

Why Evolution Matters in Endangered Species Management: the Case of *Eurycea sosorum*, the Barton Springs Salamander



Eurycea sosorum

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<http://www.ci.austin.tx.us/watershed/salamander.htm>

U.S. Species Listed as Endangered under the Endangered Species Act (ESA)

Total = 1375

**The goal of the ESA is to ensure
persistence of species in perpetuity.**

**A lot of time and money is spent to ensure
persistence of species in perpetuity.**

Why is Endangered Species Management Hard?

Basic scientific information is lacking

It is time sensitive

Incorrect predictions can have irreversible consequences.

How do you make species management decisions when data and animals are rare?

**Combine knowledge from a broad array of
scientific disciplines.**

Evolution

Ecology

Life History

Geology

Limnology

Physiology

Evolution is the most important.

**Successful protection of a species
in perpetuity must be measured in
evolutionary terms.**

Barton Springs Salamander

Eurycea sosorum



**Species in danger of extinction
typically have:**

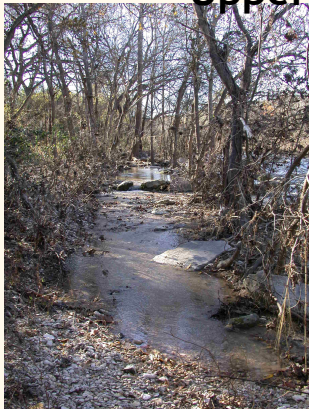
**Small range
and/or
Small population size**



Parthenia



Upper Barton



Small range?
Yes.

Eliza



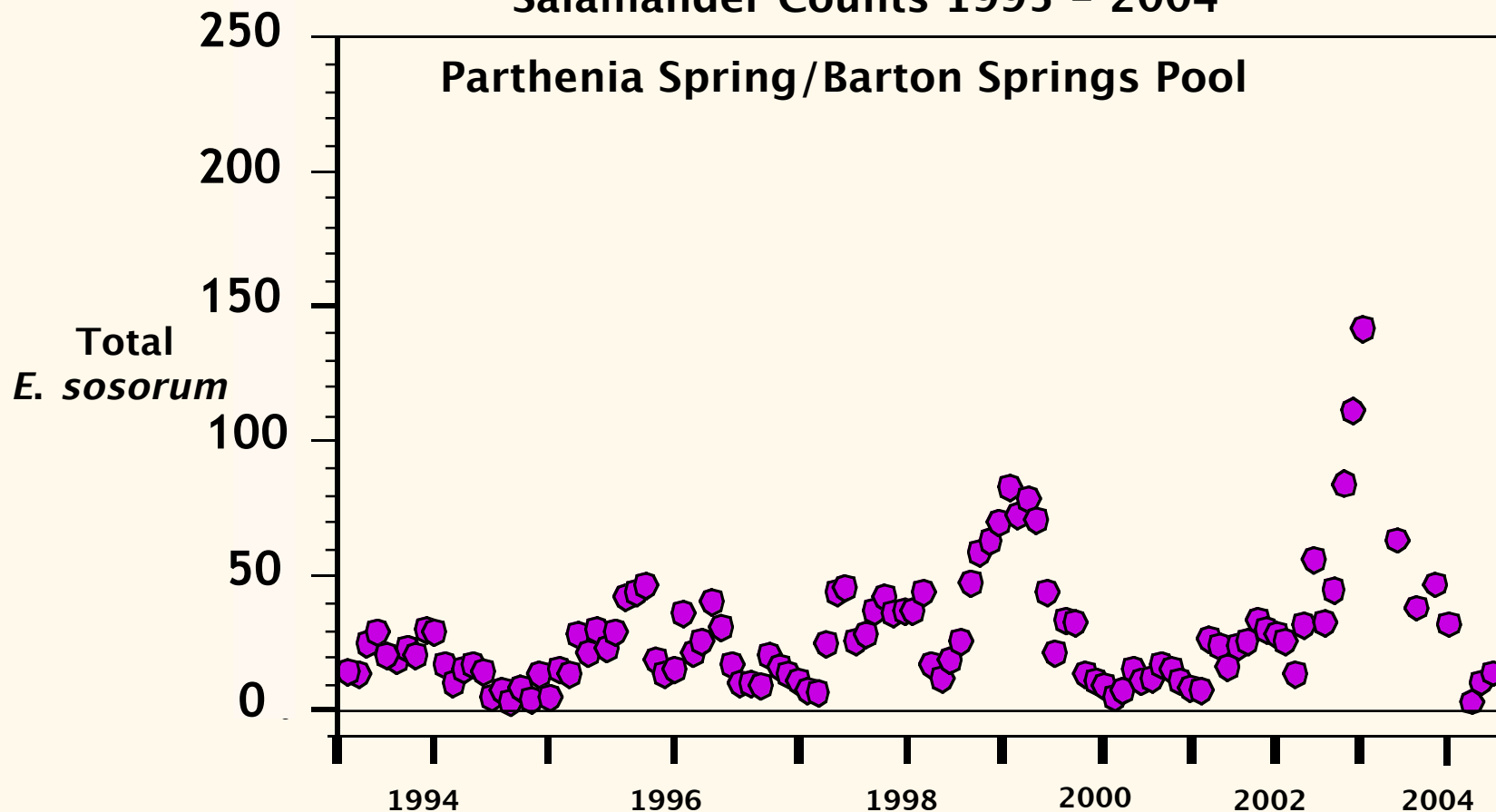
Old Mill/Sunken Garden



Small population size?

Best case -- Yes.

Salamander Counts 1995 - 2004

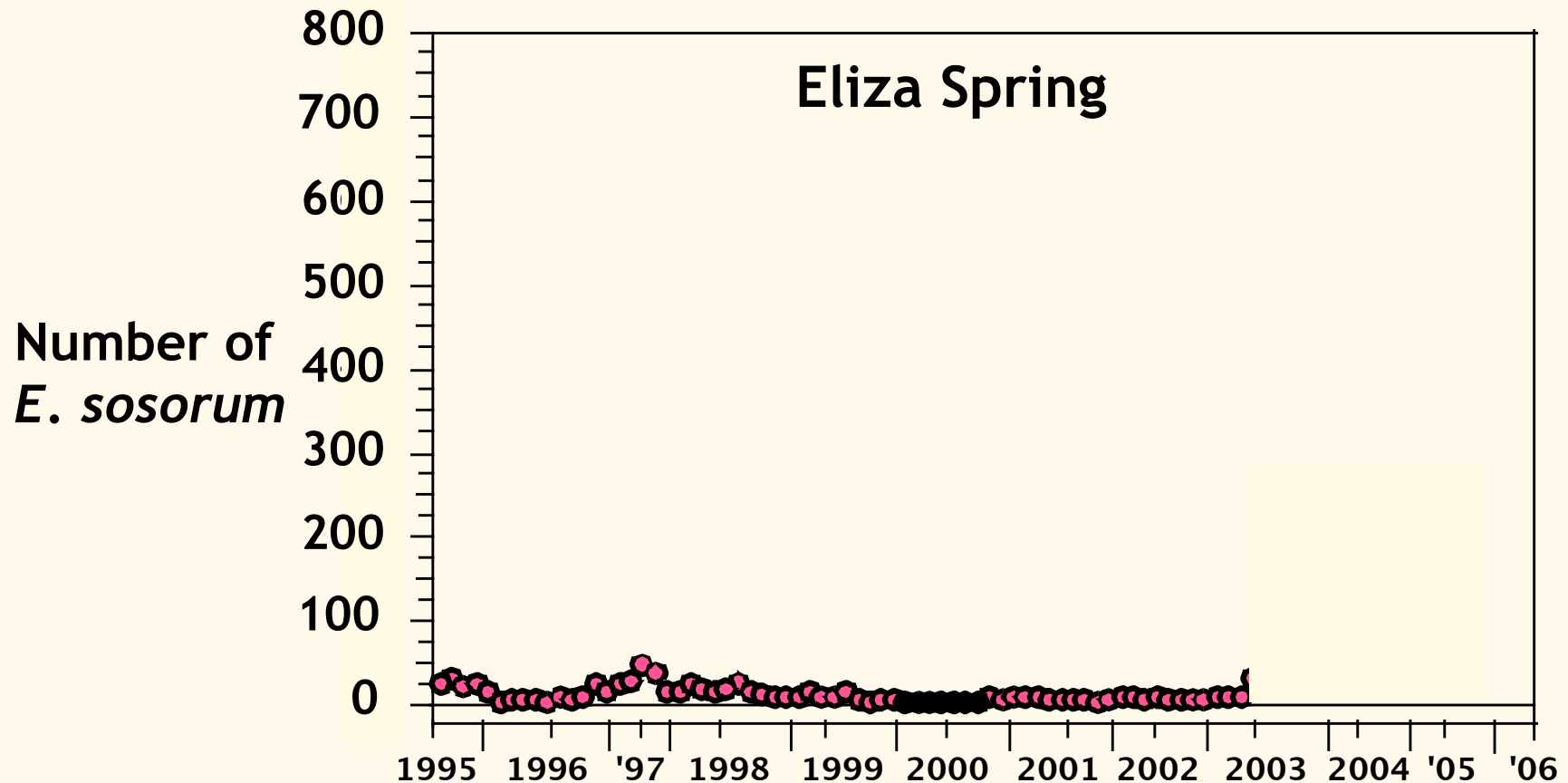


COA Data

Small population size?

Worst case: Yes.

Salamander Abundance 1995-2003



COA Data

How can evolution guide us?

Wild Population Protection and Recovery

What to do

When to do it

What results to expect

When to expect them

What to do

What environment did *E. sosorum* evolve under?

What changes in the habitat would promote a lasting increase in salamander abundance?

