:

-This project/site is located in the Lake Austin watershed, is classified as water supply rural and is exempt pursuant to the land development code section 13-2-502(b) due to having a final plat approved prior to May 18, 1986. Pursuant to section 13-2-502(b), the site is subject to city ordinance #800103-N 'Lake Austin Watershed Ordinance' (see page 2 of drawings).

-There will be no shoreline alterations or deviations.

-There are no trees in the construction area as construction is over the water. There are, however, some trees on the shore that will need selective pruning of small branches (no more than one inch in diameter) overhanging the water that may interfere with obstruction clearance of the walkway.

-There is no intent to modify the shoreline or affect navigation.

-The project will have no effect on the natural traditional character of the land or waterway.

-No modification of the shoreline or other ground disturbance which would increase the potential for erosion/sedimentation is anticipated by this project. The City of Austin general construction notes are attached to and made a part of this project for applicability in the event that unforeseen disturbance of the land area of the site is necessary to complete the approved construction. Reference: Exhibit III of the boat dock packet (5/24/91) and silt fence detail: figure 1-8, of the environmental manual.

-Construction is dependent on the lake level being lowered and will be approximately Jan/Feb 1995.

-All materials will meet Lake Austin/City of Austin codes.

-Navigation lighting will meet current City of Austin code with the end light on this dock being no further than 25 feet from the other navigation lights in the complex.

-Access to the docks is provided via an already constructed stone walkway on an easement shown on page of the drawings.

page 3

-Questions regarding this permit application should be directed to:

Charles E. Loflin
5608 Craggy Point
Austin, TX 78731
(512) 467-8680

Engineer's Seal
STATE OF TEXAS
JOHN D. DOUCET
64142
REGISTERED
PROFESSIONAL ENGINEER

Charles E. Loflin — Charles E Loflin

Billy Coleman — Billy W Coleman

Jonh D. Doucet — 12/20/94

D I S T R I B U T I O N   M E M O R A N D U M   4-NOV-1994

TO:
FROM: SITE PLAN REVIEW DIVISION/PLANNING DEPT
COMMENT DUE DATE: 25-NOV-1994
SUBJECT: DEVELOPMENT PERMIT ONLY
SP-94-0418D

PROJECT: PAULL BOAT DOCK

1407 N WESTON LA

CASE MANAGER: OWEIS, DEYAB 499-2813

APPLICATION DATE: 4-NOV-1994

ZIP:
FULL PURPOSE
WATERSHED: Lake Austin RURAL WATER SUPPLY

OWNER: PAULL, ELLEN (512)328-8414
6706 BRIDGEHILL AUSTIN, TX 78746
CONTACT: ELLEN PAULL
ENGIN: P.D.G. (512) -
3823 B BEE CAVES ROAD AUSTIN, TX
CONTACT: MIKE ALEXANDER

SITE PLAN AREA: 1.063 ACRES (46284 SQ FT)
UTILITY OR STORM SEWER LENGTH: 0 LINEAR FEET

EXISTING ZONING: RES
EXISTING USE:

TRACT	ACRES/SQ FT	PROPOSED USE
	0.000/ 0	RES. BOAT DOCK

RELATED CASE NUMBERS (IF ANY):

OTHER PROVISIONS:
TIA IS NOT REQUIRED
FEE RECEIPT #: 1520840

SUBD NAME: ROB ROY ON THE LAKE
BLOCK/LOT: LOT 39, BLOCK A
PLAT BOOK/PAGE:

PARCEL #:

VARIANCES/WAIVERS,BONUSES:

PDG
Environmental Services Division

Nov. 3, 1994

Department of Planning and Development
City of Austin
301 West Second Street
Austin, Texas 78701

Re: Engineer's Summary Letter
Lot 39, Block A
Rob Roy On The Lake Subdivision
Austin ETJ

To Whom It May Concern:

The project on the lot described above is the construction of a retaining wall at lake's edge and a small (one stall) boat dock in the lake's verge. The project is classified as a small project according to the Development Permit requirements of the city of Austin. The total impervious cover for the lot after the proposed development (excluding the single family residence) totals 684 square feet. (The single family residence is to be built on a legally platted and developed lot, and is not the focus of this application.) The total disturbed area during construction is 2200 square feet.

The lot has a total area of 48,285 square feet. The lot lies in the Lake Austin watershed, and is classified as suburban.

The development will consist of the installation of 178 linear ft. of retaining wall along the lakeside property line with side wings of 12 ft. length adjacent to each side property line. The retaining wall is to be constructed of steel reinforced concrete as described in the accompanying engineering plans. Additionally, a two stall boat dock with an area under roof of 480 square ft. is to be constructed to the north end of the retaining wall, and in contact with it. The land to the shore side of the retaining wall, including any backfill required will be reseeded with native or compatible grass or turf cover.

Calucations indicate that the effect on flow rates due to 2 year, 25 year, and 100 year storm incidents is insignificant. In fact, the presence of the wall will actually retard, slightly, the flows.

The project is to be carried out in the following order:

1. Establish temporary erosion controls to the lake side of the proposed construction.
2. Excavate and install forms for the installation of the retaining wall.
3. Install reinforcing steel in forms.
4. Place concrete in forms
5. Remove forms and finish concrete
6. Backfill as required to stabilize wall
7. Final grade and reseed
8. Remove Temporary erosion controls

Please review the accompanying plans for the proposed development at this site. If you have any further questions about this matter, please contact me.

Sincerely,

Michael Alexander, P.E.
MA/cm
386(M11-5)JAURWSTN.PAR

STATE OF TEXAS
MICHAEL ALEXANDER
39253
REGISTERED
PROFESSIONAL ENGINEER

11-3-94

D I S T R I B U T I O N   M E M O R A N D U M   6-JAN-1995

TO: COMMENT DUE DATE: 13-JAN-1995
FROM: SITE PLAN REVIEW DIVISION/PLANNING DEPT
SUBJECT: DEVELOPMENT PERMIT ONLY   SP-95-0006DS

PROJECT: BOHN RETAINING WALL

RIVERCREST DR

CASE MANAGER: PARR, RUSSELL   499-2720

APPLICATION DATE: 6-JAN-1995

ZIP: 78746   FULL PURPOSE
WATERSHED: Lake Austin   RURAL WATER SUPPLY

OWNER: BOHN, CONRAD   (512)327-1616
3201 RIVERCREST DRIVE   AUSTIN, TX   78746
CONTACT: CONRAD BOHN
AGENT: CROSS/RECEK ARCHITECTS   (512)452-0229
3313 HANCOCK   AUSTIN, TX
CONTACT: JAMES RECEK

SITE PLAN AREA: 0.001 ACRES   (62 SQ FT)
UTILITY OR STORM SEWER LENGTH: 0 LINEAR FEET

EXISTING ZONING: LA
EXISTING USE:

TRACT	ACRES/SQ FT	PROPOSED USE
	0.001/ 62	RETAINING WALL

RELATED CASE NUMBERS (IF ANY):

OTHER PROVISIONS:
QUALIFIES AS A SMALL PROJECT
TIA IS NOT REQUIRED
FEE RECEIPT #: 1580408

SUBD NAME: RIVERCREST ADDITION SECTION 1
BLOCK/LOT: BLOCK A, LOT 25
PLAT BOOK/PAGE: 13 PAGE 27

PARCEL #:

VARIANCES/WAIVERS,BONUSES:

January 5, 1995

SUMMARY LETTER

Director, Parks & Recreation Department

Dear Sir:

PARD approval is requested to construct a retaining wall along the shore of Lake Austin to bridge a gap between the ends of two existing retaining walls.

The property is in the Lake Austin Watershed. Approximately 436 square feet of dry land will be gained. There are no trees in the immediate vicinity, thus none will be affected by construction.

The proposed wall will be 94 feet long and approximately 4 feet high, of poured-in-place concrete. It will lie along a portion of the shoreline of Lot 25, Block A, Rivercrest Addition Sect. 1, starting at the southernmost terminus of an existing retaining wall lying 144 feet in a southerly direction from the NW corner of Lot 25, and continuing in a southerly direction 94 feet to connect with the northernmost terminus of a second existing retaining wall.

Construction will occur during the period between January and February 7, 1995 assuming all goes well with the City's plan to lower the level of Lake Austin by 12 feet.

Sincerely,

James O. Reed, AIA

CITY COUNCIL AGENDA REPORT
Prepared January 18, 1995

Items Being Prepared for Council Review

Recommendations for Council Action (RCA's) are being prepared for:

- Construction contract for flood repair in Shoal Creek.
- Construction contract for flood repair in Barton Creek.
- Renewal of contract for Austin Softball Umpires' Association.

Items Under Active Review

These RCA's are drafted and under review within Parks and Recreation and/or the Law, Budget, and Assistant City Manager's Offices:

- Appropriation of funds for Youth Athletic Council utility fund.
- Design and construction management contract award for Central City Entertainment Center.
- Acceptance of grant from National Trust for Historic Preservation for landscape restoration at the Ney Museum.

Items Approved and Scheduled for A Specific Meeting

The following items will be on the Council agenda within the next few weeks:

For January 19 meeting (results of action will be presented at January 24 Parks Board meeting):

- Robert L. Thomas to speak regarding Rosewood. (Citizen Communication).
- Selection of firm to provide environmental assessment at Springdale Park.
- Set public hearing on Balcones Canyonlands Conservation Plan.
- Set public hearing on Rosewood (Central City) Entertainment Center.
- Direct City Manager to prepare Blunn Creek Watershed Management Plan.
- Appointments to Arts Commission, Mexican-American Cultural Center Task Force, Renaissance Market, Urban Forestry Board.

For January 26 meeting:

- Supply agreement for concrete.

For February 2 meeting:

- Food service concession agreement for Lions Municipal Golf Course.
- Contract for canoe concession in Zilker Park.

Items Approved

The following items were approved by Council within the last two weeks:

- Budget amendment for tree grate repair on 6th Street.
- Change order for erosion control project underway on Waller Creek.
- Change order for construction project underway at the new South Austin Senior Activity Center.
- Approval of sale of three tracts of land near Highway 183 and Loop 360 by the State of Texas.
- Selection of architect for Montopolis Sports Complex.
- Approval of supply agreement for chemical toilets.

M E M O R A N D U M

TO: Parks and Recreation Board

FROM: Michael J. Heitz, AIA, Director
Parks and Recreation Department

DATE: January 19, 1995

SUBJECT: Steiner Ranch Community Recreation Center
12300 River Bend Road

The developers of the Steiner Ranch subdivision are proposing to renovate existing facilities located on Lake Austin into a Community Recreation Center. The existing facilities include a marina that is in a state of disrepair.

It is proposed to replace the existing marina structure with a new marina that duplicates the original. Because this is a replacement/renovation project and the footprint of the existing structure will not change, a Site Plan Exemption is being requested from the Department of Planning and Development. The Department of Planning and Development has indicated that approval from the Parks and Recreation Department is necessary before they will issue an exemption.

The developers' agent, Duke Garwood, Architects Inc., has indicated that the new facility will be brought up to the current code requirements for marinas, where physically possible to do so, for items such as navigation lights and fire protection.

It is not necessary for the Board to formally review and approve this project; however, because it is a major renovation of an existing facility on the lake, this proposal is for your information.

If I can provide you with any additional information, please let me know.

Jesus M. Olivares

for, Michael J. Heitz, AIA, Director
Parks and Recreation Department

December 23, 1994

Mr. Michael Heitz, Director
Parks and Recreation Department
City of Austin
P. O. Box 1088
Austin, TX 78767

RE: Request for Preliminary Courtesy Review
Steiner Ranch Proposed Marina/Shore Improvements

Dear Mr. Heitz:

Please allow this letter as our formal request for a preliminary courtesy review by the Parks Board and Parks and Recreation Department of the aforementioned project.

The Project entails replacement of two existing, dilapidated marina structures and related new shoreline improvements at a property located on Lake Austin at 12300 River Bend Road, Austin, Texas. These improvements will be done in conjunction with existing building renovation on-site to develop a Community Recreation Center for the Steiner Ranch Neighborhoods. The Community Center is currently under Plan Review for Building Permit with construction scheduled in the Spring 1995.

The marina project entails removal of the dilapidated structures and replacement with two new marina structures that duplicate the original footprints and number of slips.

There will also be shoreline headwall replacement, addition of a small boardwalk, and a new beach area complete with a protected swimming area.

We believe this project to be a positive upgrade to this currently dangerous, abandoned area and look forward to your review and support. We intend to try to present plans/sketches by January 10, 1995 in time for the January 24th Parks Board meeting. Please schedule us for this time. We will be eventually seeking a "Site Plan Exemption" for these improvements from the City due to the fact that this is a marina replacement/renovation project and understand Parks and Recreations Dept./Parks Board approval is necessary before we can seek this exemption.

Please feel free to call if you have any questions.

Respectfully yours,

Duke C. Garwood

Duke C. Garwood

dent

Paul T. Chippindale, PhD Candidate
1008 W. 25 1/2 Street, #204
Austin, Texas 78705

Professor David M. Hillis
2609 Westover Street
Austin, Texas 78703

Dear Mr. Chippindale and Professor Hillis:

Thank you for your letter of December 20, 1994 concerning the maintenance of Barton Springs. I appreciated hearing from you.

I assure you that the City of Austin is committed to protection of the Salamanders, as well as finding a better way to maintain the pool. We realize the potential impact of the use of chlorine in the pool and will certainly consider all the factors before making any decision on changing the current maintenance procedures at Barton Springs.

If you need further information, please contact Debbie Dorsey, Program Manager, Parks and Recreation Department at 476-4521 or Nancy McClintock, Environmental and Conservation Services Department, 499-2652.

Sincerely,

Bruce Todd
Mayor

xc: Michael J. Heitz, AIA, Director
Parks and Recreation Department

1008 W. 25 1/2 Street, #204
Austin, Texas 78705 (PTC)

2609 Westover Street
Austin, Texas 78703 (DMH)

KIT

#24883

Mayor Bruce Todd and the Austin City Council
124 West 8th Street
Austin, Texas 78701

20 December 1994

Dear Mayor Todd and members of the Austin City Council:

We are biologists who have studied the Barton Springs salamander (*Eurycea sosorum*) since 1987 (DMH) and 1989 (PTC); together with A.H. Price we formally named this species and provided information on its distribution and biology in a 1992 scientific paper (copy enclosed). We are very disturbed by the recent Parks Board decision to recommend reintroduction of chlorine for cleaning of the shallow end of Barton Springs Pool. In the fall of 1992 we, along with many others from diverse state, federal, and private groups (e.g. the Lower Colorado River Authority, Texas Parks and Wildlife Department, Texas Water Commission, University of Texas at Austin, U.S. Fish and Wildlife Service, Hill Country Foundation, Sierra Club, and regular Barton Springs Pool swimmers) strongly advised against the use of chlorine due to its toxicity and the great risk that its use poses to aquatic life in the pool. Our action was prompted by swimmers' observations of large numbers of dead fishes floating on the pool's surface following a routine cleaning with chlorine on 28 September 1992. Apparently, this was not the first occurrence of such a fish kill. In a SCUBA dive on 1 October 1992, we were able to locate Barton Springs salamanders only in the immediate vicinity of the outflows of the main springs in the pool, whereas we had been able to find individuals over a much wider area in the pool approximately two months earlier. This strongly suggests that chlorine killed large numbers of salamanders, along with the fishes. The lag time between the chlorine accident and our dive, coupled with the small size of the salamanders and the fact that they live mainly under rocks and in gravel on the pool floor, probably explains why no bodies were found.

The above observation contradicts the statement in the Parks Board resolution that "...there is no reliable evidence that previous maintenance procedures had threatened the vialility [sic] of the Barton springs [sic] Salamander". The sudden decline in the numbers and range of the salamander immediately following the use of chlorine constitutes very good evidence of the threat that chlorine use poses.

The Parks Board resolution also states that, "...the Barton Springs salamander has not yet been officially designated as an endargered [sic] species". While this is true, it also is true that the U.S. Fish and Wildlife Service has recommended this species for federally endangered status, which means that the chances for listing are very good. Since our actions in 1992, the City of Austin has acted in good faith to protect aquatic life in the pool and educate the public about the salamander and the Barton Springs ecosystem.

City representatives have met regularly with biologists and others to develop non-chemical cleaning methods. It takes time to develop such strategies, and experiments with alternate cleaning procedures are still in progress. Why reverse the trend of cooperation and environmentally friendly approaches now? If the salamander is listed, use of chlorine likely will be banned, and the only effect of its reintroduction will have been to create animosity between the City of Austin and those charged with protection of the salamander.

We agree that it is desirable to reduce slipperiness in the shallow end of the pool for safety reasons, but this must be done in such a way as to minimize harm to the organisms that live in the deep end of the pool. Barton Springs is not a regular swimming pool, but rather a semi-natural swimming hole. Users should understand that as such, they cannot expect a sterile, lifeless environment. If this is what one desires, Austin has many other pools to accommodate a wide range of tastes.

Ironically, in a recent survey of swimmers' preferences conducted at Barton Springs Pool, a staggering 158 respondents "strongly agreed" or "agreed" that they were "...in favor of chemical-free cleaning techniques in order to protect the animal and plant life in the pool"; only 18 "disagreed" or "strongly disagreed" with this statement. Thus, the Parks Board resolution goes against the wishes of the vast majority of regular and semi-regular users of Barton Springs Pool. Given this situation, and the grave threat that a return to chlorine poses for aquatic organisms at Barton Springs, the actions of the Parks Board can only be described as a misguided solution that could have dire consequences for the Barton Springs ecosystem and the existence of an animal that is known from nowhere else in the world. Thus, we urge the City Council to maintain the ban on the use of chlorine and other toxic chemicals for "cleaning" Barton Springs Pool.

Sincerely,

Paul T. Chippindale
PhD Candidate

David M. Hillis
Professor

Attachment for RFAI ...

Herpetologica, 49(2), 1993, 248–259

A NEW SPECIES OF PERENNIBRANCHIATE SALAMANDER (*EURYCEA*: PLETHODONTIDAE) FROM AUSTIN, TEXAS

PAUL T. CHIPPINDALE[1], ANDREW H. PRICE[2], AND DAVID M. HILLIS[1]

[1]*Department of Zoology, The University of Texas, Austin, TX 78712, USA*
[2]*Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, TX 78744, USA*

ABSTRACT: A new species of salamander of the genus *Eurycea* is described from Barton Springs, Austin, Texas, USA. The new species is known only from two hydrologically connected sets of springs in and adjacent to Austin's Barton Springs swimming pool. It is morphologically and biochemically distinct from all known species of plethodontids. The new species is endangered by its limited distribution in an environmentally sensitive ecosystem that is threatened by the direct and indirect impacts of human development, and population sizes appear to have been reduced significantly in the past two decades. Recent efforts to modify maintenance practices at Barton Springs Pool and to protect the Barton Springs Aquifer appear to have reversed this trend, but the species is still in critical danger of extinction.

Key words: Caudata; Plethodontidae; Hemidactyliini; *Eurycea sosorum* new species; Endangered species; Texas; Barton Springs

THE springs and caves of the Edwards Plateau region of central Texas constitute islands of habitat for numerous populations of aquatic organisms, including perennibranchiate hemidactyliine plethodontid salamanders of the genera *Eurycea* and *Typhlomolge*. This group of salamanders has been taxonomically problematic for many years, due largely to a combination of morphological conservatism, maintenance of larval morphologies in most members of the group, and the possibility of morphological parallelism or convergence in members of the group that occupy similar habitats (see Sweet, 1977, 1978, 1982, 1984, for reviews of the distribution and taxonomic treatments of this group). Most surface-dwelling, and many cave-dwelling, populations of perennibranchiate *Eurycea* in central Texas currently are assigned to the species *Eurycea neotenes* Bishop and Wright 1937. Several populations in this group occur in the rapidly expanding Austin metropolitan area and are threatened to varying extents by habitat degradation, urban runoff, and water pollution. The group of springs known as Barton Springs, which have been modified to form a spring-fed swimming pool in the City of Austin, constitute the only known habitat for the new species of *Eurycea* described in this paper.

MATERIALS AND METHODS

We use the following abbreviations for morphological measurements: AG (axilla-groin length), ALL (anterior limb length, from anterior insertion to tip of third finger), ED (eye diameter; i.e., anterior–posterior diameter of the externally visible, dark disc of the eye), HLA (head length A: distance from tip of snout to center of gular fold), HLB (head length B: distance from tip of snout to posterior margin of eye), HLC (head length C: distance from tip of snout to posteriormost gill insertion), HLL (hind limb length, from groin to tip of third toe), HW (head width immediately posterior to jaw articulation), IOD (interocular distance), SL (standard length: distance from tip of snout to posterior margin of vent), and TL (tail length, from posterior margin of vent to tip). Abbreviations for collections are: BCB (Bryce C. Brown collection, Strecker Museum, Baylor University), MVZ (Museum of Vertebrate Zoology, University of California, Berkeley), and TNHC (Texas Natural History Collection of the Texas Memorial Museum, University of Texas, Austin).

For morphometric analyses, we used 23 alcohol-preserved specimens of the new species. For comparison, we used topotypical *Eurycea neotenes* from near Helotes, Bexar Co., plus representatives of several other surface-dwelling populations that are currently assigned to *E. neotenes* or are thought to be most closely related to that species (see Appendix I for list of specimens and localities). For convenience, we will refer to these populations as *E. neotenes* in this paper, although several species may be involved; we will address the status of *Eurycea neotenes* elsewhere. We chose populations from the region to the south of the Colorado River from Hays Co. through western Kendall Co., because this region includes populations that are most similar genetically to the new species based on our ongoing molecular studies. We also included representatives of *E. nana*, a surface-dwelling species from San Marcos Springs in Hays Co., which occurs in the same geographic region. Most morphometric characters that we used were the same as, or very similar to, those described by Sweet (1984). Measurements for morphometric analysis were made as follows: AG, SL, and TL were measured with dial calipers; ALL, HLA, HLB, HLC, HW, and IOD were measured using an ocular micrometer at ×7.5 magnification; and ED was measured with an ocular micrometer at ×64 magnification with backlighting. All measures were rounded to the nearest 0.1 mm for subsequent analyses except ED, which was rounded to the nearest 0.01 mm. We log-transformed ($\log_{10}$) all measures prior to analysis. We chose not to measure any individuals with SL < 22.5 mm; the vast majority of individuals used in the study were known or inferred (based on size) to be sexually mature. [It is possible that a few individuals measured were in the process of maturation.] We conducted a discriminant function analysis (DFA) using the MDA program in the BioΣtat II multivariate statistical package (Pimentel and Smith, 1986), and designated each population used for analysis as an a priori group, for a total of seven groups (see Appendix I for names and taxonomic status of these groups). We also requested a posteriori assignments of individuals to the initially specified groups, based on Geisser classification probabilities (Geisser, 1977; Pimentel and Smith, 1986). For counts of costal grooves (not included in morphometric analyses), we followed Burger et al. (1950) and assumed the presence of no more than one groove in the axilla and in the groin; in some specimens these grooves were indistinct. For osteological examination, two specimens were cleared and double-stained with Alizarin Red and Alcian Blue, following the protocol given by Dingerkus and Uhler (1977).

We used standard methods of horizontal starch-gel electrophoresis (Murphy et al., 1990) to resolve the products of 25 enzyme-encoding loci for 10 individuals of the new species. This work is part of an ongoing, broad-scale study of relationships among central Texas hemidactyliine plethodontids of the genera *Eurycea* and *Typhlomolge*; thus far we have collected allozyme data for approximately 300 individuals from 49 populations from throughout the Edwards Plateau region of central Texas. Further details of electrophoretic methods, and data for other members of the group, will be presented elsewhere. Genetic distances reported here were calculated using the BIOSYS-1 program (Swofford and Selander, 1981).

The habitat of the new species has been the focus of a recent initiative by the citizens of Austin to protect and preserve the Barton Springs Aquifer. In honor of the citizens of Austin and their desire to protect the habitat of the Barton Springs salamander (through their passage of the SOS, or Save Our Springs, Ordinance; see Etymology), we name the new species

Eurycea sosorum sp. nov.

Eurycea neotenes: Brown, 1950 (in part); Baker, 1961 (in part; mapped locality only).

Eurycea neotenes neotenes: Brown, 1967 (in part; mapped locality only).

Eurycea sp.: Sweet, 1978, 1984.

Holotype.—TNHC 51184 (field number PC/DMH 92-112) (Fig. 1), an adult male (based on external examination only)

FIG. 1.—*Eurycea sosorum* (TNHC 51184, holotype SL = 24.9 mm), from the outflow of the Parthenia outlet of Barton Springs in Barton Springs Pool, Zilker Park, Travis County, Texas.

collected from the outflow of Parthenia (Main) Springs in Barton Springs Pool, Zilker Park, Travis Co., Texas (30°15′48″ N, 97°46′14″ W) on the afternoon of 24 November 1992 by David M. Hillis, Paul T. Chippindale, Andrew H. Price, and Doyle Mosier at a depth of approximately 4–5 m, during a SCUBA dive.

Paratypes.—Collected 1946: TNHC 6317–6321. 1974: MVZ 122712–726. 1988–1992: TNHC 50915–32, 51180–83, 51185–92. Cleared-and-stained: TNHC 51178–79. All paratypes were collected at Barton Springs, Travis Co., Texas.

Etymology.—The species is named in honor of the citizens of Austin, Texas, whose efforts to protect the quality of Barton Springs resulted in the passage of a citizens' aquifer-protection initiative in 1992. This initiative is known locally as the SOS (Save Our Springs) Ordinance, and its supporters are known as SOSers. The specific name *sosorum* is the plural mixed-gender genitive form of the acronym SOS.

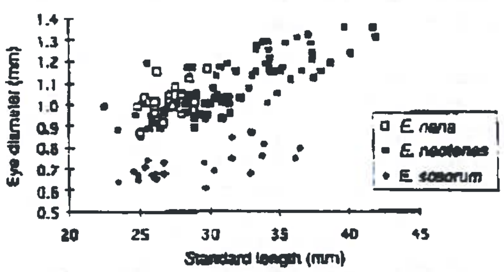

FIG. 2.—The relationship between eye diameter and standard length in *Eurycea neotenes* (filled squares), *E. nana* (open squares), and *E. sosorum* (filled diamonds).

Diagnosis.—*Eurycea sosorum* can be distinguished from other Texas perennibranchiate *Eurycea* (currently assigned to *E. neotenes*, *E. nana*, and *E. tridentifera*, plus the putative hybrids known as *E. latitans* and *E. troglodytes*) by its unique combinations of both morphological and allozyme characters (allozyme data are not yet available for *E. latitans* and *E. troglodytes*). The slight "shovel-nose" that is apparent in most specimens is not as extreme as that of *E. tridentifera*, but does distinguish most individuals of *E. sosorum* from members of surface populations that currently are assigned to *E. neotenes* and *E. nana*. The eyes of *E. sosorum* are significantly reduced in comparison to individuals from other surface-dwelling populations of central Texas *Eurycea*. There was no overlap in ratios of eye diameter to standard length between *E. sosorum* and representatives of any of the other populations that we examined (Fig. 2). *Eurycea*

TABLE 1.—Sample sizes and summaries of measurements (in millimeters) for specimens of *Eurycea* examined for morphometric variation. For each variable in each population, mean values ± 1 SD are given, followed by ranges in parentheses. Refer to text for explanation of abbreviations for each measure. Sample sizes are in parentheses following population names.

Measure	Population/taxon						
	Boardhouse Springs (7) (*E. neotenes*)	Helotes Creek Spring (19) (*E. neotenes*)	Comal Springs (19) (*E. neotenes*)	Fern Bank Spring (19) (*E. neotenes*)	Cibolo Creek Spring (19) (*E. neotenes*)	San Marcos Springs (21) (*E. nana*)	Barton Springs (29) (*E. sosorum*)
SL	36.57 ± 2.30 (34.1–40.2)	32.22 ± 5.49 (22.5–42.0)	27.76 ± 2.83 (23.5–34.3)	30.55 ± 2.75 (25.6–35.9)	33.81 ± 2.88 (28.3–38.1)	27.05 ± 1.36 (24.9–29.9)	29.24 ± 4.05 (23.5–36.5)
AC	20.06 ± 1.42 (18.3–23.1)	18.98 ± 3.50 (12.8–24.7)	15.20 ± 1.87 (12.8–19.4)	17.73 ± 1.71 (14.5–21.5)	18.94 ± 1.69 (16.2–21.6)	15.44 ± 0.97 (13.7–18.0)	15.97 ± 2.81 (11.7–20.4)
TL	26.73 ± 1.53 (20.1–31.4)	27.44 ± 6.17 (17.8–38.3)	19.01 ± 3.26 (12.0–27.8)	21.74 ± 2.42 (17.5–25.4)	23.58 ± 3.63 (17.1–32.0)	23.58 ± 3.63 (17.1–32.0)	21.11 ± 4.31 (13.6–30.7)
HLA	6.33 ± 0.95 (5.5–8.2)	5.87 ± 0.77 (4.6–7.7)	5.21 ± 0.65 (4.2–6.7)	5.37 ± 0.64 (4.2–6.8)	6.23 ± 0.55 (5.4–7.0)	4.54 ± 0.32 (4.0–5.0)	5.25 ± 0.63 (4.0–6.5)
HLB	5.86 ± 0.46 (5.1–6.4)	5.11 ± 0.62 (4.0–6.5)	4.85 ± 0.52 (3.7–5.9)	4.72 ± 0.35 (4.1–5.4)	5.48 ± 0.51 (4.7–6.4)	3.98 ± 0.26 (3.6–4.5)	5.47 ± 0.73 (4.1–7.4)
HCL	8.67 ± 0.92 (7.6–10.4)	7.88 ± 1.04 (6.1–9.7)	7.18 ± 0.76 (5.5–8.7)	7.14 ± 0.59 (6.1–8.3)	8.48 ± 0.81 (7.2–10.0)	6.17 ± 0.404 (5.6–7.4)	7.83 ± 0.90 (5.9–9.9)
HW	4.97 ± 0.47 (4.2–5.6)	4.70 ± 0.69 (3.3–6.1)	4.34 ± 0.42 (3.8–5.4)	4.45 ± 0.514 (3.8–5.8)	4.94 ± 0.53 (4.1–5.9)	3.64 ± 0.36 (3.1–4.4)	4.38 ± 0.67 (3.3–5.9)
IOD	1.64 ± 0.22 (1.3–1.9)	1.37 ± 0.24 (1.0–2.0)	1.28 ± 0.15 (1.0–1.7)	1.45 ± 0.204 (1.0–1.7)	1.66 ± 0.25 (1.3–2.2)	1.13 ± 0.17 (0.9–1.4)	1.60 ± 0.25 (1.2–2.0)
HLL	6.84 ± 0.57 (6.0–7.8)	6.64 ± 1.12 (4.6–8.8)	5.37 ± 0.45 (4.5–6.1)	5.39 ± 0.48 (4.9–6.4)	6.43 ± 0.58 (5.5–7.3)	5.12 ± 0.40 (4.2–5.8)	6.96 ± 0.91 (5.4–8.1)
ALL	6.39 ± 0.76 (5.5–7.4)	6.02 ± 0.92 (4.4–7.6)	4.85 ± 0.46 (4.2–5.9)	5.14 ± 0.36 (4.6–5.8)	5.86 ± 0.55 (5.0–6.7)	4.72 ± 0.35 (4.0–5.2)	6.14 ± 0.81 (5.2–8.3)
ED	1.199 ± 0.046 (1.15–1.28)	1.159 ± 0.136 (0.99–1.35)	1.009 ± 0.126 (0.85–1.27)	1.006 ± 0.078 (0.89–1.18)	1.126 ± 0.094 (0.96–1.32)	1.012 ± 0.072 (0.87–1.16)	0.721 ± 0.074 (0.61–0.87)

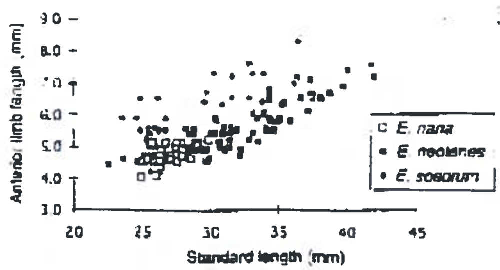

FIG. 3.—The relationship between anterior limb length and standard length in *Eurycea neotenes* (filled squares), *E. nana* (open squares), and *E. sosorum* (filled diamonds).

sosorum generally has proportionately longer limbs than other surface-dwelling central Texas *Eurycea* (Table 1, Fig. 3). For the 23 specimens that we measured, the ratio of anterior limb length to standard length ranged from 0.19–0.26 ($\bar{x}$ = 0.22). In comparison, for the specimens of *E. neotenes* and *E. nana* that we examined, the highest ALL/SL ratios observed were 0.17–0.21 ($\bar{x}$ = 0.19) in topotypical *E. neotenes* and 0.15–0.21 ($\bar{x}$ = 0.18) in specimens from Comal Springs.

Most specimens of *E. sosorum* (88% of the 40 examined by Sweet, 1984) possess 16 presacral vertebrae; other surface-dwelling members of the *E. neotenes* species group typically have 17, although a few individuals in some populations possess 16 (Sweet, 1984; see also Variation and Osteology).

The dorsal coloration of most specimens is distinctive. *Eurycea sosorum* exhibits varying degrees of dorsal blotching and mottling (see Variation) due to an irregular mixture of melanophores, pigment gaps, and iridophores. Most individuals exhibit pale, irregular dorsal patches due to lack of melanophores; in addition, many individuals exhibit high concentrations of silvery-white iridophores that can be so dense that they partially obscure the melanophores. Although pigment loss occurs in other cave-dwelling members of the *Eurycea neotenes* group (Sweet, 1978), the combination of pigment gaps and frequently high concentrations of dorsal iridophores appears to be unique to *E. sosorum*.

Based on allozymes, *E. sosorum* can be distinguished from other populations of central Texas *Eurycea* and *Typhlomolge rathbuni* by a unique combination of alleles, including a high (80%) frequency novel allele at the Peptidase-A (E.C. 3.4.13.11; leucyl-L glycine substrate) locus, and an apparently fixed allele at the Peptidase-D (E.C. 3.4.13.9; L-phenylalanyl-L-proline substrate) locus that otherwise is seen only in geographically distant populations that are currently referred to *E. neotenes*. Based on the preliminary allozyme data, the average Rogers' (1972) genetic distance between *E. sosorum* and the cluster of populations to which it is most similar is 0.169 (range: 0.114–0.210). Further details of the molecular work will be presented elsewhere in a broad-scale analysis of relationships of central Texas hemidactyliines.

Description of holotype.—SL = 24.9 mm). AG = 12.4 mm, ALL = 6.5 mm, HLA = 5.6 mm, HLB = 5.9 mm, HLC = 8.5 mm, HLL = 6.7 mm, HW = 4.9 mm, IOD = 1.7 mm, and ED = 0.64 mm. The eyes are very small (ED/SL = 0.026, ED/HW = 0.132). The head is noticeably deepest posterior to the eyes in lateral profile, giving the salamander a slight "shovel-nosed" appearance. The head is widest in dorsal aspect just anterior to the gill insertions; from there the outline of the head angles inward slightly to the level of the eyes, and angles inward slightly more from the eyes to the snout. Viewed from above, the snout is distinctly truncate. The three pairs of gills are well developed. There are 15 costal grooves. There are four fingers on each hand, and five toes on each foot. The tail is relatively short; the ventral tail fin is very narrow and in vertical profile is only clearly defined along the posterior third of the tail. The dorsal tail fin is well-developed, especially along the posterior third of the tail, and is clearly visible along the full length of the tail, from approximately the level of the hind limb insertions.

The dorsal pattern is variable and generally mottled with a combination of melanophores and areas lacking in dark pigment, presenting (in life) an overall color of olive brown with a base color of yellowish cream; the effect is one of a coarse-grained, blotchy "salt-and-pepper" pattern. In ethanol, the overall color is brownish gray with off-white mottling. The trunk is finely and intensely speckled with melanophores; the ventral surface is creamy to translucent. Scattered melanophores invade the ventral surface, mainly in the areas immediately posterior to the gills and front limbs. The underside of the tail is mottled with melanophores. The limbs are unevenly mottled dorsally and the dorsal surfaces of the fingers and toes are speckled with melanophores. The ventral surfaces of the limbs are mainly clear, with occasional melanophores. The tail fins are finely speckled with melanophores. The dorsal surface of the tail displayed a narrow orange-yellow stripe from the level of the hind limb insertions to the tip in life. On the ventral surface of the tail, the living specimen had a narrow orange-yellow stripe from the posterior margin of the vent to the tip. Dark canthal lines are present, and a faint postorbital bar is apparent. The iris (in life) was golden with black mottling. There is a dark line of irregularly arranged melanophores immediately below the line of the mouth. A row of nine large, irregularly shaped paravertebral spots (areas in which dark pigment is lacking) is present on each side along the trunk between the limb insertions; these spots continue but are less well-defined on the tail. A pair of large parietal spots is present as an anterior extension of each row. Partially overlapping these spots is a row of smaller, silvery-white iridophores that appear under magnification as clusters of shiny "flakes" just below the surface of the skin; these were clearly visible only in life. The gills were bright red in life; they are speckled with scattered melanophores that are more evident in the preserved specimen.

Variation.—The maximum snout-vent length for *E. sosorum* measured in this study was 36.5 mm (total length 62.6 mm; TNHC 50918). Substantially larger individuals have been observed by us in the field, however. The width of the head varies considerably; Sweet (1978) initially described the head as relatively small and narrow, but in some larger specimens the head appears proportionately very broad. Sweet (personal communication to P. Chippindale) has confirmed this observation. With this broadening of the head, the degree of truncation of the snout appears to diminish in some individuals. The number of costal grooves (which are often poorly defined and difficult to count) varies from 13 ($n = 1$) to 14 ($n = 11$) to 15 ($n = 13$) to 16 ($n = 1$). Sweet (1984) examined 40 specimens of *E. sosorum* and reported a strong mode of 16 presacral vertebrae: 35 individuals had this number, while two had 15 and three had 17. Degree of development of the tail fins varies considerably among individuals, although dorsal and ventral tail fins are usually clearly visible, at least along the posterior portion of the tail.

The dorsal color in life varies among individuals, from dark through medium gray, to purplish gray or gray-brown, to yellowish brown, to yellowish cream. Variation in color is also seen in preserved specimens, although this variation is much less pronounced, and in some older specimens the patterning is faded. The degree of dark dorsal mottling due to the presence of melanophores is highly variable, covering from roughly one-third of the dorsal surface to the entire dorsal surface [these estimates are based on our observations and those of Sweet (1978), who examined many additional specimens that cannot be located]. Most individuals display some variation of the characteristic mottled/coarse "salt-and-pepper" pattern; in some specimens, the melanophores are relatively widely dispersed, yielding an overall pale appearance, whereas in a few specimens they are so dense that these individuals appear dark gray in life. Dark canthal lines are distinguishable in most specimens, but are obscured by aggregations of melanophores in a few individuals. Many individuals exhibit a moderately well developed lateral row of pigment gaps, although these are indistinct or absent in some animals. The concentration of dorsal and lateral iridophores is highly variable; in life, most individuals possess a lateral row of iridophores, and some individuals exhibit areas of silvery white dorsal pigmentation due to the presence of high concentrations of iridophores. Iridophores have been visible in varying concentrations in nearly all the live specimens that we have examined. The iridophores quickly fade in preservative (apparently during formalin fixation), so they may be difficult or impossible to discern in museum specimens.

Osteology.—Two cleared and double-stained specimens (TNHC 51178 and 51179, standard lengths = 30.4 and 32.6 mm, respectively) were examined with reference to characters described by Wake (1966), Mitchell and Smith (1972), and Sweet (1977). Maxillae, septomaxillae, nasals, and prefrontals are absent. Orbitosphenoids are present. The frontoparietal fontanelle is very extensive in both specimens. The frontals are elongate; their posterior margins are somewhat rounded and overlap the parietals, while the tapering anterior ends appear to be overlapped by the frontal processes of the premaxillae. The partes dentales of the premaxillae are fused together, but the frontal processes of the premaxillae are separate throughout their lengths. The vomer and palatopterygoid are dentate and not fused to each other. The parasphenoid lacks tooth patches in both specimens, and the tooth-bearing coronoid is clearly visible in both. The elements of the hyobranchial apparatus are primarily cartilaginous, but specimen TNHC 51179 displays a single patch of mineralization near the distal ends of each of the first ceratobranchials. The expanded posterior portion of the second basibranchial is largely ossified in specimen TNHC 51179 (although the lateral tips are unossified); it remains cartilaginous in TNHC 51178. This structure is triradiate and asymmetrical in both specimens, and a median notch is particularly pronounced in TNHC 51179. In both specimens, the posterior (median) projection of the second basibranchial appears to be a separate unit. Both specimens exhibit the characteristic 16 presacral vertebrae. The vertebrae lack alar processes on the parapophyses, and the diapophyses extend well beyond the lateral margins of the zygapophyses throughout the vertebral column. The carpals and tarsals are cartilaginous; in TNHC 51179, eight carpals and nine tarsals are present (these are poorly stained in specimen TNHC 51178). Phalangeal formulae are: 1-2-3-2 (hand) and 1-2-3-3-2 (foot).

Morphometric analysis.—*Eurycea sosorum* was readily diagnosable based on the discriminant function analysis (DFA). Most of the discrimination between *E. sosorum* and the other groups included in the DFA occurred along the first canonical variate axis (Fig. 4), whereas discrimination that was possible among the other populations and taxa occurred primarily along the second or higher canonical axes. For this reason, we present details of the relevant axis (CV1) only; morphometric discrimination among other Texas *Eurycea* will be addressed elsewhere. The first canonical variate (CV1) accounted for 73.3% of the total discrimination among groups in the analysis and was influenced most strongly by eye diameter (95.3% of the variance of the measure), anterior limb length (79.9%), and hind limb length (63.4%). Overall size (as measured by SL) contributed relatively little to CV1 (10.2%). The two limb length measures had positive loadings on CV1, whereas eye diameter had a negative loading on CV1. Thus, the high scores along this axis for *E. sosorum* largely reflect the relatively long limbs and small eyes of this species compared to others. In fact, a bivariate plot of eye diameter versus standard length readily separates *E. sosorum* from the other species (Fig. 2). CV1 can be defined as:

$$\begin{aligned} \mathrm{CV1} = {} & 8.471\ \mathrm{SL} + 10.100\ \mathrm{HLB} \\ & + 5.317\ \mathrm{HLC} + 8.048\ \mathrm{IOD} \\ & + 9.786\ \mathrm{HLL} + 16.215\ \mathrm{ALL} \\ & - 9.752\ \mathrm{AG} - 2.992\ \mathrm{TL} \\ & - 3.537\ \mathrm{HLA} - 11.347\ \mathrm{HW} \\ & - 54.874\ \mathrm{ED} - 5.746, \end{aligned}$$

where for each measure X, $\log_{10}(X + 1)$ is used.

Individual scores for *E. neotenes* on CV1 ranged from −3.430–0.977 ($\bar{x} = -0.911$, SD = 0.964); for *E. nana*, range = −3.693–0.356 ($\bar{x} = -1.887$, SD = 1.061); and for *E. sosorum*, range = 4.404–8.340 ($\bar{x} = 6.179$, SD = 1.209).

