



A Collection of Fish from Parthenia and Old Mill springs, Austin, Texas: Implications for Endangered Salamander Conservation

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ABSTRACT

The Barton Springs and Austin Blind salamanders (*Eurycea sosorum* and *E. waterlooensis*, respectively) are federally endangered species found in several springs in or near Austin, Texas. Two of these springs along Barton Creek (Old Mill and Parthenia springs) that provide salamander habitat have been impounded for human use and recreation. These impoundments have changed the natural flow regime and serve to entrap fish during overbank floods. The presence of predatory fish may result in behavioral responses by salamanders that constrain dispersal, feeding, growth or reproduction. We conducted a pilot study to assess the frequency of fish predation on *E. sosorum* and *E. waterlooensis* in Parthenia and Old Mill springs by collecting and preserving fish and examining their gut contents. A secondary goal was to document the fish community with voucher specimens to record changes in community composition over time. A single predation event of a hatchling *E. waterlooensis* by a green sunfish confirmed that fish do prey on salamanders in the wild. Periodic fish removal and/or exclusion may improve conditions for salamanders at Old Mill Spring.

INTRODUCTION

The Barton Springs and Austin Blind salamanders (*Eurycea sosorum* and *E. waterlooensis*, respectively) are federally endangered species found in several springs in or near Austin, Texas (Fig. 1). Barton Springs is the fourth largest spring in Texas and the primary discharge point for the Barton Springs segment of the Edwards Aquifer (Fig. 1). The main spring was impounded in the late 1920's when two concrete dams were constructed across Barton Creek to create Barton Springs Pool (BSP), a popular semi-natural swimming area in Zilker Park near downtown Austin (Fig. 1). Two other smaller springs – Eliza and Old Mill springs – have also been modified to create spring-fed pools. The damming of Barton Creek has changed the water depth, flow, light and temperature regimes, and rate of sediment transport in the spring-stream ecosystem (City of Austin 2013). The negative effects of the dams on the structure and function of the Barton Creek ecosystem have not been studied, though natural history museum collections have documented a major shift in fish community composition compared to pre-dam conditions (Labay et al. 2011). A collection of fish made at Barton Springs in 1884 in the lower one kilometer of “Spring Creek” (=Barton Creek) upstream from its confluence with the Colorado River documented 24 species of fish (Jordan and Gilbert 1886), seven of which have never again been documented in the greater Barton Creek Watershed (Labay et al. 2011). Populations of some species have declined upstream and downstream of BSP, such as the Central Stoneroller (*Campostoma anomalum*) (Labay et al. 2011). This well-studied algivorous minnow has been shown to cause a variety of direct and indirect trophic-level cascade effects in small streams (Power and Matthews 1983; Matthews 1998), avoiding areas where predatory largemouth bass (*Micropterus salmoides*) are present (Power et al. 1985). *Micropterus salmoides* and other centrarchid fish (*Lepomis spp.*) are usually abundant in Barton Springs, while *C. anomalum* are rare at best, or perhaps even absent (pers. obs.).

Although trophic interactions between fish and salamanders in Barton Springs have never been investigated, the presence of predatory fish may result in behavioral responses that constrain salamander dispersal, feeding, growth or reproduction in the wild. In captivity, chemical cues from predatory fish result in antipredator behavior in captive-hatched *E. sosorum* (DeSantis et al. 2013). Sunfish (*Lepomis spp.*) and greenthroat darters (*Etheostoma lepidum*) have been observed eating salamanders flushed from the benthic substrate during SCUBA salamander surveys (N. Bendik, D. Chamberlain, pers. comm.). We conducted a pilot study to

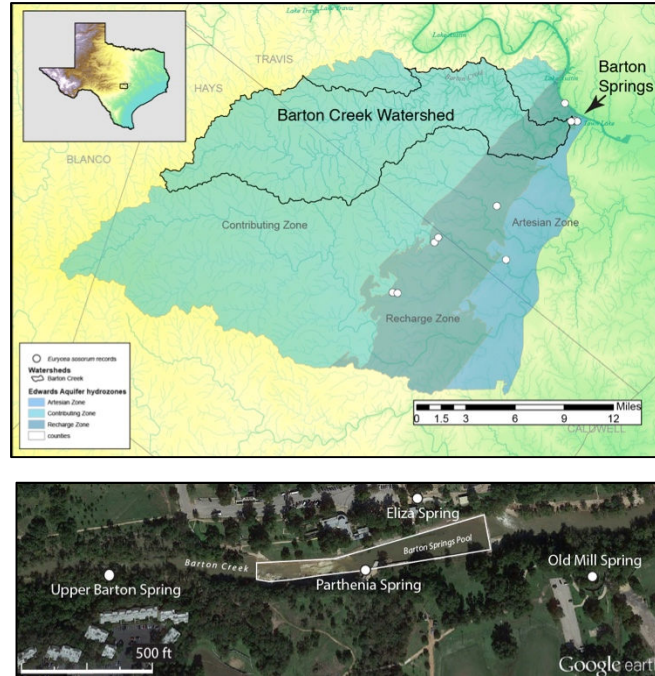


Figure 1. Top panel: Hydrozones of the Barton Springs segment of the Edwards aquifer showing the boundary of the Barton Creek Watershed and localities of Barton Springs salamanders (*Eurycea sosorum*). Bottom: the four springs of the Barton Springs group and boundary of Barton Springs Pool. The pool is dammed both upstream and downstream.

assess the frequency of fish predation on Barton Springs and Austin Blind salamanders (*Eurycea sosorum* and *E. waterlooensis*, respectively) in Barton Springs Pool and Old Mill Spring by collecting and preserving fish and examining their gut contents. A secondary goal was to document the fish community in BSP and Old Mill with voucher specimens as part of ongoing monitoring in these sites.