Eliza Spring

1890s



1920s



1950s



Eliza Spring 2002



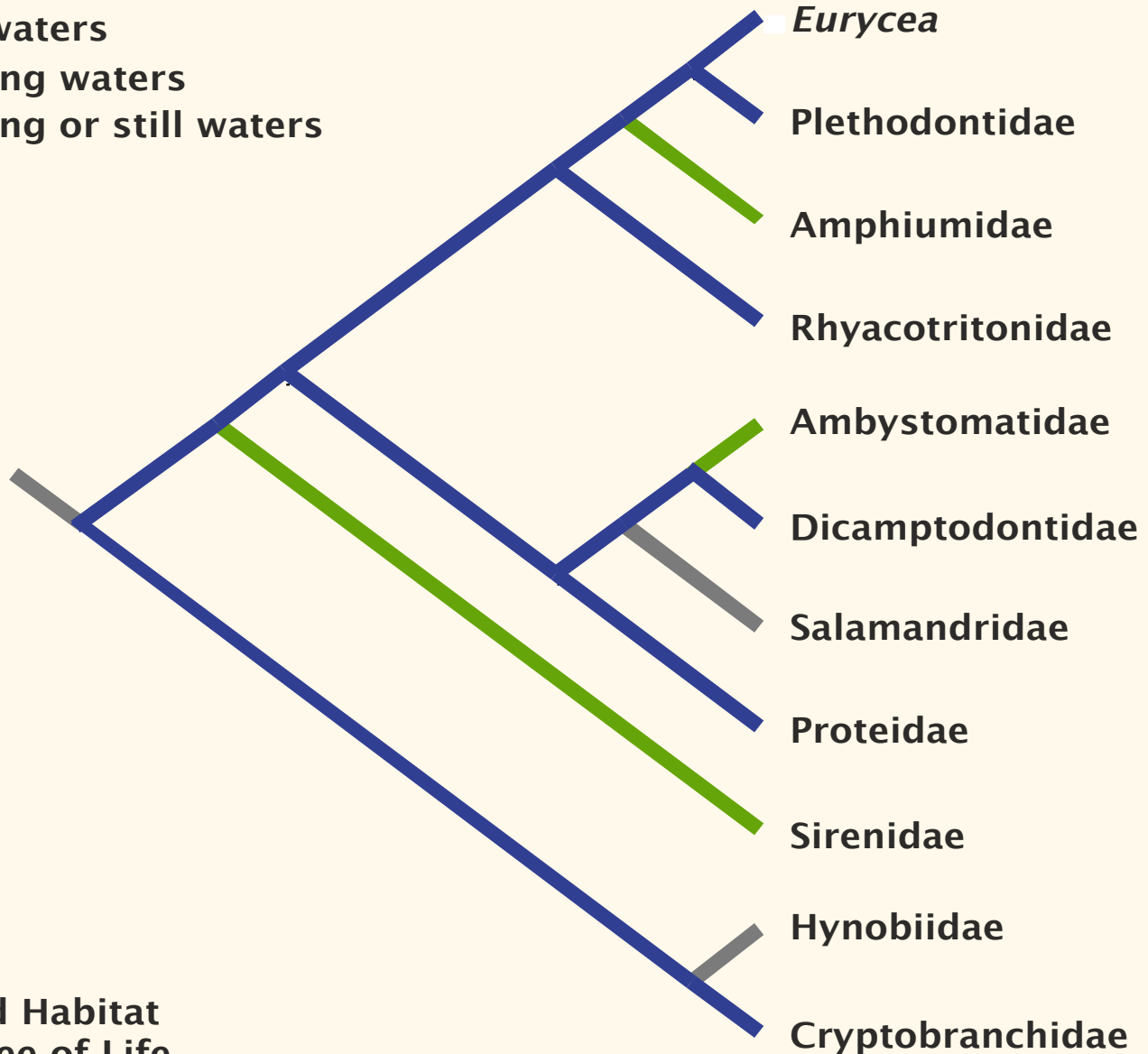
Aquatic Habitat Mapped on Caudata Phylogeny



still waters

running waters

running or still waters



Phylogeny and Habitat
taken from Tree of Life

What to do

What environment did *E. sosorum* evolve under?

Perennial flowing stream

What changes in the habitat would promote a lasting increase in salamander abundance?

Make the “pond” a stream.

When to do it

When is the cost of doing nothing greater than doing something?

Mean salamander abundance to 2003 = 9.

Not exactly an evolutionarily resilient population.

Do Something Now.

What results to expect

What would be an evolutionarily relevant improvement?

Increase in abundance via reproduction

When to expect them

What time frame is consistent with inferred life history (e.g. r- vs. k-selection)?

Minimum 6 months to 1 year if other environmental conditions favor reproduction.

What I did

Unplugged inflow and outflow paths.

Hand excavated excess rock and debris down to thin layer over concrete floor.

Reintroduced native aquatic plants.

Culled mosquitofish and crayfish populations.

Before Habitat Reconstruction



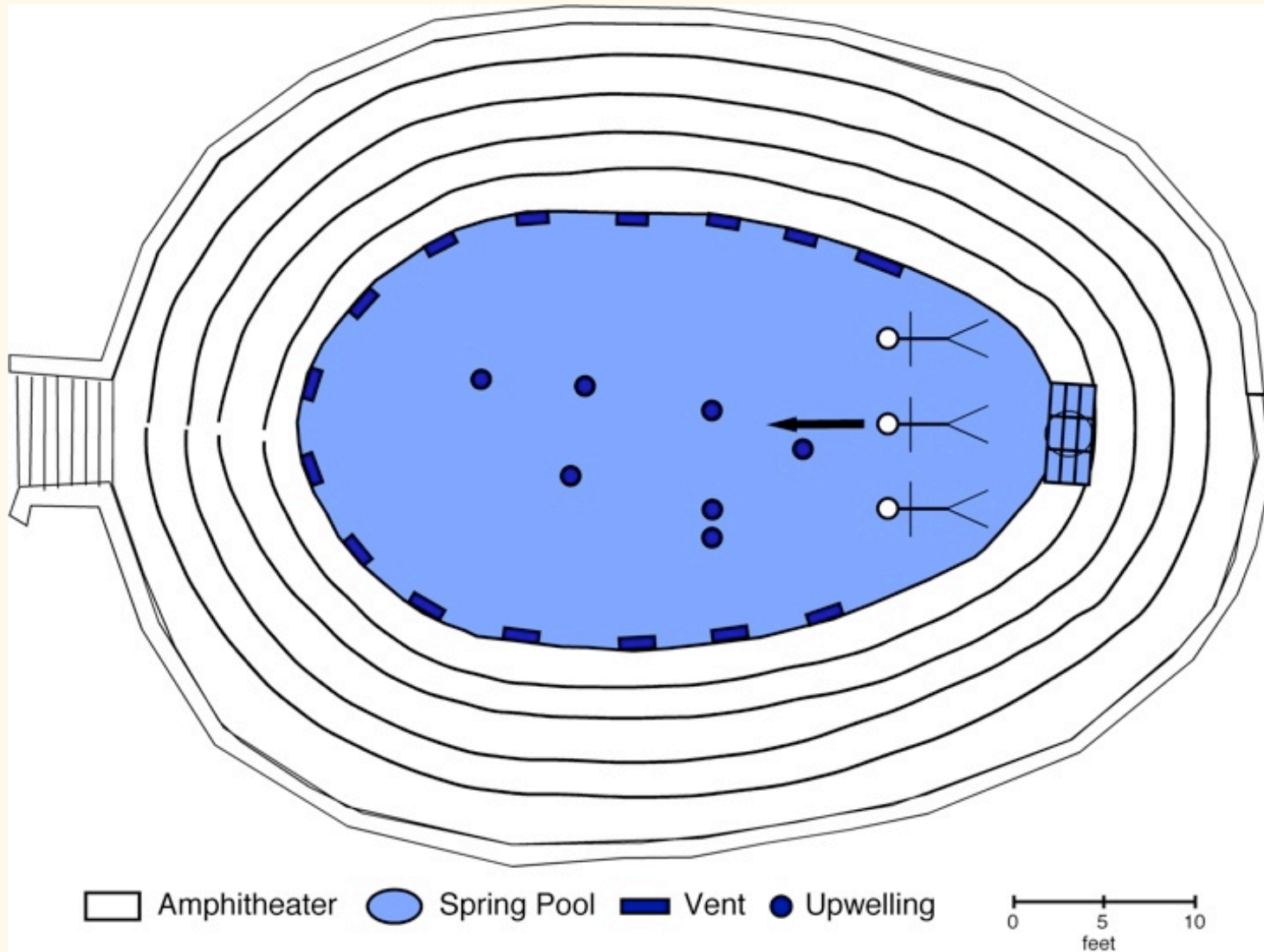
Eliza Spring - July 2001

After Habitat Reconstruction

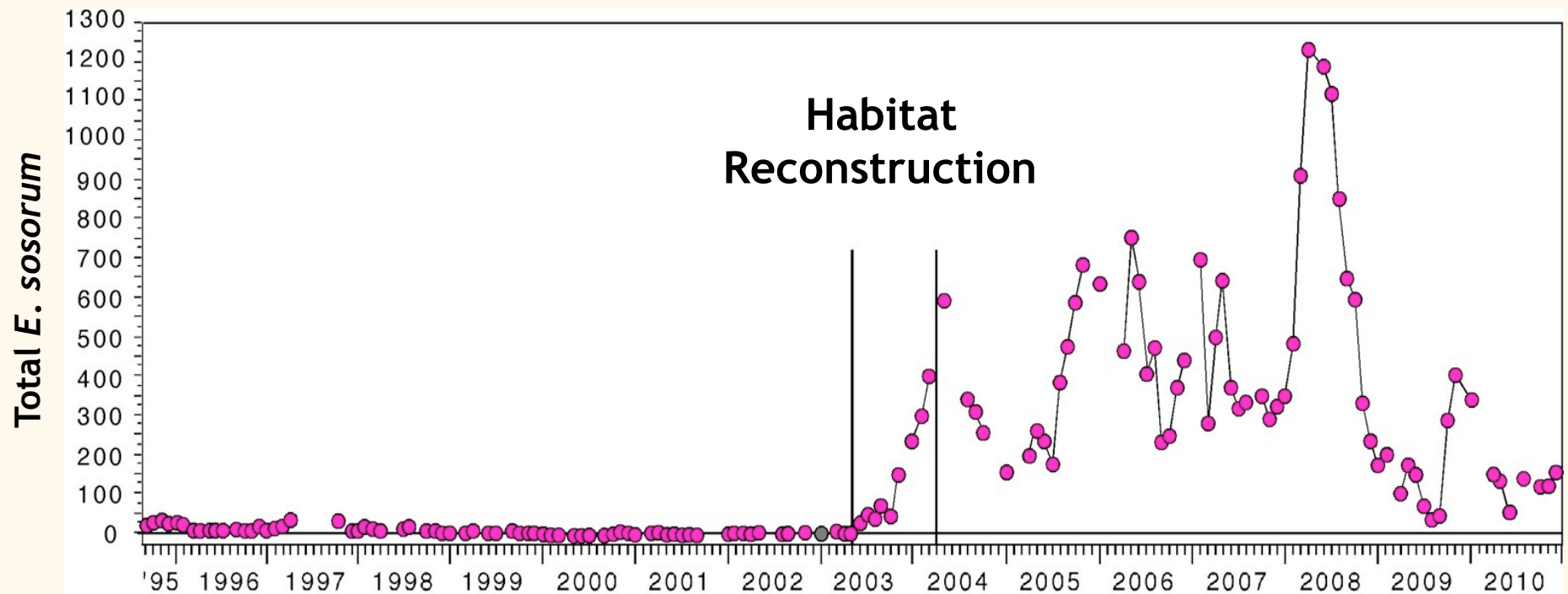


Eliza Spring - August 2006

