

# A Multi-Disciplinary Approach to Saving One of the Last Great Wild Rivers in Texas

Sarah Robertson



Have you ever been to the Devils River?

A. Yes

B. No



The Devils River



An aerial photograph of a river with exceptionally clear water, revealing a rocky and vegetated riverbed. The river flows through a lush green landscape with dense vegetation on the banks. In the distance, rolling hills are visible under a cloudy sky. Two small kayakers are seen paddling down the river, providing a sense of scale.

*"The most pristine river in Texas"*

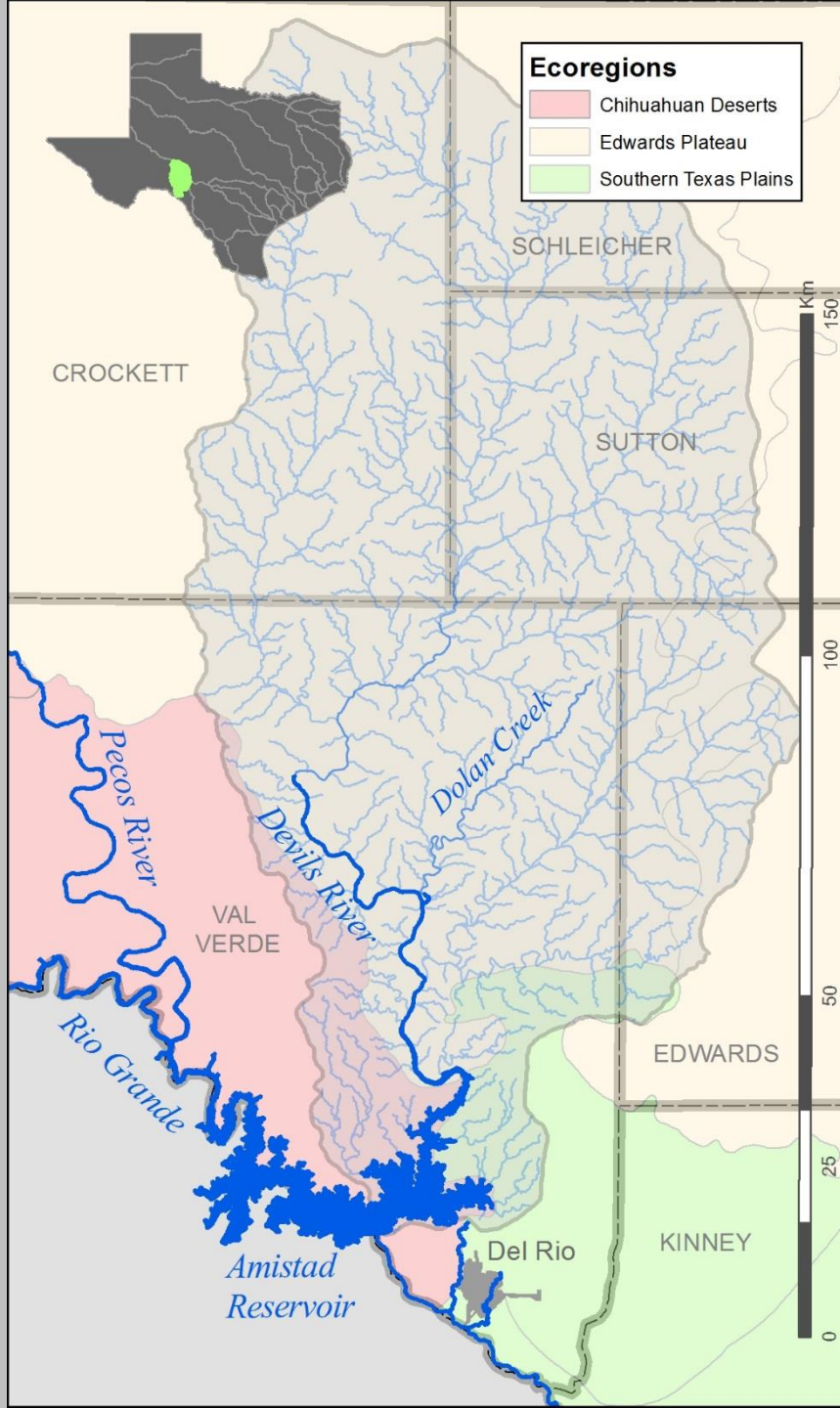
*Wilderness paddling experience*

*Ecologically diverse*

*Top bass fishing experience*

*Spring-fed, crystal clear*





# Devils River

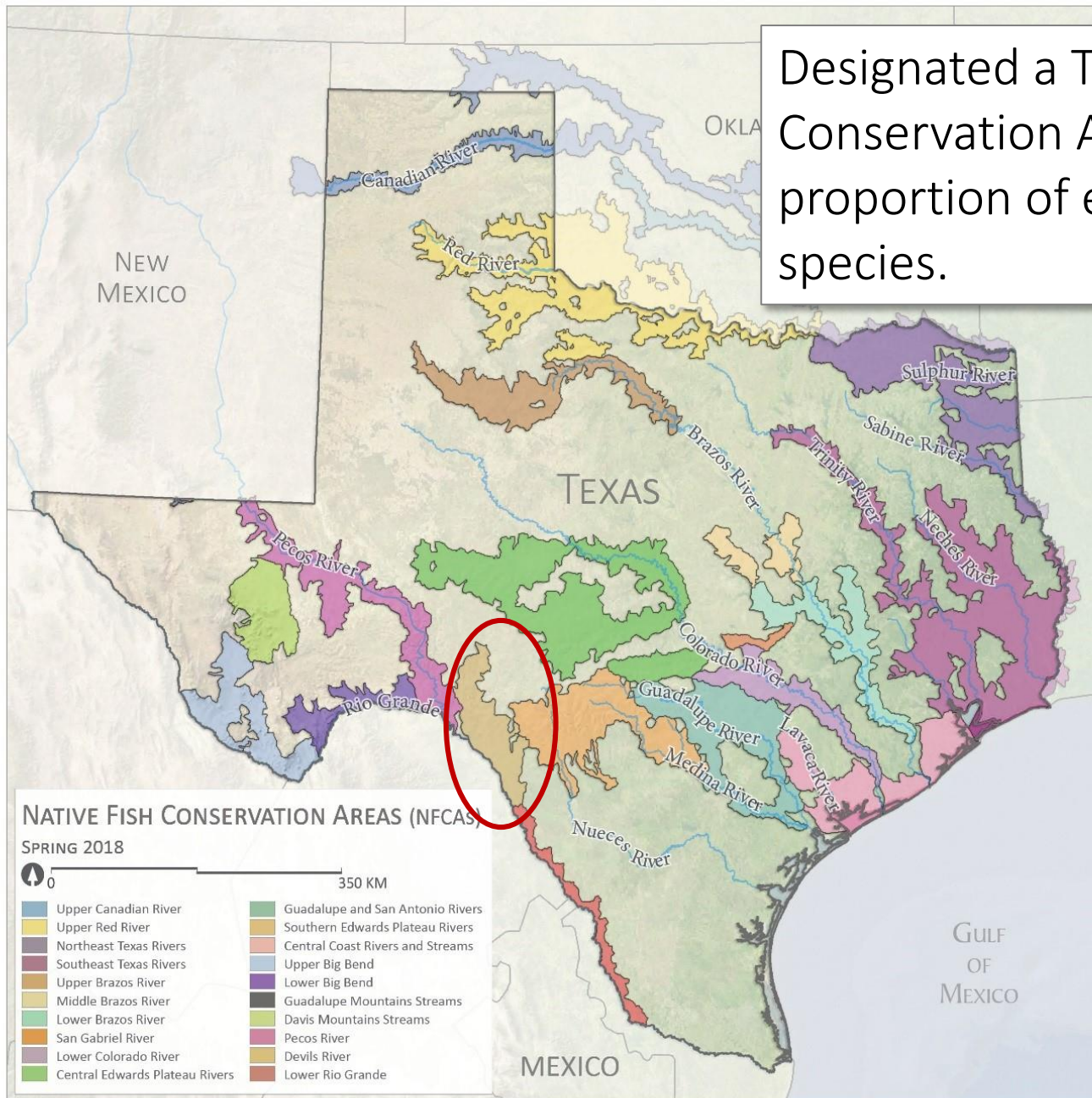
- 90 miles total, with 60 perennially flowing miles
- 197,000 acre-ft/year
- Numerous springs along its length
- Important water source for Lake Amistad and the Lower Rio Grande Valley
- Occurs at the nexus of three ecoregions

How many state threatened or endangered species call the Devils River home?

- A. 1
- B. 2
- C. 3
- D. 4
- E. Over 5



Designated a TPWD Native Fish Conservation Area due to high proportion of endemic fish species.



# Fishes of the Devils River



**Longnose Gar**  
*Lepisosteus osseus*



**Spotted Gar**  
*Lepisosteus oculatus*



**Central Stoneroller**  
*Camptostoma anomalum*



**Blacktail Shiner**  
*Cyprinella venusta*



**Proserpine Shiner**  
*Cyprinella proserpina*



**Manantial Roundnose Minnow**  
*Dionda argentosa*



**Devils River Minnow**  
*Dionda diaboli*



**Texas Shiner**  
*Notropis amabilis*



**Sand Shiner**  
*Notropis stramineus*



**Bullhead Minnow**  
*Pimephales vigilax*



**Gizzard Shad**  
*Dorosoma cepedianum*



**Common Carp**  
*Cyprinus carpio*



**River Carpsucker**  
*Carpoides carpio*



**Gray Redhorse**  
*Moxostoma congestum*



**Mexican tetra**  
*Astyanax mexicanus*



**Rio Grande Darter**  
*Etheostoma grahami*



**Headwater Catfish**  
*Ictalurus lupus*



**Channel Catfish**  
*Ictalurus punctatus*



**Flathead Catfish**  
*Pylodictus olivarius*



**Mosquitofish**  
*Gambusia sp.*



**Sailfin Molly**  
*Poecilia latipinna*



**Conchos Pupfish**  
*Cyprinodon eximius*



**Green Sunfish**  
*Lepomis cyanellus*



**Longear Sunfish**  
*Lepomis megalotis*



**Redear Sunfish**  
*Lepomis microlophus*



**Bluegill**  
*Lepomis macrochirus*



**Redbreast Sunfish**  
*Lepomis auritus*



**Redspotted Sunfish**  
*Lepomis miniatus*



**Largemouth Bass**  
*Micropterus salmoides*



**Smallmouth Bass**  
*Micropterus dolomieu*



**Blue Tilapia**  
*Oreochromis aureus*



**Rio Grande Cichlid**  
*Herichthys cyanoguttatus*



# Devils River

## Species of Greatest Conservation Need



# Devils River State-Threatened Species

Devils River Minnow



Texas Hornshell



Conchos Pupfish



Proserpine Shiner



Rio Grande Darter



Texas Shiner



Manantial Roundnose  
Minnow



Headwater Catfish





# Devils River Federally-Listed Species

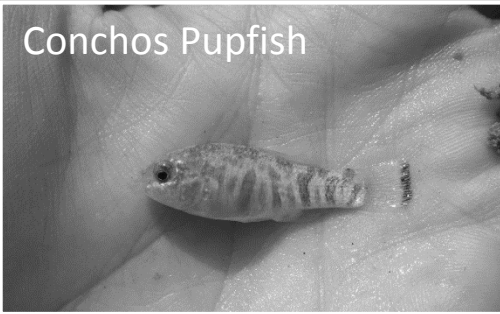
Devils River Minnow (FT)



Texas Hornshell (FE)



Conchos Pupfish



Proserpine Shiner



Rio Grande Darter



Texas Shiner



Manantial Roundnose  
Minnow



Headwater Catfish



# Other Devils River Threatened, Endangered Species





## Other Notable Species



Monarch Butterfly  
Migration Path



One of the largest  
Mexican Free-tail  
Bat Colonies at  
Fern Cave



Threats



What factors are threatening the future of the Devils River?

- A. Groundwater pumping
- B. Invasive species
- C. Unsustainable recreation
- D. All of the above

# Threats to the Devils River



Invasive Species



Habitat Loss



Poor stewardship





# Threats to the Devils River



Invasive Species



Habitat Loss



Poor stewardship



# Threats to the Devils River



Invasive Species



Habitat Loss



Poor stewardship





# Threats to the Devils River

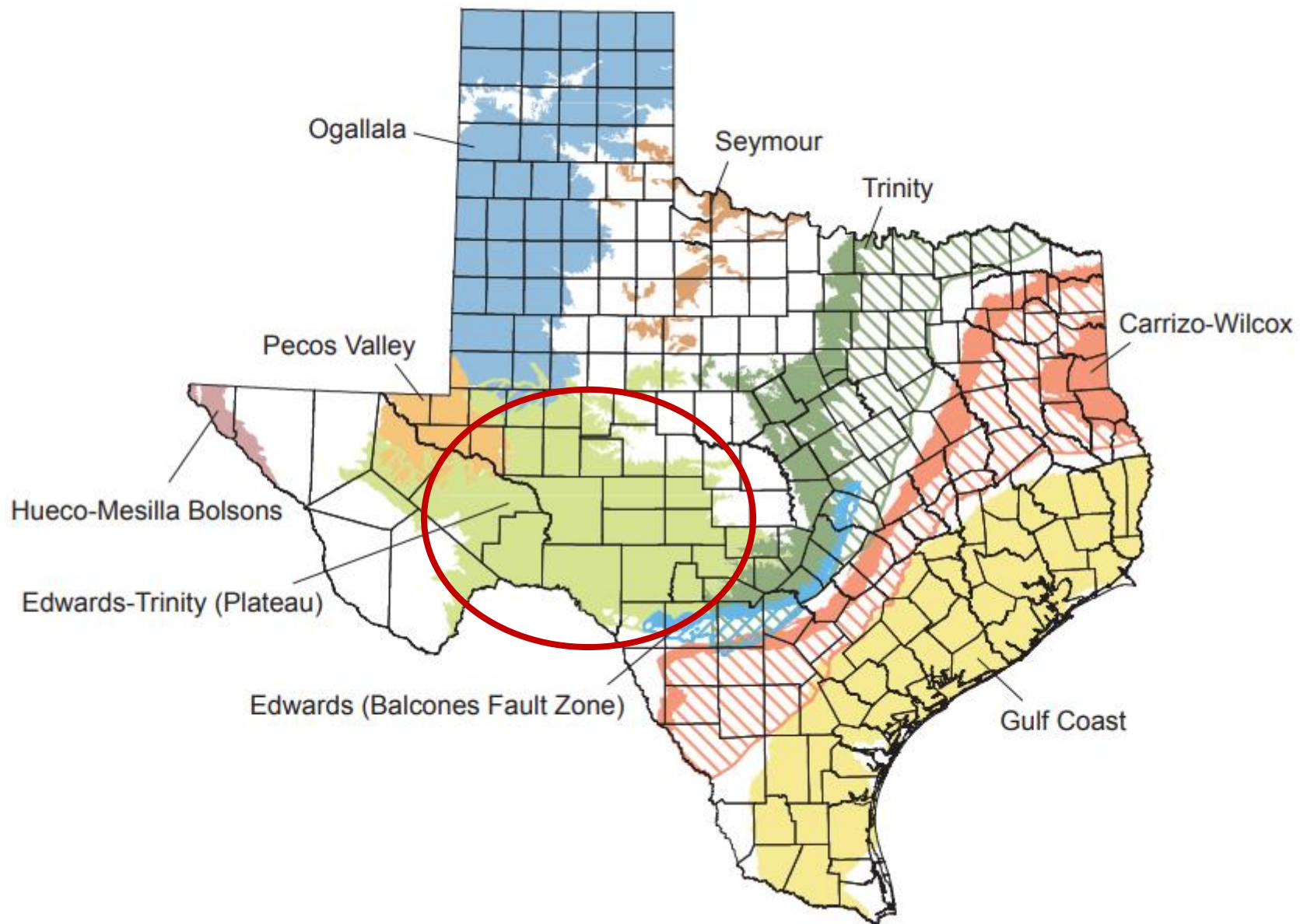


The most immediate and least understood threat to the river is large-scale groundwater pumping.

What aquifer provides baseflows to the Devils River?

- A. Carrizo-Wilcox
- B. Edwards Trinity
- C. Ogallala





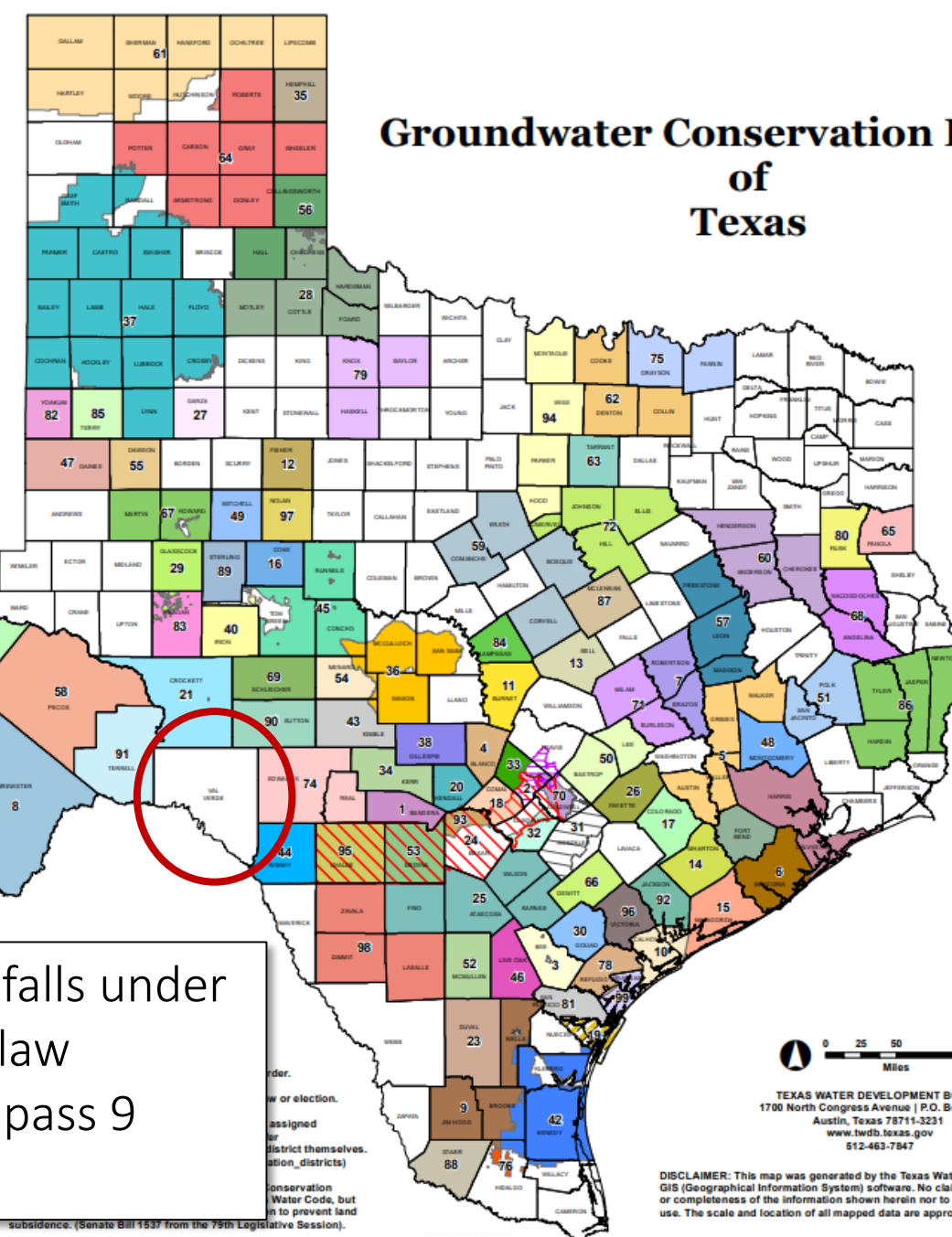
# Confirmed Groundwater Conservation Districts \*

1. Bandera County River Authority & Ground Water District - 11/7/1989
2. Barton Springs/Edwards Aquifer CD - 8/13/1987
3. Bee GCD - 1/20/2001
4. Blanco-Pedernales GCD - 1/23/2001
5. Bluebonnet GCD - 11/5/2002
6. Brazoria County GCD - 11/8/2005
7. Brazos Valley GCD - 11/5/2002
8. Brewster County GCD - 11/6/2001
9. Brush Country GCD - 11/3/2009
10. Calhoun County GCD - 11/4/2014
11. Central Texas GCD - 9/24/2005
12. Clear Fork GCD - 11/5/2002
13. Clearwater UWCD - 8/21/1999
14. Coastal Bend GCD - 11/6/2001
15. Coastal Plains GCD - 11/6/2001
16. Coke County UWCD - 11/4/1986
17. Colorado County GCD - 11/6/2007
18. Comal Trinity GCD - 6/17/2015
19. Corpus Christi ASRCD - 6/17/2005
20. Cow Creek GCD - 11/5/2002
21. Crockett County GCD - 1/26/1991
22. Culberson County GCD - 5/2/1998
23. Duval County GCD - 7/25/2009
24. Edwards Aquifer Authority - 7/28/1996
25. Evergreen UWCD - 8/30/1965
26. Fayette County GCD - 11/6/2001
27. Garza County UWCD - 11/5/1996
28. Gateway GCD - 5/3/2003
29. Glasscock GCD - 8/22/1981
30. Goliad County GCD - 11/6/2001
31. Gonzales County UWCD - 11/2/1994
32. Guadalupe County GCD - 11/4/1999
33. Hays Trinity GCD - 5/3/2003
34. Headwaters GCD - 11/5/1991
35. Hemphill County UWCD - 11/4/1997
36. Hickory County No. 1 - 8/14/1982
37. High Plains UWCD No. 1 - 9/29/1951
38. Hill Country UWCD - 8/8/1987
39. Hudspeth County UWCD No. 1 - 10/5/1957
40. Irion County WCD - 8/2/1985
41. Jeff Davis County UWCD - 11/2/1993
42. Kenedy County GCD - 11/2/2004

## Confirmed Groundwater Conservation Districts (Cont.) \*

43. Kimble County GCD - 5/3/2002
44. Kinney County GCD - 11/2/2002
45. Lipan-Kickapoo WCD - 11/3/1987
46. Live Oak UWCD - 11/7/1989
47. Llano Estacado UWCD - 11/3/1998
48. Lone Star GCD - 11/6/2001
49. Lone Wolf GCD - 2/2/2002
50. Lost Pines GCD - 11/5/2002
51. Lower Trinity GCD - 11/7/2006
52. McMullen GCD - 11/6/2001
53. Medina County GCD - 8/26/1991
54. Menard County UWCD - 8/14/1999
55. Mesa UWCD - 1/20/1990
56. Mesquite GCD - 11/4/1986
57. Mid-East Texas GCD - 11/5/2002
58. Middle Pecos GCD - 11/5/2002
59. Middle Trinity GCD - 5/4/2002
60. Neches & Trinity Valleys GCD - 11/6/2001
61. North Plains GCD - 1/2/1955
62. North Texas GCD - 12/1/2009
63. Northern Trinity GCD - 5/15/2007
64. Panhandle GCD - 1/21/1956
65. Panola County GCD - 11/6/2007
66. Pecan Valley GCD - 11/6/2001
67. Permian Basin UWCD - 9/21/1985
68. Pinerywoods GCD - 11/6/2001
69. Plateau UWC and Supply District - 3/4/1974
70. Plum Creek CD - 5/1/1993
71. Potter County GCD - 11/6/2001
72. Pecos GCD - 11/6/2001
73. Presidio GCD - 11/6/2001
74. Real GCD - 11/6/2001
75. Real GCD - 11/6/2001
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89. Real GCD - 11/6/2001
90. Real GCD - 11/6/2001
91. Real GCD - 11/6/2001
92. Real GCD - 11/6/2001
93. Real GCD - 11/6/2001
94. Upper Trinity GCD - 11/6/2007
95. Uvalde County UWCD - 9/1/1993
96. Victoria County GCD - 8/5/2005
97. Wes-Tex GCD - 11/5/2002
98. Wintergarden GCD - 1/17/1998

- Harris-Galveston Subsidence District
- Fort Bend Subsidence District
- County Boundaries



# Groundwater Conservation Districts of Texas

- Val Verde County falls under “rule of capture” law
- GCD has failed to pass 9 times

subsidence. (Senate Bill 1537 from the 79th Legislative Session).

Groundwater Conservation District GIS Data created by the Texas Commission on Environmental Quality. For more information, please contact TCEQ at 512-239-1000 or was@tceq.texas.gov.



TEXAS WATER DEVELOPMENT BOARD  
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www.twdb.texas.gov  
512-463-7847

DISCLAIMER: This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Map date: NOV-2015

MISSION: The Texas Water Development Board's (TWDB) mission is to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.





## Devils River Could Feel Impact of Hunt for Water

Thanks to conservation efforts and its remote location, the Devils River is seen as one of the state's last pristine rivers. But change could be coming for the river, as some are eyeing its basin for new water supplies.

BY NEENA SATIJA, THE TEXAS TRIBUNE AND REVEAL NOV. 28, 2013 6 AM



The Devils River, which runs through the Dolan Falls Preserve, is known by nature enthusiasts as one of the most pristine rivers in Texas. © Leslie Boorhem-Stephenson

## Rio Grande Water Users Fear Groundwater Pumping Project

A controversial groundwater pumping plan that opponents argue could threaten the lower Rio Grande's already depleted supply is highlighting a conundrum in Texas water law.

BY NEENA SATIJA, THE TEXAS TRIBUNE AND REVEAL JAN. 29, 2014 6 AM

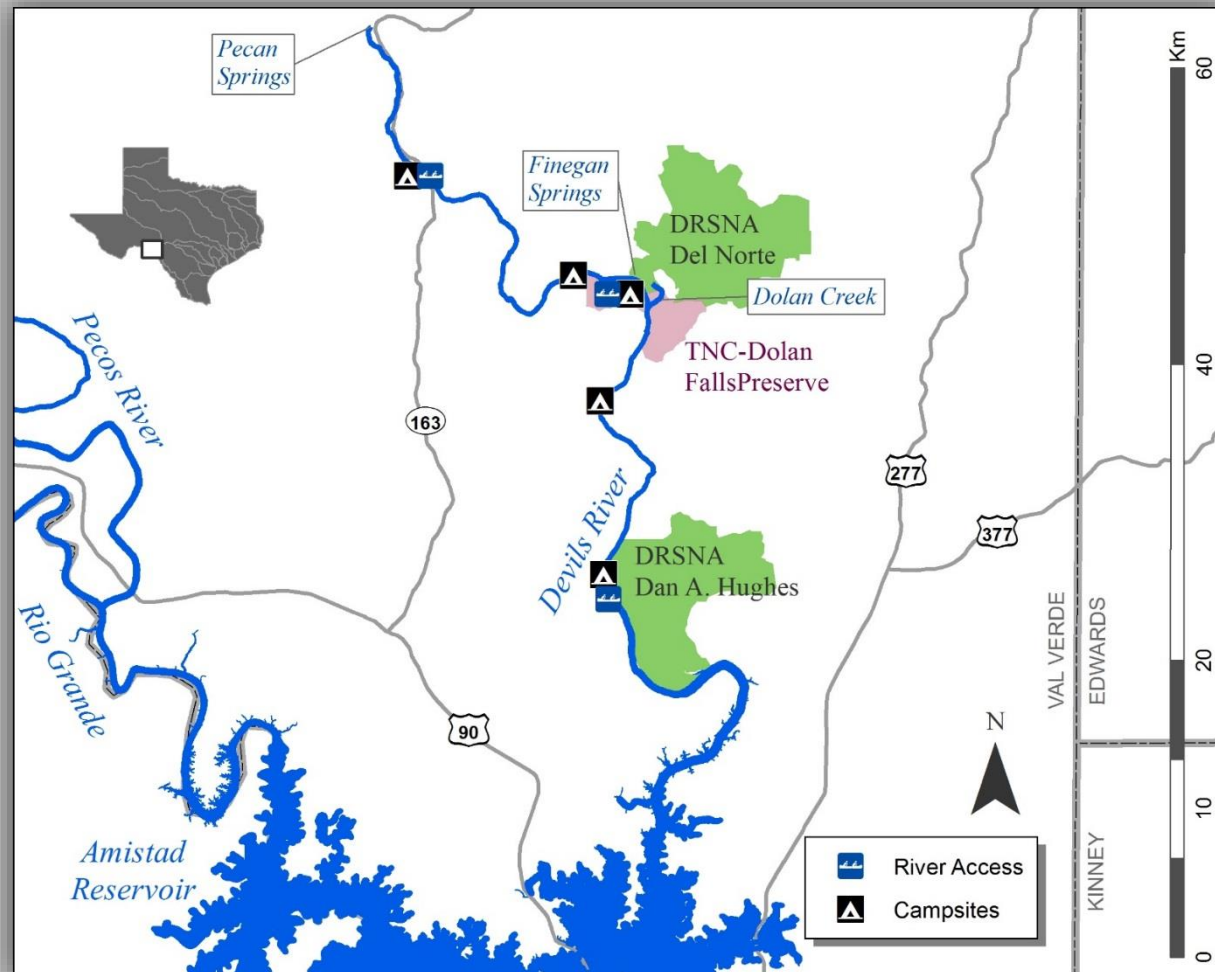


© Cal West / Todd Wiseman

- