# *Environmental Threats to the Barton Springs Salamander*

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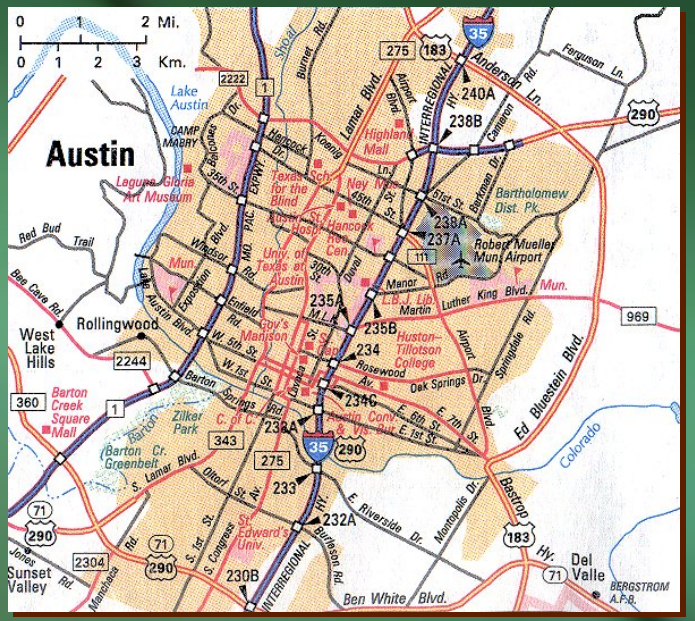
# *What is the Barton Springs Salamander?*

- Member of the Plethodontidae family (lungless salamander)
- Aquatic and neotenic; retains larval, gill-breathing morphology for entire life
  - Does not metamorphose
  - Does not leave water

# *Threats to the Barton Springs Salamander*

- Listed as an endangered species since 1997 for the following reasons
  - Degradation of the quality and quantity of water that feeds Barton Springs
  - Modification of the surface habitat
  - Inadequacy of measures to protect the salamander and the water source
  - Extreme vulnerability to environmental degradation

# *Why is it endangered?*




- Barton Springs is located in a highly dense, urban area
- It consists of four springs connected via an aquifer-fed system
- Specific habitat needs
  - Hydrology - regulated water flow and water content
  - Surface - perennially flowing spring water that is clean, clear, well-oxygenated, neutral (pH near 7) with temperature between 70-72°F; need clean, loose substrate to live in
  - Diet - small live invertebrates that live in this substrate

# *Importance of Water Flow*

- Quality, quantity and speed of water flow must be balanced for survival of the salamander
  - Water must move across gills and body to breathe
  - Eggs must be oxygenated for embryonic development
  - Clean, moving water allows for maintenance of invertebrate diet
  - Reproduction occurs by the use of clean plants and rocks
  - First three months are critical to juvenile survival and growth
- Without habitat heterogeneity, water quality, adequate space, stable environmental conditions and food availability the salamander *will be incapable of reproduction*

# *Factors Contributing to Endangered Status*

## -Water Quality-

- Normal conditions: physical, chemical and biological means purify the water
- High precipitation: storm runoff brings sediment, fertilizer nutrients and chemicals
  - pesticides, petroleum hydrocarbons, heavy metals
- Urbanization creates impervious surfaces (pavement, buildings, sidewalks) - these prevent natural percolation of runoff water
  - In addition to water pollution, erosion and siltation are frequent occurrences
- In areas of limited natural buffers at the surface level there is little chance for natural improvement of the water quality and thus the runoff is extremely harmful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## -Water Quality-

- Dissolved oxygen - necessary for egg development; median concentration has been declining for year, from 6.8 mg/L down to 4.1 mg/L
- Conductivity - used to approximate salinity of terrestrial and aquatic environments, which indicates internal water balance
  - High conductivity has detrimental effects on the Barton Springs Salamander, with 100% mortality resulting in just 24 hours when conductivity reaches 1145µS/cm
  - Influenced by anthropogenic factors; current level is between 566-867µS/cm and trends indicate rising levels
- Supersaturation - supersaturated water can contain dissolved atmospheric gases in concentrations greater than 100%, and these contaminants alter an organism's tolerance to supersaturation

# *Factors Contributing to Endangered Status*

## -Water Quality-

- Sediments - act as sinks for contaminants and erosion washes the debris into the water body
  - Often contain petroleum hydrocarbons, pesticides, and PAHs
  - Habitat deletion, clogging gills, reduction of food sources, vision obstruction
- Nutrients - excessive nutrients make algal blooms die, which deoxygenates the water
  - Industrial pollutants, human and animal waste, fertilizers
- Heavy Metals - toxic concentration levels
  - Metal corrosion, paint flaking, vehicle wear, deicing salts, construction sites
- Pesticides - those that do not degrade rapidly can result in morphological and developmental aberrations
- Domestic Wastewater - contribute pharmaceuticals, bacterial pathogens, and toxic contaminants to spring water
  - Septic tanks, sewage collection systems, irrigation with treated wastewater
- Transportation - trash, oil, grease, accidental spills to water sources

# *What's next?*

- BMPs: Best Management Practices
- Methods determined to be most effective and practical for prevention and reduction of pollution
  - Public information programs, street sweeping, structural controls

# Conservation Measures

- Land acquisition and conservation easements - City of Austin purchased land in the contributing and recharge zones
  - Preserves land, protects water quality from urbanization
- Water Quality Protection Recommendation - guidelines established and distributed to protect water sources
  - Minimize water degradation from established and new developments
- HCP - implemented to avoid, minimize, and mitigate any incidental take from the salamander that result from operation and maintenance of the Barton Springs Pool
- Habitat Restoration - drainage infrastructure cleaned, sediments flushed and aquatic plants transplants from upper Barton Springs to other connected springs
  - This has also reduced the populations of fish that are predatory to the Barton Springs Salamander, while increasing the salamander population

# *Potential Impacts*

*if further steps are taken to save the Barton Spring Salamander…*

- Recreational access
- Pool maintenance
- Installation of a pump system