Based on Geisser classification probabilities (Geisser, 1977), all 23 specimens of

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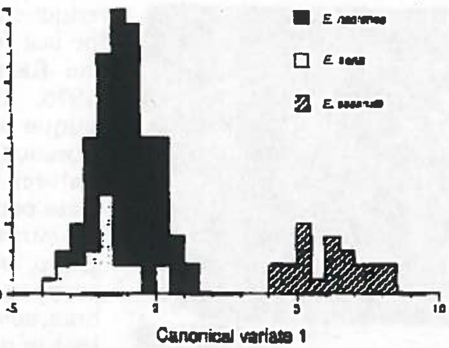

FIG. 4.—Distribution of specimens of *Eurycea neotenes* (dark shading), *E. nana* (light shading) and *E. sosorum* (crosshatching) along the first canonical variate of the discriminant function analysis. See text for details of CV1.

E. sosorum were assigned to the correct group, and no individuals from any other populations were incorrectly assigned to the *E. sosorum* group (some misclassifications did occur among the other groups, particularly among the populations currently assigned to *E. neotenes*).

These results are consistent with those of Sweet (1984), who included *E. sosorum* (which he called *Eurycea* sp. from Travis Co.) in a larger morphometric discriminant function analysis that involved both surface and cave-dwelling central Texas *Eurycea*. [Sweet also included meristic counts in his analyses that were not used in the present study.] Sweet's analyses showed that *E. sosorum* was readily discriminable from other central Texas *Eurycea*, with the exception of one individual (of 32) that was misclassified as *E. neotenes* in a posteriori tests.

Distribution.—*Eurycea sosorum* is known only from the immediate vicinity of the outflows of two clusters of springs in Zilker Park in the City of Austin, Travis Co., Texas, collectively called Barton Springs (Figs. 5, 6). These springs flow throughout the year and maintain an approximately constant temperature of 20 C

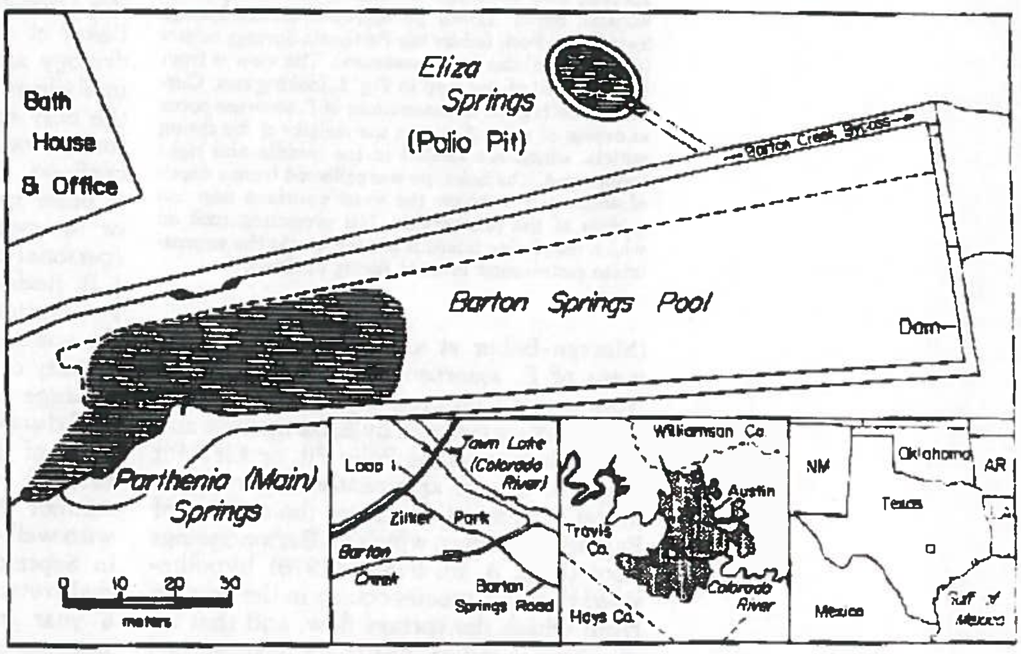

FIG. 5.—Known distribution of *Eurycea sosorum* and details of Barton Springs Pool and vicinity. Inset maps (from right to left) show: (1) location of Austin, Texas, (2) location of the Zilker Park area within Austin (the City of Austin is indicated by dark stippling), and (3) location of Barton Springs Pool along Barton Creek in Zilker Park. The main map shows the current surface distribution of *E. sosorum*, indicated by horizontal hatching. Solid dots mark spring outflows. The dashed line indicates the 1.5 m depth contour, which marks the approximate limits of the surface of the pool when it is lowered for cleaning purposes.

FIG. 6.—Upper photograph: Eliza outlet of Barton Springs, now modified to form a concrete pool of variable depth. Lower photograph: Barton Springs Swimming Pool, fed by the Parthenia Springs outlets (the main habitat for *E. sosorum*). The view is from the west end of the map in Fig. 5, looking east. Currently, the highest concentrations of *E. sosorum* occur at depths of about 3–5 m in the vicinity of the spring outlets, which are located in the middle and right foreground. The holotype was collected from a depth of about 4–5 m below the water's surface near the middle of the photograph. The projecting rock on which the diving board is located marks the approximate easternmost limit of spring outflows.

(Martyn-Baker et al., 1992). Most specimens of *E. sosorum* have been collected from a small (approximately 15 m diameter) wading pool fed by Eliza Springs and known locally as the Polio Pit, or Elks' Pit (Figs. 5, 6). An apparently larger population occurs in the area of the outflow of Parthenia Springs, which fill Barton Springs Pool (Figs. 5, 6). Sweet (1978) hypothesized that this species occurs in the aquifer from which the springs flow, and that individuals found on the surface have washed out of primarily subterranean habitat. However, recent evidence suggests that *E. sosorum* is predominantly a surface-dwelling species that has undergone a severe reduction in available surface habitat over the last few decades (see Natural History and Reasons for Endangerment). Sweet (1978, 1984) regarded *E. sosorum* as unique among the central Texas perennibranchiate *Eurycea* in its possession of features that he interpreted as intermediate between those exhibited by epigean (= surface-dwelling) members of the group, and cave-dwellers, specifically body proportions, numbers of presacral vertebrae, coloration and tooth counts. We note that in general Sweet's (1978, 1982, 1984) approach was to recognize a minimum number of species in the central Texas *Eurycea*, and he referred the vast majority of spring and cave populations to *E. neotenes*. However, he strongly advocated recognition of the Barton Springs population as a distinct species based on its unique morphology (Sweet, 1978, 1984).

The Barton Springs Aquifer is hydrologically distinct from other underground waters in central Texas; these waters are collectively called the Edwards Aquifer (for a non-technical summary, see Martyn-Baker et al., 1992; for details of the hydrology and geology of the region, refer to Slade et al., 1986). *Eurycea sosorum* is the only species of *Eurycea* known from the Barton Springs Aquifer and its spring outflows. This species has not been found in other springs and caves that are fed by or intersect the Barton Springs Aquifer (personal observations; W. H. Russell and J. R. Reddell, personal communications to P. Chippindale). This further suggests that the species is restricted to the immediate vicinity of Barton Springs, and is unlikely to range extensively underground.

Natural history.—Few details of the biology of this species are known. Recently hatched young have been found in November, March, and April, and females with well-developed eggs have been found in September through January. One female retained well-developed eggs for over a year in captivity. Recently captured specimens contain the remains of amphipods in their stomachs, and captive specimens feed on amphipods, earthworms, whiteworms, brine shrimp, and commercial fish food pellets. At present, specimens are usually found under rocks or in gravel in about 0.1–5 m of water, but *E. sosorum* will also take refuge among aquatic vascular plants and algae when such habitat is available. In this respect, the behavior of this species is very similar to that of *E. nana* at San Marcos Springs, Hays Co. Our observations, and the evidence cited below (see Reasons for Endangerment), indicate that *E. sosorum* makes extensive use of surface spring habitat when given the opportunity. This species clearly is capable of living underground, and as Sweet (1978, 1984, personal communication) has emphasized, it shows several morphological features that are associated with subterranean living in other members of the *E. neotenes* species group. We suspect that *E. sosorum* is predominantly a surface-dweller that also is able to live underground.

Using SCUBA equipment, relatively large numbers of *E. sosorum* can be observed; for example, on 24 November 1992 we (P. Chippindale and D. Hillis) counted at least 150 individuals during a 2-h dive in Barton Springs Pool. Thus, prospects for more thorough, long-term studies of this species in the field are excellent, provided that habitat and water quality can be maintained.

Reasons for endangerment.—Prior to 1989, aquatic vascular plants were abundant in Barton Springs Pool. According to field notes, some of the first specimens of this species were collected from among plants in Barton Springs in 1946 by Bryce C. Brown and Alvin Flury (BCB 1879–1885 and TNHC 6317–6321; the BCB specimens have been destroyed, although the field tags remain at the Strecker Museum, Baylor University). They apparently were abundant at the Eliza Springs outlet as recently as the early 1970's, when "dozens or hundreds" could be found at a time by searching through submerged leaves (J. R. Reddell, personal communication to P. Chippindale). In contrast, in surveys of Eliza Springs between 1987 and 1992, we rarely found more than one or two individuals, and often found none. In 1992, City of Austin staff agreed to stop cleaning the outlet at Eliza Springs, and the habitat at that location has rapidly improved. Bottom sediments and vascular plants have become established, and the salamander population has increased substantially, 15 individuals were observed during a SCUBA survey on 16 November 1992. Prior to October 1992, City of Austin employees partially drained Barton Springs Pool as often as twice per week, used chlorine to clean the shallow end and side walls, and used high-pressure fire hoses to wash silt and loose algae from the shallow end into the spring outflows. Following a chlorine-induced vertebrate kill in Barton Springs on 28 September 1992, individuals of *E. sosorum* could be located only around the immediate outflow of the largest of the Parthenia Springs openings (during a SCUBA survey on 1 October 1992). After this date, city employees stopped using chlorine to clean Barton Springs Pool, a volunteer-assisted manual cleaning effort was initiated, and waste water from the shallow end was diverted from the spring openings. The habitat in the pool has improved rapidly since that time; vascular plants have begun to re-establish themselves and *E. sosorum* appears to be rapidly re-expanding its range in the pool. We currently are monitoring the status of the surface population of *E. sosorum* using SCUBA surveys. We also are working closely with City of Austin staff and representatives of state and federal agencies to help develop maintenance procedures that are compatible with the survival of *E. sosorum* and the continued use of Barton Springs by humans. This will be accompanied by an education campaign to inform the public about the Barton Springs salamander and the ecosystem that exists in the pool.

The new maintenance practices at Barton Springs Pool appear to be suitable for maintenance of a healthy population of *E. sosorum*. We see no conflict between human use of the pool for swimming and the continued existence of this species. Indeed, many Austinites have adopted *E. sosorum* as a symbol of water quality and the uniqueness of Barton Springs, and the salamander is even depicted on a popular T-shirt. Additional threats to the species include urban runoff, increased development in the Barton Creek watershed, and the risk of a catastrophic toxic chemical spill or sewer line breakage in the urban zone surrounding Barton Springs. The Barton Springs Aquifer has been designated by the Texas Water Commission as one of the aquifers most vulnerable to pollution in Texas.

Eurycea sosorum has been listed (as the Barton Springs salamander, *Eurycea* sp.) by the U.S. Fish and Wildlife Service as a candidate for federal protection (Category 2) under the Endangered Species Act since 1982 (Federal Register 1989, 54:558). Recently, M. Kirkpatrick and B. Mahler petitioned for its listing as a federally Endangered Species (in two petitions: one submitted in January 1992 and the other, requesting emergency listing, submitted in November 1992). The initial petition has been ruled valid by the USFWS (Federal Register 1992, 57:58779–58781), and at the time of writing the USFWS is further investigating the basis for listing of this species. *Eurycea sosorum* appears to have one of the smallest ranges of any vertebrate in North America, occurs in an area of extreme environmental sensitivity, and is highly vulnerable to extinction.

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APPENDIX I

Specimens Examined for Morphometric Variation

Eurycea neotenes: Bexar Co.: Helotes Creek Spring (type locality): MVZ 120043–46, 120048, 120051–54, 120056, 120068, 120076, 120079, 120085–86, 120090–93. Blanco Co.: Boardhouse Spring: TNHC 51121–27. Comal Co.: Comal Springs: MVZ 120392, 120407, 120415, 120419, 120424, 120427–28, 120430–32, 120434, 120445–46, 120448–50; TNHC 51052–53, 51056. Hays Co.: Fern Bank Spring: TNHC series 31004, informally tagged as specimens 2, 3, 5, 7–8, 10–12, U1, U3–6, and X; TNHC 51104, 51106–07, 51112. Kendall Co.: Cibolo Creek Tributary Spring: MVZ 121234, 121240–41, 121243, 121245, 121248–49, 121253, 121255, 121257–58, 121260–262, 121266, 121269, 121279, 121282, 121287.

E. nana: Hays Co., San Marcos Springs: TNHC series 50901, informally tagged as specimens 1–3, 4–6, and 8–9; TNHC series 21661, informally tagged as specimens 1–9; TNHC 46289–290, 46292, 46294.

E. sosorum: Travis Co.: Barton Springs (Eliza and Parthenia outlets): MVZ 122712–716, 122718; TNHC 50915–18, 50920–21, 50923–25, 50928, 50931–32, 51180, 51183–86.

Note Added in Press

In January 1993, *Eurycea sosorum* was found in the outflow of the Sunken Gardens Springs, also known as Old Mill or Walsh Springs (Brune, 1981). These springs are part of the Barton Springs group and are located approximately 300 m east of the main (Parthenia) springs.

Atten: Phil Friday (Peter – you [illegible] Can [illegible] on this [illegible])

Re: File No SP-94-0346-D
Lakes Haven Boat House "B"
3500 Rivercrest Drive

The proposal for this project appears to be more of a commercial project.

There are several private boat slips adjacent to the proposed one which home owners own, and they maintain

With any more construction in this small area will cause more erosion and be detrimental to this beautiful lake. There is too much debris that accumulates there which propably is a run off from the Creeks that empty into the lake

I would like to see this lake kept as beautiful and as clean as possible so all can enjoy for years to come.

It appears that it would abut my property

Thank you for your attention to this

Florence B. Salesbury

3704 Rivercrest Dr.
Austin Tex 78746