METHODS

We collected fish on three occasions at two different spring sites in the Barton Springs complex where salamanders occur. On November 12, 2014 and again on March 25, 2015, we sampled at Old Mill Spring (OMS), Zilker Park, Austin, Texas, USA using a 6-panel sinking monofilament gill net, 36-m long x 1.8-m tall (Sierra Nets, Lee Vining, CA). Fish were collected from BSP and in Barton Creek below BSP on November 20, 2014 using seines, minnow traps, gill nets, trammel nets, and polespears. Voucher specimens were anesthetized using clove oil, tissue for genetic analysis, preserved in 10% formalin, and deposited in the Texas Natural History Collection (TNHC) at the University of Texas at Austin for identification and cataloging. Stomach and hindgut were dissected, examined, preserved, in formalin, and deposited in the TNHC.

RESULTS

A list of specimens collected is provided in the Appendix. A total of 28 green sunfish (*Lepomis cyanellus*) and one bass (*Micropterus sp.*) were collected from OMS over the course of two sampling events. Fifty-five fish were collected from BSP, including *Micropterus spp.*, *Astyanax mexicanus* (non-native), *Herichthys cyanoguttatus* (non-native), *Lepomis auritus*, and *L. miniatus*. Examination of gut contents yielded mostly unidentifiable hindgut contents, along with invertebrates and other fish. A single hatchling *E. waterlooensis* was found in the stomach contents of one of the green sunfish from OMS (Fig. 3). Both were preserved and deposited in the TNHC (fish, TNHC 58574; salamander, TNHC 92953). A natural history note documenting



Figure 2. Left: green sunfish (*Lepomis cyanellus*); right: hatchling *Eurycea waterlooensis* found in stomach of sunfish. Both specimens were preserved and deposited in the TNHC (fish, TNHC 58574; salamander, TNHC 92953).

this observation is currently in review at *Herpetological Review*.

DISCUSSION

The results of this pilot study provide evidence that fish do prey on salamanders, at least in Old Mill Spring. Although only one salamander was recovered from a fish stomach, predation on salamanders likely occurs more frequently than these results suggest, for several reasons. First, the odds of collecting a fish that has ingested a salamander recently enough that it remains identifiable are slim. Second, the low abundance of salamanders at Old Mill Spring reduces the likelihood of documenting predation events even further. Finally, the majority of our sampling occurred during the winter, when fish are less likely to be actively foraging. Regular fish removal and exclusion at OMS would be prudent, and may facilitate the recolonization of this site by salamanders. Future restoration efforts aimed at widening the spring stream and lowering the water level of the impounded spring pool may reduce fish predation on salamanders by making the habitat less favorable for centrarchid fish, and less likely that fish will become trapped in the spring pool when Barton Creek floods.

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APPENDIX

Catalog Number	Date	Locality	Genus	Species	Common Name	Count
58544	11/20/2014	Barton Springs pool near spring	<i>Lepomis</i>	<i>miniatus</i>	redspotted sunfish	2
58545	11/20/2014	Barton Springs pool near spring	<i>Lepomis</i>	<i>auritus</i>	Redbreast sunfish	5
58546	11/20/2014	Barton Springs pool near spring	<i>Herichthys</i>	<i>cyanoguttatus</i>	Rio Grande cichlid	2
58547	11/20/2014	Barton Springs pool near spring	<i>Micropterus</i>	<i>sp</i>	Bass	46
58548	11/20/2014	Barton Springs pool near spring	<i>Astyanax</i>	<i>mexicanus</i>	Mexican tetra	2
58564	11/12/2014	Barton Creek below Barton Springs dam	<i>Micropterus</i>	<i>sp</i>	bass	4
58565	11/12/2014	Barton Creek below Barton Springs dam	<i>Lepomis</i>	<i>miniatus</i>	redspotted sunfish	3
58566	11/12/2014	Barton Creek below Barton Springs dam	<i>Fundulus</i>	<i>notatus</i>	Blackstripe topminnow	4
58567	11/12/2014	Barton Creek below Barton Springs dam	<i>Gambusia</i>	<i>affinis</i>	Western mosquitofish	7
58568	11/12/2014	Barton Creek below Barton Springs dam	<i>Lepomis</i>	<i>microlophus</i>	Redear sunfish	1
58569	11/12/2014	Barton Creek below Barton Springs dam	<i>Etheostoma</i>	<i>lepidum</i>	Greenthroat darter	2
58570	11/12/2014	Barton Creek below Barton Springs dam	<i>Campostoma</i>	<i>anomalum</i>	Central stoneroller	3
58571	11/12/2014	Barton Creek below Barton Springs dam	<i>Lepomis</i>	<i>macrochirus</i>	Bluegill	7
58572	11/12/2014	Barton Creek below Barton Springs dam	<i>Astyanax</i>	<i>mexicanus</i>	Mexican tetra	26
58573	11/12/2014	Barton Creek below Barton Springs dam	<i>Menidia</i>	<i>beryllina</i>	Mississippi silverside	47
58574	11/12/2014	Sunken Gardens at Barton Springs	<i>Lepomis</i>	<i>cyanellus</i>	Green sunfish	15
58575	11/12/2014	Sunken Gardens at Barton Springs	<i>Micropterus</i>	<i>salmoides</i>	Largemouth bass	1
	3/25/2015	Sunken Gardens at Barton Springs	<i>Lepomis</i>	<i>cyanellus</i>	Green sunfish	13