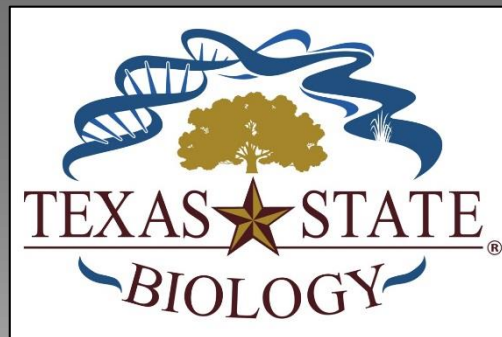


# Evaluation of long-term temperature and low dissolved oxygen tolerances of larvae and adult Comal Springs riffle beetle

Dr. Weston Nowlin

and

Dr. Benjamin Schwartz



# CSRB and Spring Flows



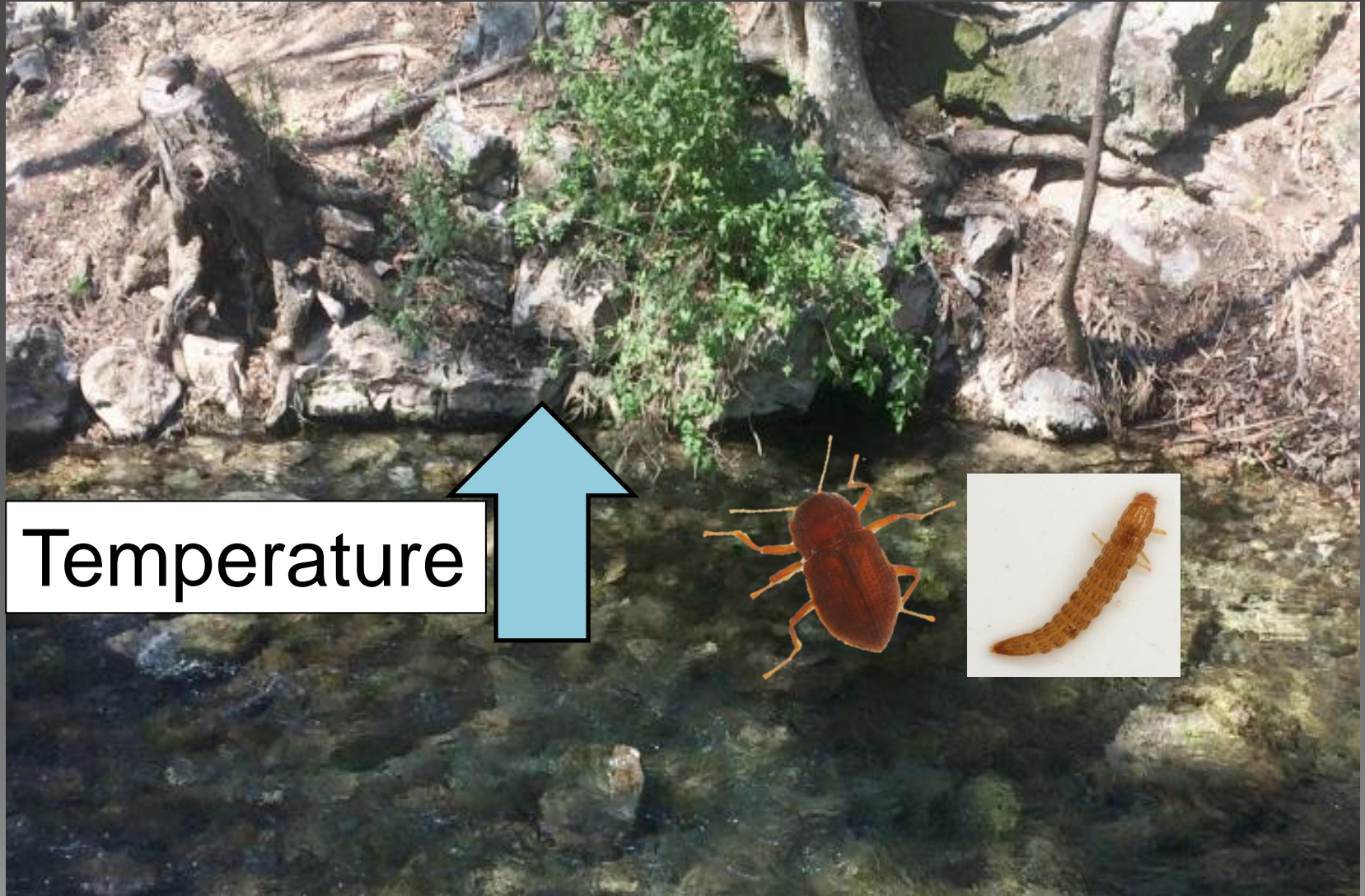


# CSRB and Spring Flows





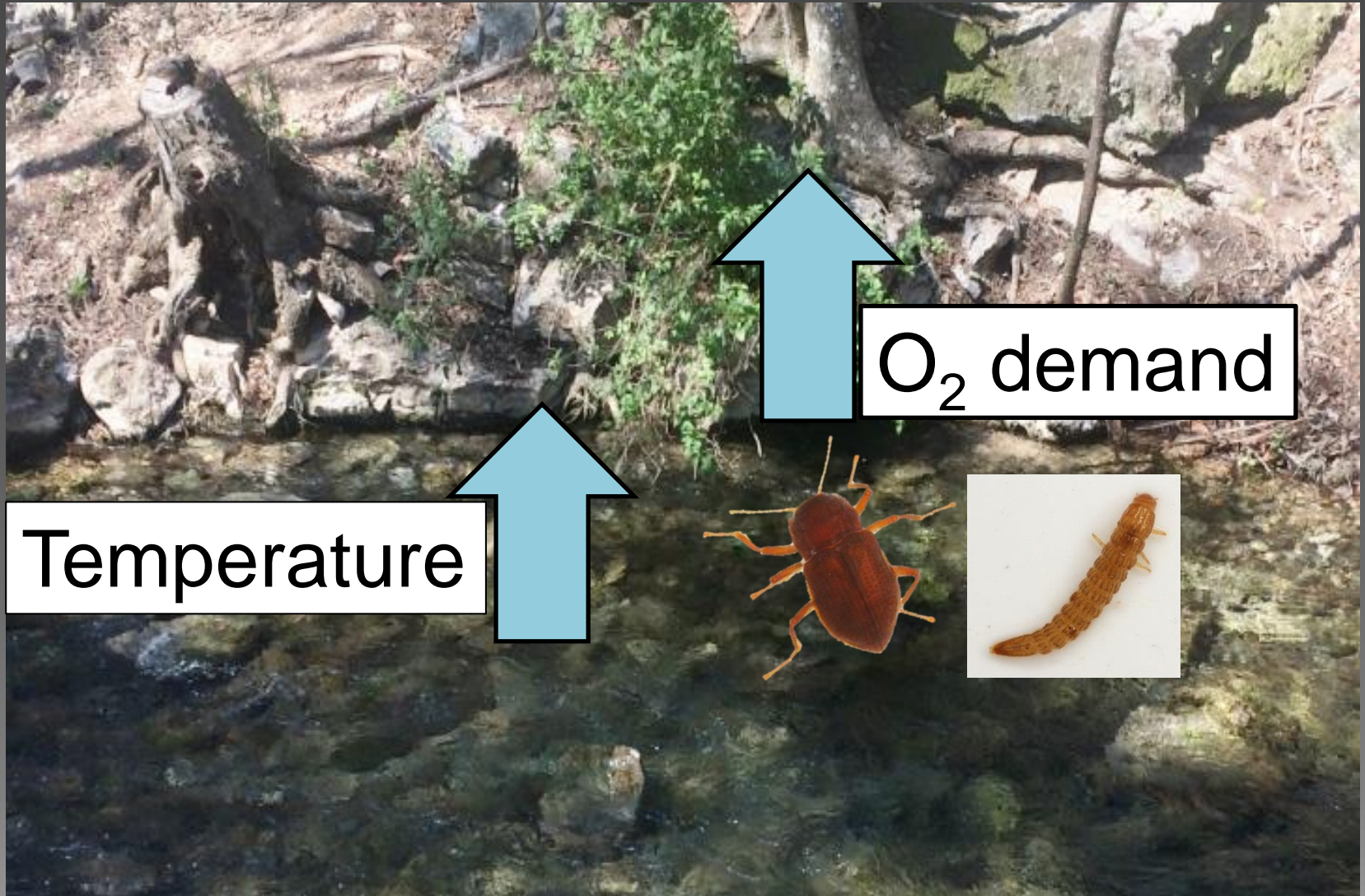
# CSRB and Spring Flows



Temperature



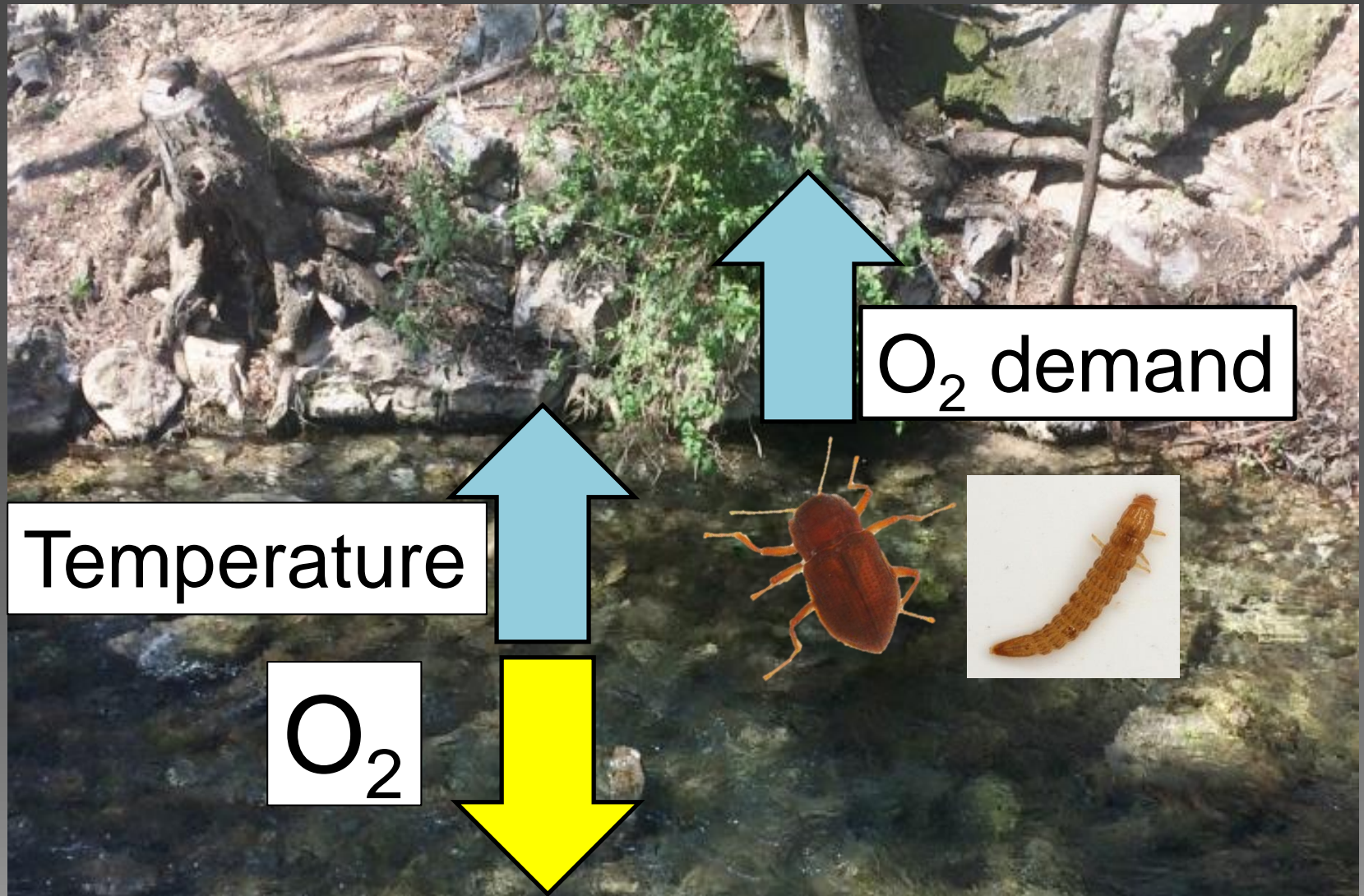
# CSRB and Spring Flows



Temperature

O<sub>2</sub> demand

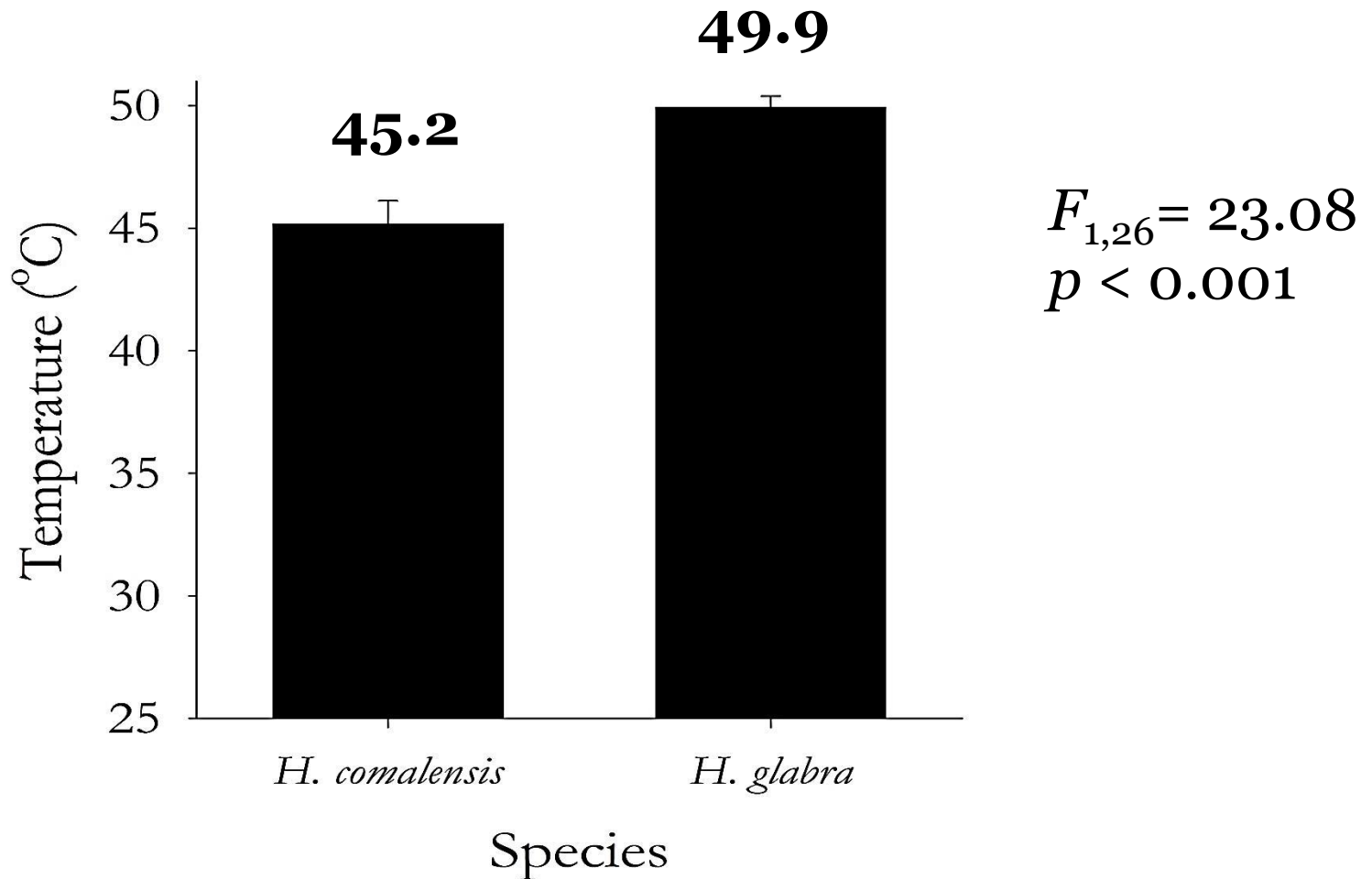
# CSRB and Spring Flows





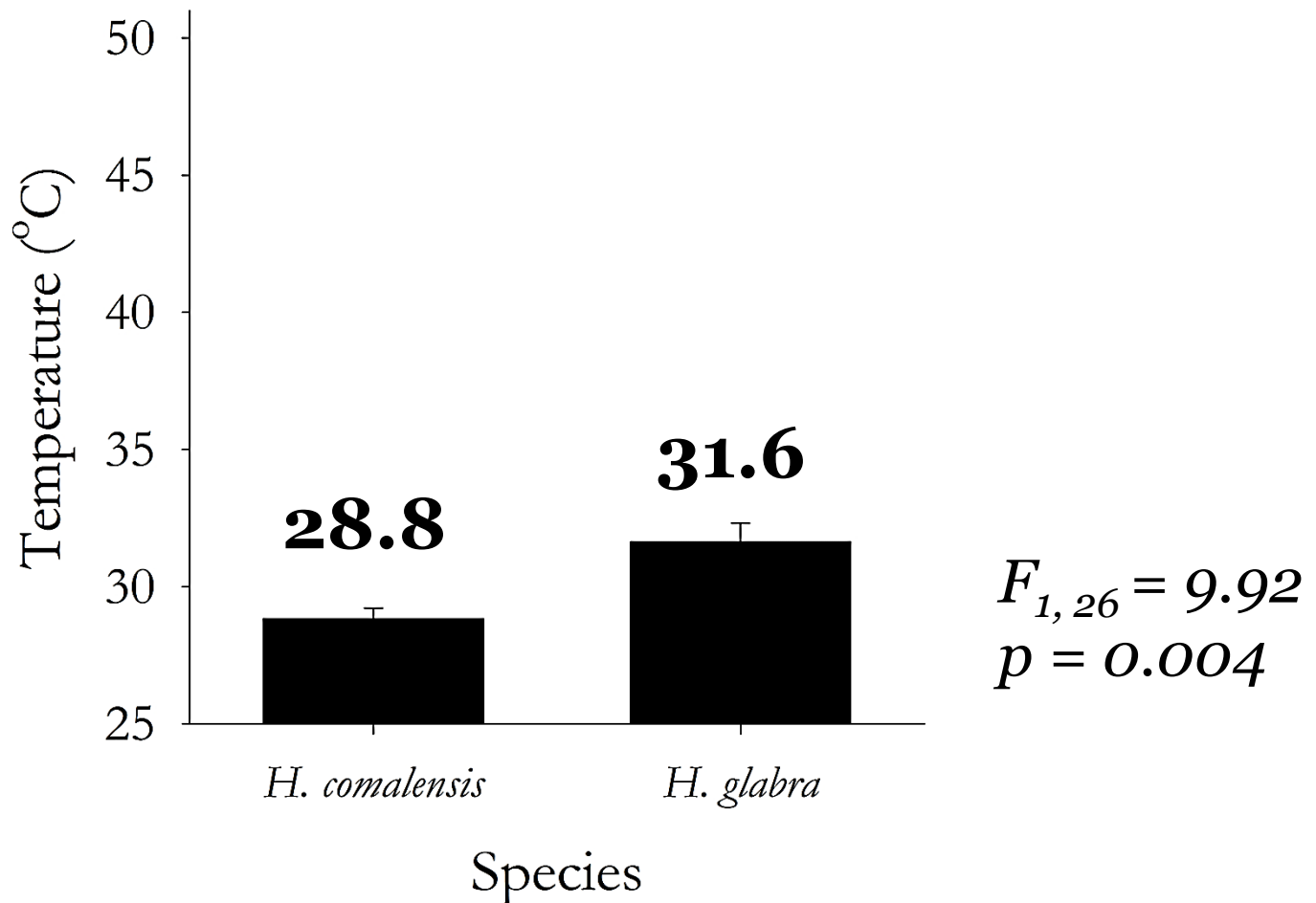
# Short-Term Temperature Responses

LOR



# Short-Term Temperature Responses

## Rapid movement

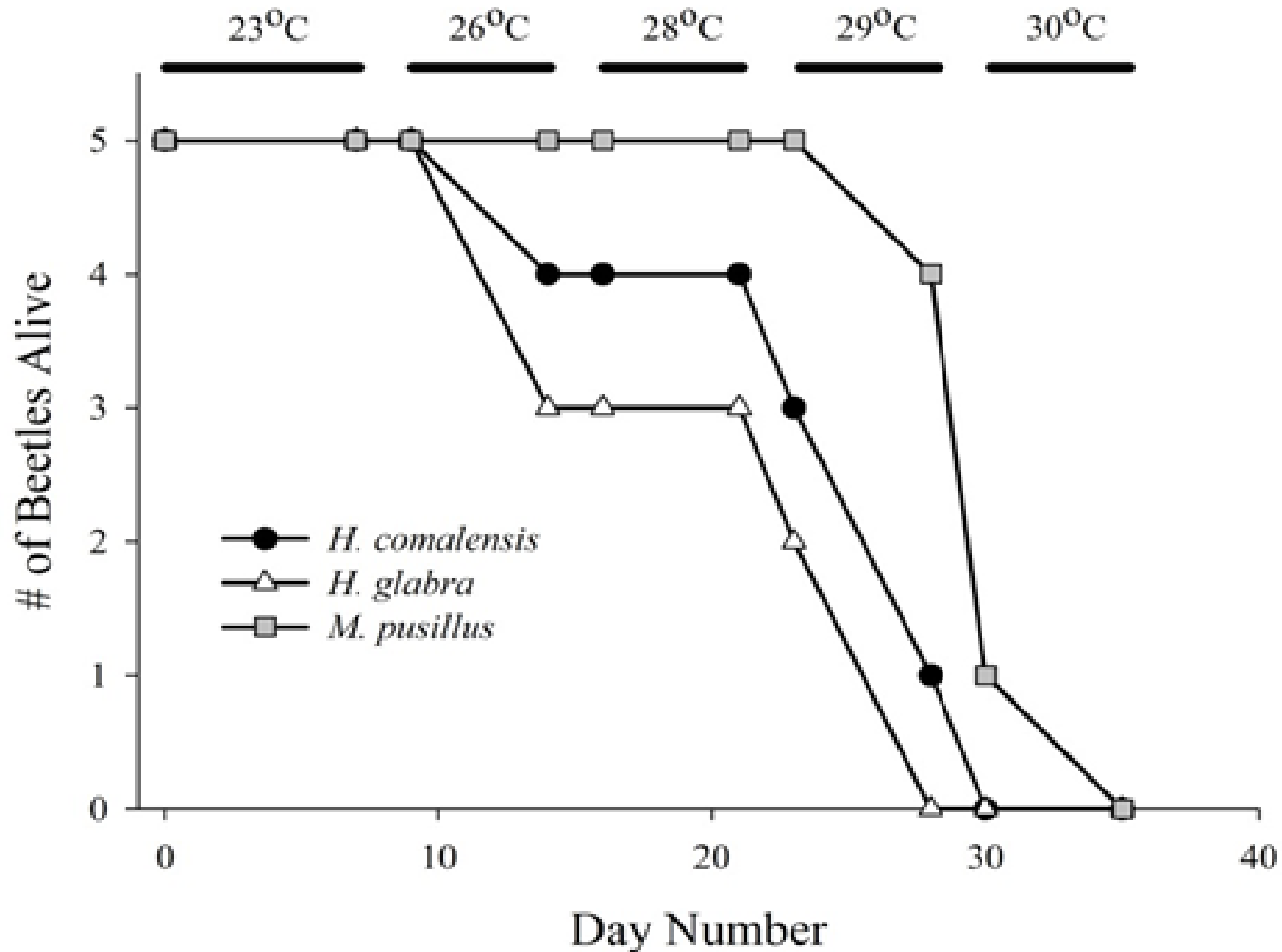




# Long-Term Study Results

- Performed on *H. glabra* only
  - Gradually changed condition over 24-h period
  - Temperature LOR at 36.3<sup>0</sup>C
  - DO LOR at 0.48 mg/L after about 10 hours of exposure

# Gradually Increasing Temperatures Habitat Connectivity Study





# Study Objectives

- Examine individual and combined roles of relatively long-term increases temperatures and declines in DO concentrations.
- Compare long-term temperature and DO response among Elmid species that differ slightly in habitat associations
- Explore use of non-listed surrogate species

*H. comalensis*



*H. glabra*



*H. vulnerata*

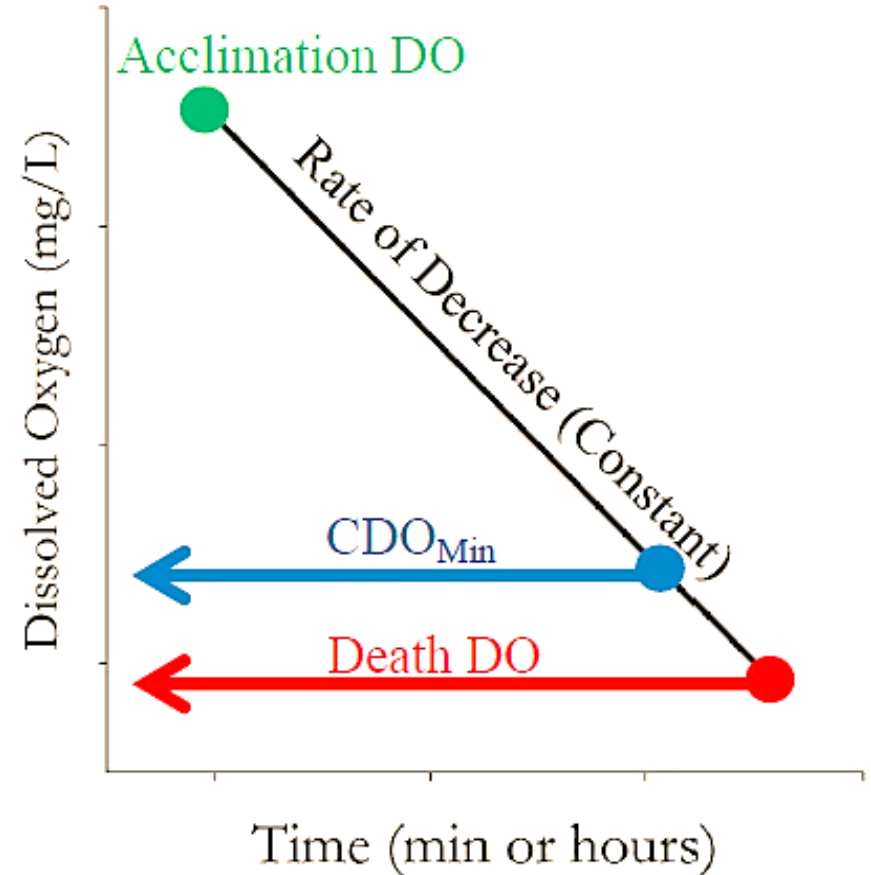
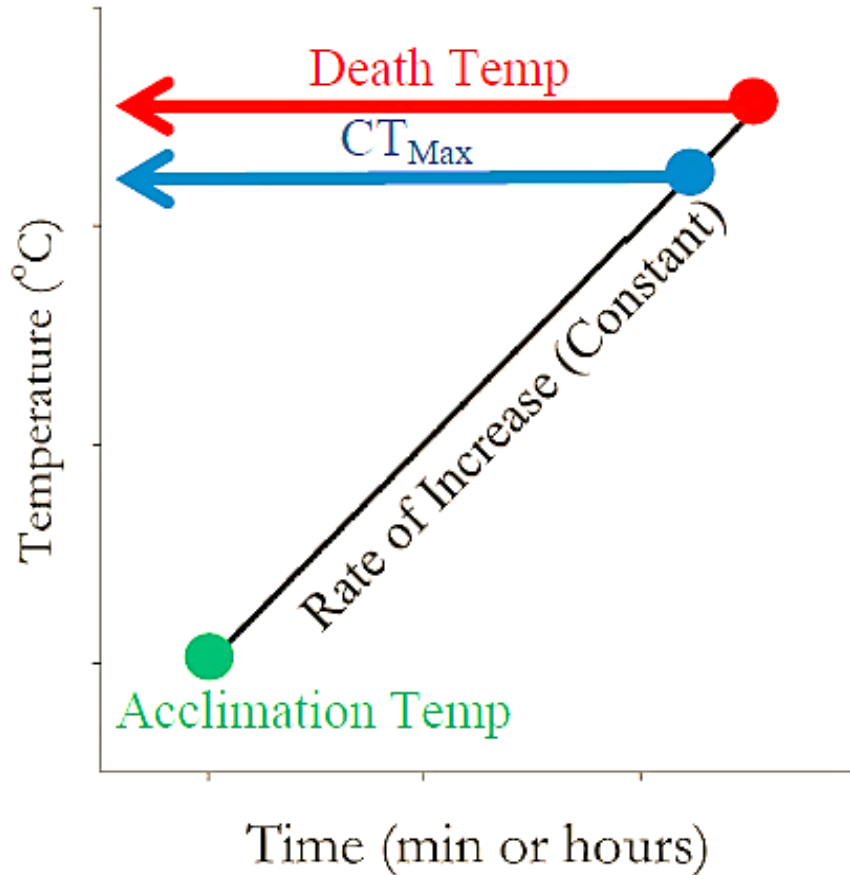




# First Set of Experiments

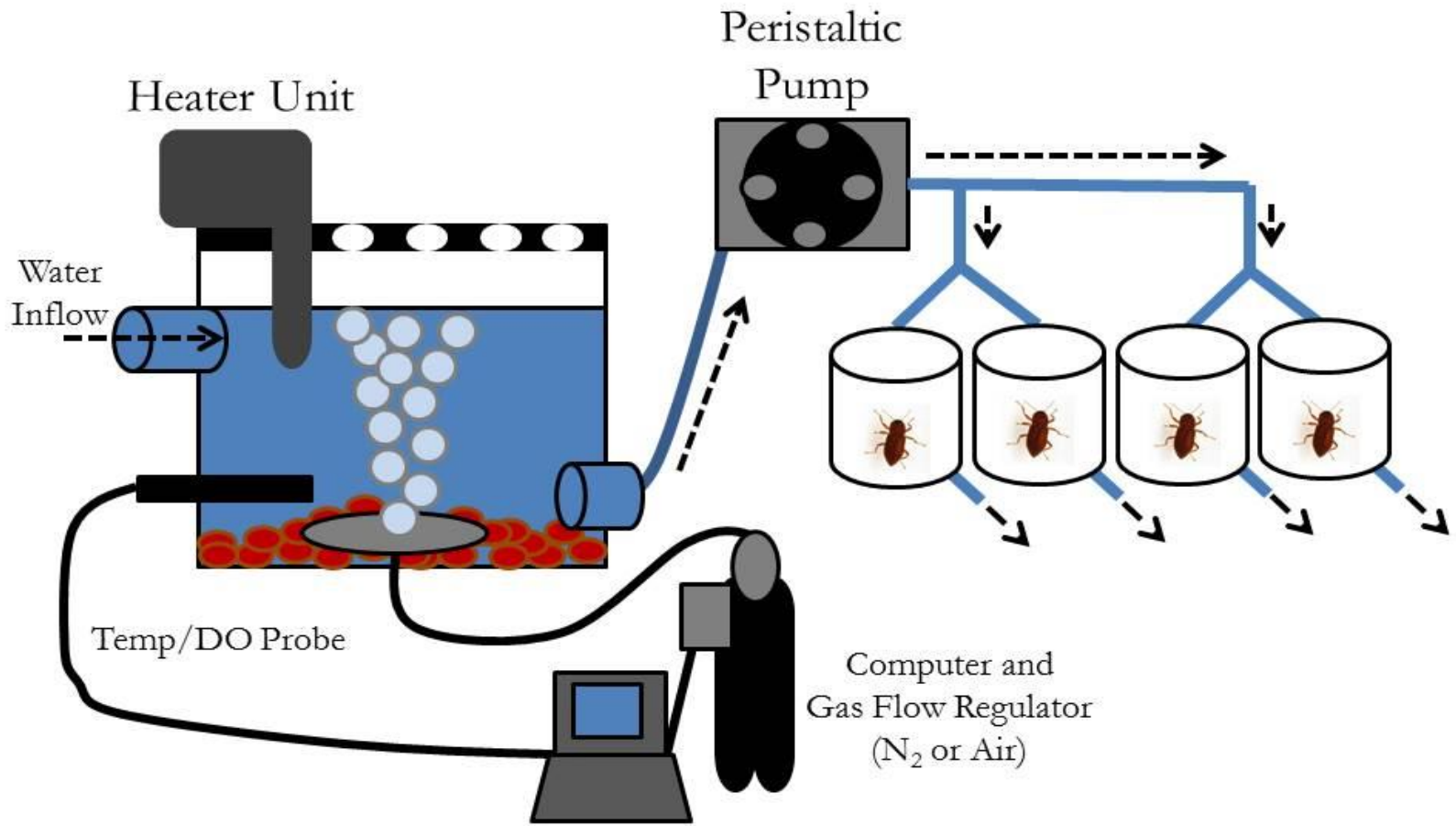
- Assess LOR responses to *H. comalensis* to relatively slow changes in temperature and DO over a 24-h period
  - “False positive” rates for LOR is not a concern
  - Really not an LOR... They stop all activity and curl up
- Utilize the same experimental set-up and methods as the previous study with *H. glabra*
- Given the ambient DO concentration (4 mg/L) and temperature 23°C, allowing DO to “drift” with temperature in experiments not realistic
  - Undersaturated DO at 23°C

# Critical Threshold Methodology





# Critical Threshold Experiments



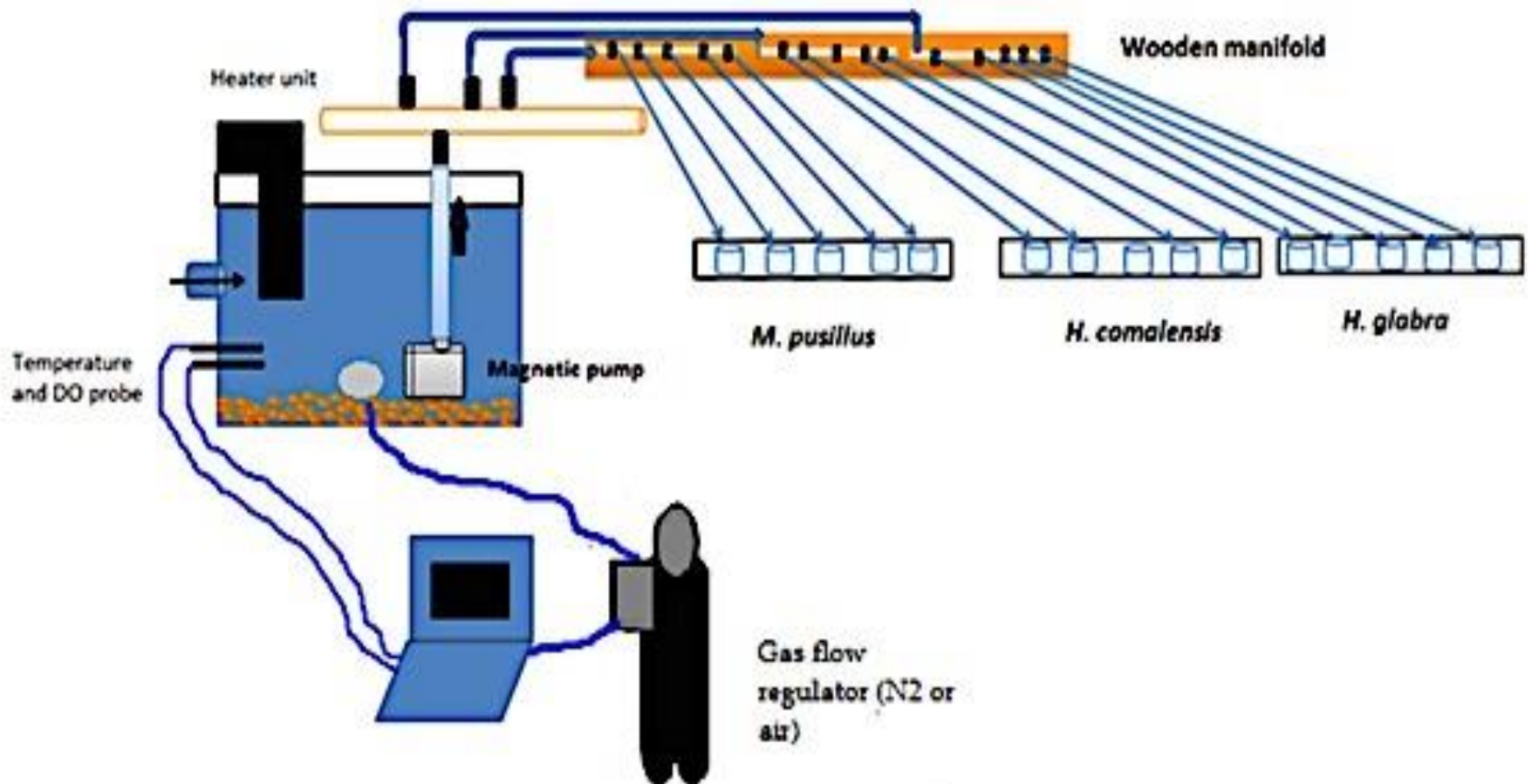
# Data Analysis

- Critical temperature and DO thresholds will be determined with observed LOR
- Differences among life stages (adult *vs* larvae) for DO and temperature endpoints will be assessed with one-way ANOVA

# Second Set of Experiments

- Assess adult and larval *H. comalensis* to long-term and persistent conditions to determine how survival and performance is affected by persistent high temperatures or DO
- Compare to several other species of riffle beetles
  - Spring-associated and surface water-associated
- Slowly acclimate to a temperature or DO and hold at conditions for ~2 month period
- 23, 26, 29, 32°C
- 4, 3, 2, 1 mg DO/L

# Long-Term Survival and Stress at Various Temperatures





# Data analysis

- Compare % survival of beetles across the various temperature or DO concentrations at the end of the experimental period using one-way ANOVA
- Compare responses to temperatures reported in the literature (Harpster 1941, 1944)

# Comal Springs Data Analysis

- Review of 14 years of Comal temperature and DO data from the Biological Monitoring program.
- Establish the natural and observed range in temperatures and DO in the system during different flow conditions
- Compare it to Critical Thresholds observed in experiments and the temperature- and DO-survival data obtained in second set of experiments