Drive Survey Method

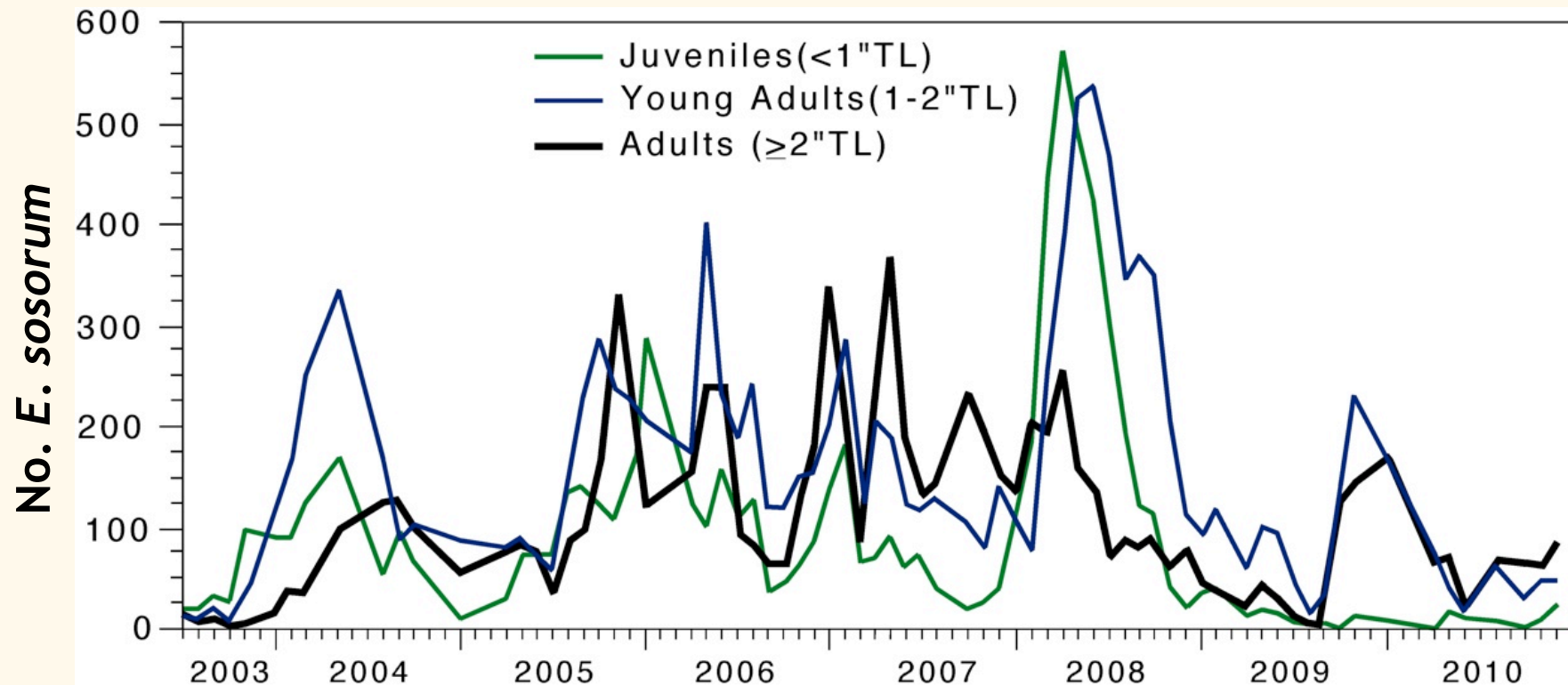


Abundance Increase? Yes. Eliza Spring



Recruitment? Yes.

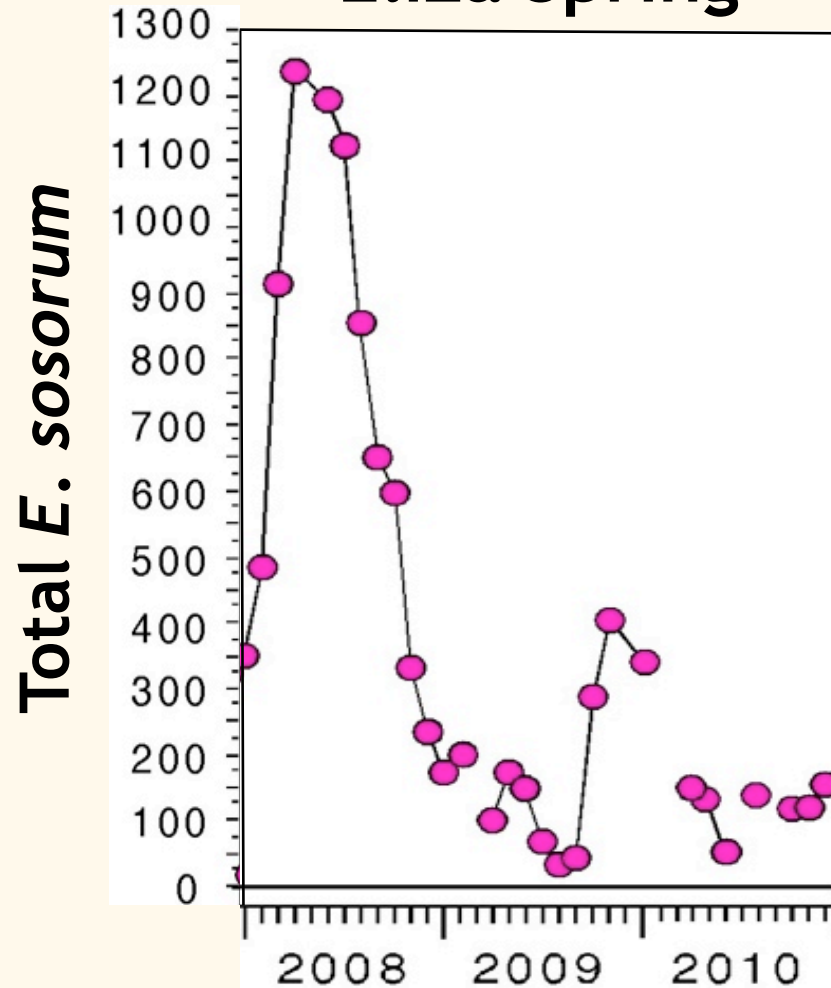
Eliza Spring



Yippee!!! It worked!

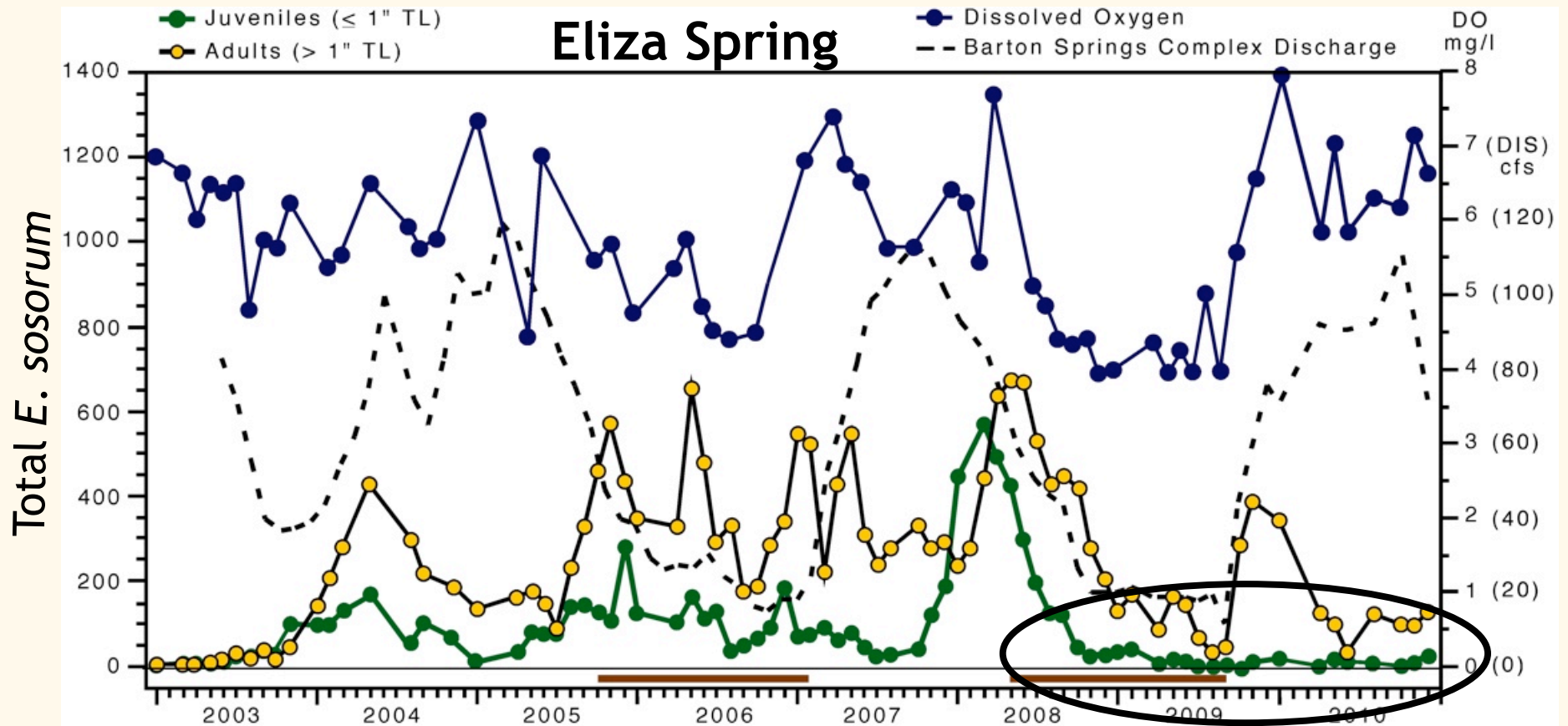
Wait, what about that drop 2008 - 2010?

Eliza Spring



Drought.

There are nearly no juveniles.



Why Evolution Matters

No reproduction = no evolution = no species persistence.

Although *E. sosorum* evolved under floods and droughts...

Large human influence on frequency, severity, and duration of droughts

Is the observed improvement in population size enough to ensure adaptation to future selection?

Evolution Matters!

Evolution is the most important perspective in managing endangered species.

Successful protection of a species in perpetuity must be measured in evolutionary terms.

The Scientific Advisory

Committee:

Tom Wilcox

Brian Hunt

Beth Churchwell

Meredith Mahoney

Joe Martin

Harry Miller

Mary Poteet

Steve Frost

University of Texas at Austin *et al.*

David Hillis

Keith Crandall

Jim Bull

Mike Ryan

Eric Pianka

Dean Hendrickson

Camille Parmesan

Sam Sweet

Paul Chippindale

Ben Pierce

City of Austin

Nate Bendik

Liza Colucci

Todd Jackson

Scott Hiers

Sylvia Pope

Mateo Scoggins

Dee Ann Chamberlain

Robert Hansen

Ed Peacock

Tom Ennis

Tom Nelson

Taxpayers

U.S. Fish and Wildlife Service

Paige Najvar

Will Amy

Luella Roberts

Charlotte Kucera

Thank you, Thank you!!!

Salamander Surveyors

Hayley Gillespie

Martin Schlaepfer

Dave Bickford

Ted Townsend

Drew Davis

Kendra Cookie

Alisha Shah

Todd Jackson

Mike Colucci

Tim McKenna

Tom Pilz

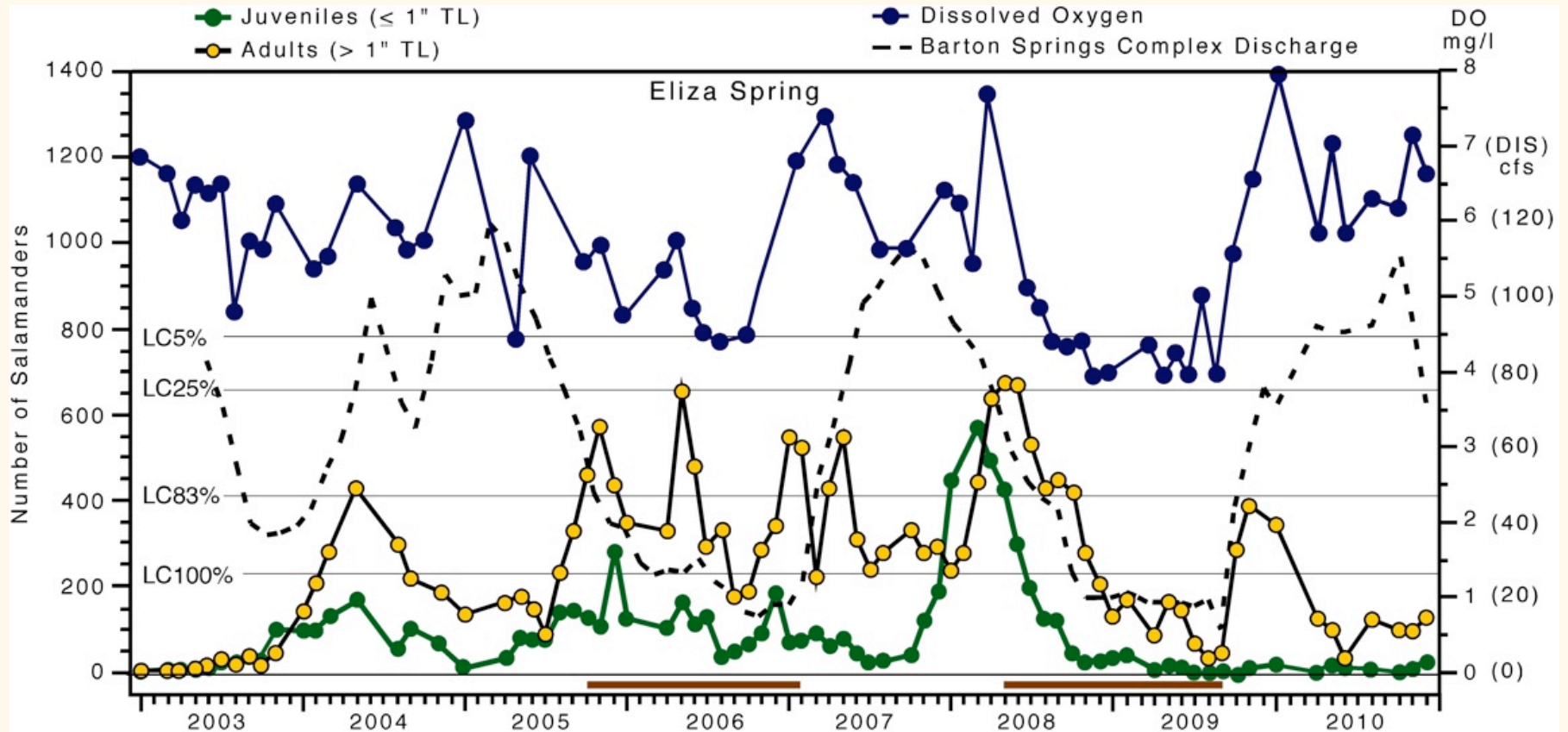
Ed Oborny

Colin Peden

Dave Andersen



Eliza Spring





Are there relationships between other factors and salamander abundance?

Yes.

Substrate

**Sediment depth, cover,
and composition**

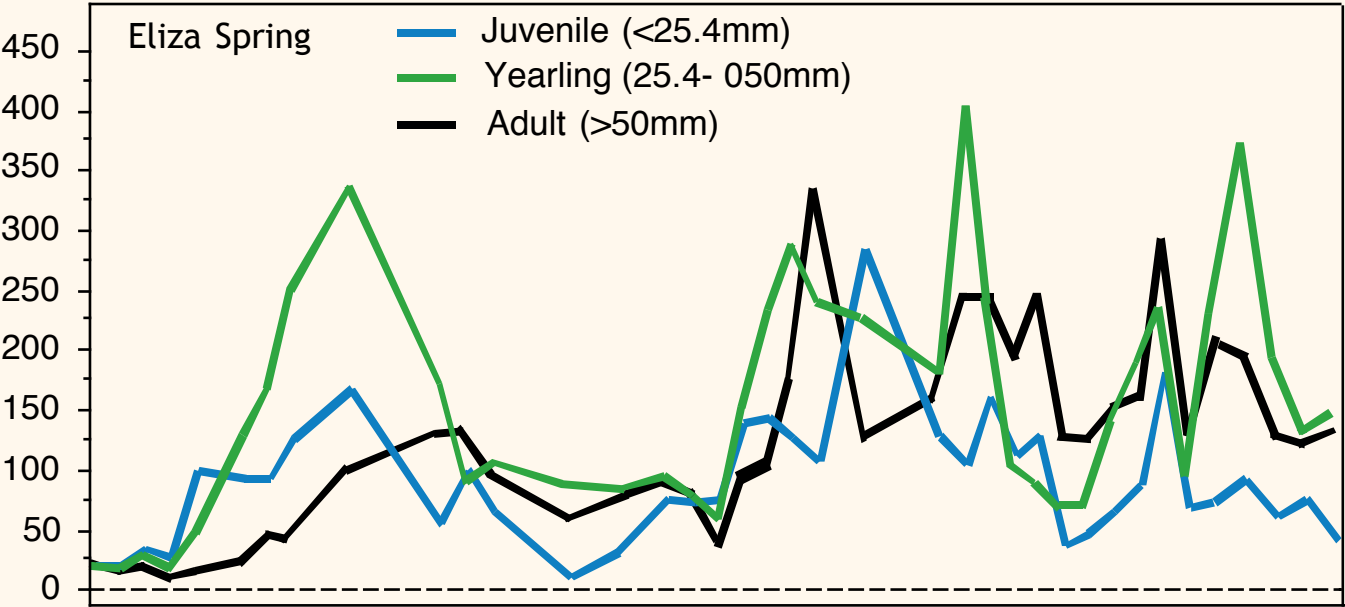
What have we learned?

There is a cost to doing nothing.

Be brave.

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

Eurycea sosorum Recruitment



What is unique about managing the endangered species?

There is a dearth of basic scientific data on rare species and their habitats.

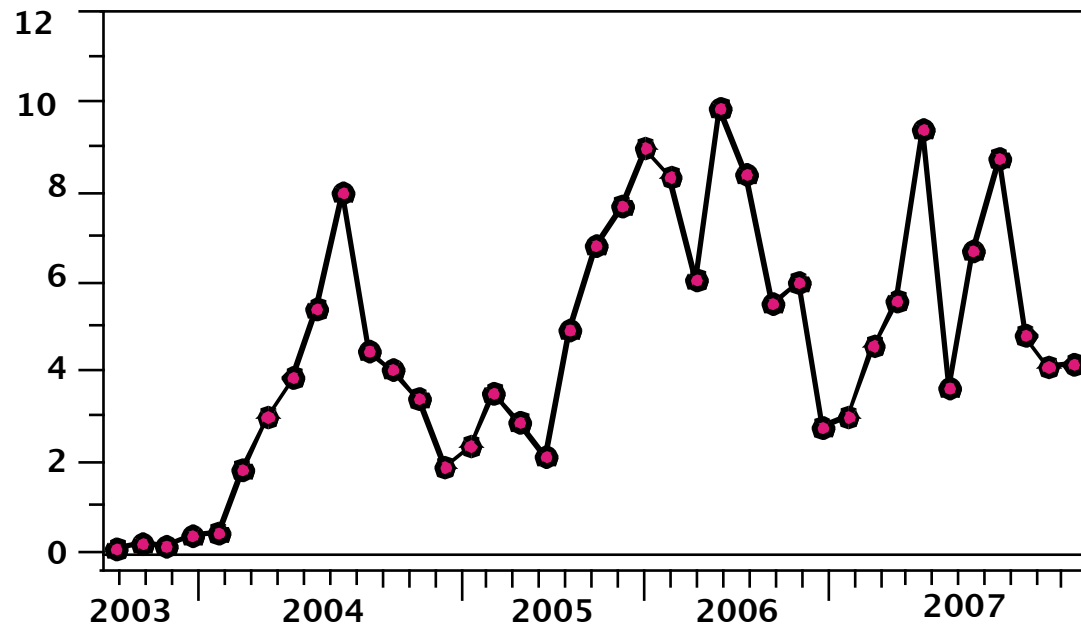
It is time sensitive and incorrect predictions can have irreversible consequences.

It is subject to the influence of politics.

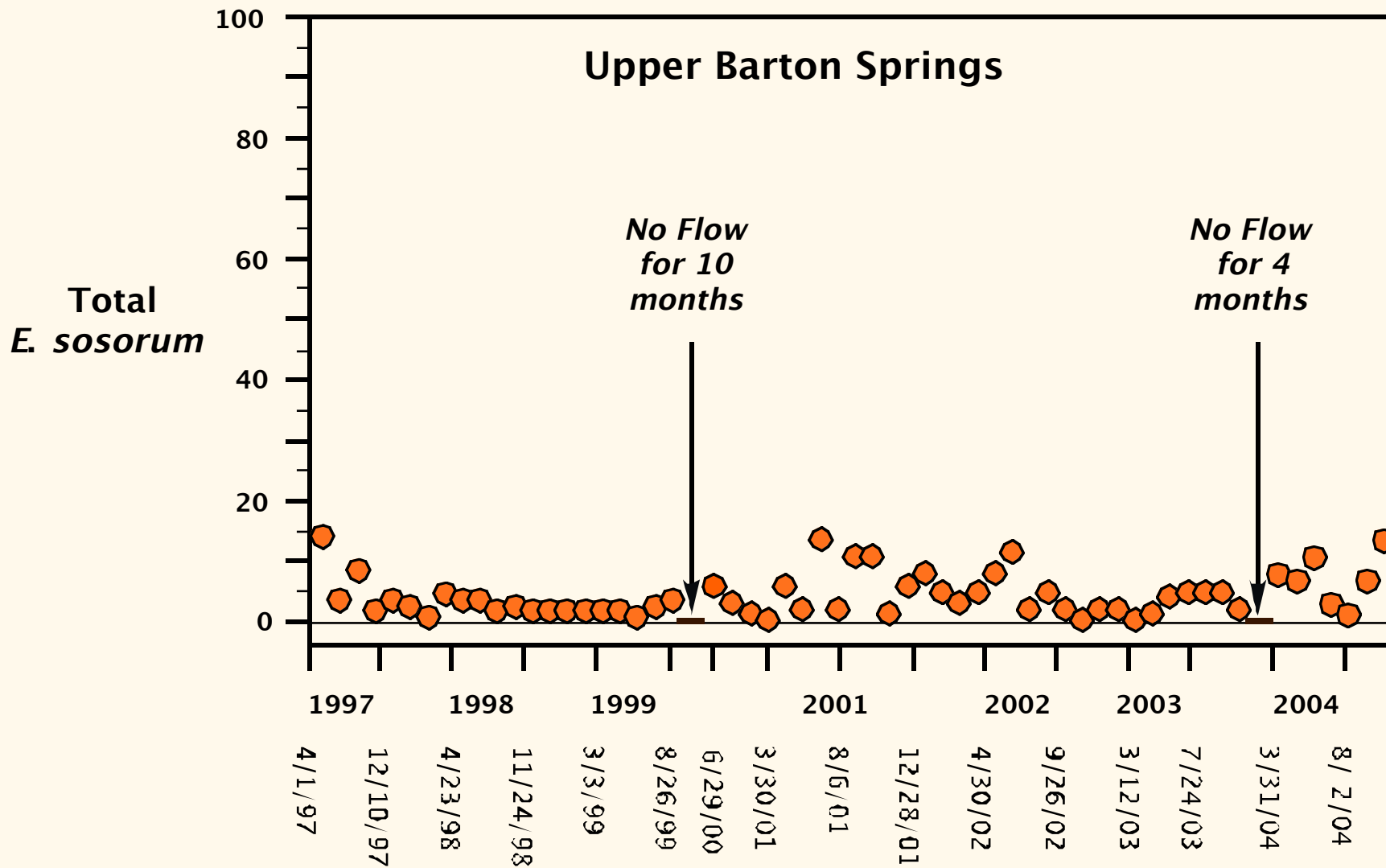
Eliza Spring

Salamander Density 2003 - 2007

No. *E. sosorum* /
sq. meter



Salamander Counts 1997 - 2004





All Endangered, Threatened, and Candidate *Eurycea* and *Typhlomolge* Live in the Edwards Aquifer of Texas.

Systematic Biology

A JOURNAL OF THE
Society of Systematic Biologists

E. tridentifera



E. pterophila



T. rathbuni

E. naufragia

E. chisholmensis



E. troglodytes

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