Climate Change, the Edwards Aquifer, and the Endangered Salamanders of Barton Springs, Austin, Texas

Eurycea sosorum

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Photo this page by Lisa O’Donnell
U.S. Species Listed as Endangered, Threatened, or Candidates
Total = 1516

2% are Amphibians (23)
47% are Salamanders (13)
53% are *Eurycea* (7)

*All images courtesy of Wiens et al. 2003*
Edwards Aquifer is a hotspot for karst species diversity.

Why?
Edwards Aquifer
Islands of Water
(MacArthur and Wilson 1967)

Figure from Hauwert et al. 2002
Edwards Aquifer
_Eurycea_ sites

Figure from Chippindale 1993  San Marcos  Austin
Eurycea sosorum, the Barton Springs Salamander
Federal endangered status in 1997
The Endangered Species Act requires that we ensure its existence in wild in perpetuity.
How hard will this be?
There is a dearth of basic scientific data on rare species and their habitats.
Mean Monthly *E. sosorum* Abundance
1993–2007

Mean number of salamanders

mean = 61
se = 7

COA Data
**Eurycea sosorum**

Natural History

**Lungless Salamander**
- Respires via permeable skin and gills

**Small, relatively long-lived**

**Solely Aquatic**
*Does not metamorphose*
- attains sexual maturity but retains some juvenile traits, gills

**Eats aquatic invertebrates**
Eurycea sosorum
Reproduction

Elaborate and extended courtship

Internal fertilization

Eggs laid singly underground

No parental care

Average Fecundity: 20 eggs per clutch?

Time to hatch: 30 – 60 days?

Non-seasonal breeding
Parthenia Spring/Barton Springs

Eliza Spring

Location Map of Barton Springs

Upper Barton Spring

Zenobia/Old Mill/Sunken Garden
Eurycea sosorum
Natural History

Inhabits epigean areas of spring-fed streams emerging from karst aquifer

Characteristics of Barton’s Springs:
perennial (as far as we know)
isothermal
undersaturation of O2
supersaturation of CO2
fast transport of H2O
(and anything therein)
What triggers reproduction?

Parthenia Spring (Barton Springs Pool)

- Discharge cfs (USGS)
- *E. sosorum*

Spring Discharge (cfs)

Number of Salamanders

Spring 1993 - 2003

Discharge and salamander population over the years.
Salamander abundance tends to increase 6 months after peak discharge.

Parthenia Spring (Barton Springs Pool)

Discharge cfs (USGS)  
E. sosorum

Salamander abundance tends to increase 6 months after peak discharge.
Barton Springs Salamanders must have clear, clean, flowing spring water.
Which anthropogenic changes in the environment would threaten this salamander species?
Endangered Species Act Listing for *Eurycea sosorum*

“The primary threat to the Barton Springs salamander [sic] is degradation of the quality and quantity of water that feed Barton Springs resulting from urban expansion over the Barton Springs watershed (including roadway, residential, commercial and industrial development).”
Barton Springs Aquifer Discharge

What are the historical conditions?
  e.g., short and long-term patterns of water quantity and rainfall

What are current conditions?
  e.g., more frequent or longer droughts, reduced dissolved oxygen, increases in other ions, etc.

Which changes are human induced?
  e.g., pumping, impervious cover in recharge zones, impoundments, climate change
Endangered Species Act Listing for *Eurycea sosorum*

“The primary threat to the Barton Springs salamander [sic] is degradation of the quality and quantity of water that feed Barton Springs ......”

What natural phenomenon directly affects groundwater quantity?
What is the biologically relevant time frame?

Less than one year.

Why?

Variation in water flow over short time frames provides cues for reproduction.

Responses to environmental cues evolve when those cues are reliable over evolutionary time.
Assessing likely affects of increasing climate change on particular species requires:

Finer scale of examination than regional.

The scale will depend on the biologically relevant variables.
Barton Springs Salamanders must have clear, clean, flowing spring water. Isn’t that what we need, too?
If the species that have already gone extinct due to climate change (Parmesan) is a harbinger of what is to come……

What is the cost of doing nothing?
And, now, for some good news........
Thanks for listening!
Before Habitat Reconstruction

Eliza Spring – July 2001

After Habitat Reconstruction

Eliza Spring – August 2006
There was an increase in large adults followed by reproduction.

Increase in Juveniles --> Increase in Yearlings --> Increase in Adults

*Eurycea sosorum* Recruitment

Eliza Spring
- **Blue**: Juvenile (<25.4mm)
- **Green**: Yearling (25.4-050mm)
- **Black**: Adult (>50mm)