Introduction

• The Edwards Aquifer
  – Artesian aquifer system provides drinking water and recreational water sources to San Antonio, Austin, San Marcos, New Braunfels
  – Recharge and contributing zones are generally associated with the Texas Hill Country
  – Springs provide habitat for several endangered species
## Endangered Springs Species

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Binomen</th>
<th>Listing Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fountain darter</td>
<td><em>Etheostoma fonticola</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>San Marcos gambusia</td>
<td><em>Gambusia georgei</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Texas blind salamander</td>
<td><em>Typhlomolge rathbuni</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Comal Springs riffle beetle</td>
<td><em>Heterelmis comalensis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Comal Springs dryopid beetle</td>
<td></td>
<td></td>
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<tr>
<td>Peck’s Cave amphipod</td>
<td><em>Stygobromus pecki</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Texas wild rice</td>
<td><em>Zizania texana</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>San Marcos salamander</td>
<td><em>Eurycea nana</em></td>
<td>Threatened</td>
</tr>
</tbody>
</table>
EAA HCP

- Edwards Aquifer Authority (EAA) Habitat Conservation Plan (HCP) February 2013
  - Supports Incidental Take Permit for activities associated with regulating and pumping of groundwater from the Edwards Aquifer
  - Developed through a stakeholder consensus process (utility, environmental, municipal, agricultural, industry)
  - Permit holders:
    - Edwards Aquifer Authority
    - San Antonio Water System
    - City of San Marcos
    - City of New Braunfels
    - Texas State University
Rehabilitation Activities

- City of New Braunfels
  - Old channel restoration
  - Flow split management
  - Aquatic vegetation restoration
  - Non-native animal species control
  - Decaying vegetation removal
  - Restoration of riparian zones and riffle beetle habitat improvement
  - Gill parasite control
  - Household hazardous waste program
  - Litter control and floating vegetation management
  - Golf course management plan
Into the Water We Go!
Invasive Species Removal

- Giant ramshorn snail (*Marisa cornuarietis*)
- Armored catfish (*Pterygoplichthys disjunctivus*)
- Tilapia (*Oreochromis aureus*)
- Nutria (*Myocastor coypus*)
Primary Ecosystem Concerns

• Degradation of shoreline habitat – nutria
• Damage to native vegetation – all
• Displacement of native fishes – tilapia, armored catfish
• Consumption of endangered species – all
• Competition with endangered species – all
Removal Methods

- Nutria – live trapping and culling
- Armored catfish – spear fishing
- Tilapia – fyke nets and spear fishing
- Ramshorn snails – hand gathering
Progress to Date

- Reduced detection of exotics
- Removal of ≈3.0 tons of biomass
- Increased detection of natives fish species

<table>
<thead>
<tr>
<th>Species</th>
<th>Number Removed</th>
<th>Mass (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilapia</td>
<td>2,250</td>
<td>2,112.0</td>
</tr>
<tr>
<td>Armored catfish</td>
<td>391</td>
<td>424.4</td>
</tr>
<tr>
<td>Nutria</td>
<td>40</td>
<td>220.34</td>
</tr>
<tr>
<td>Giant ramshorn snails</td>
<td>1,182</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,863</strong></td>
<td><strong>2,764.44</strong></td>
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</tbody>
</table>
Thanks

- City of New Braunfels
- Edwards Aquifer Authority
- SWCA team members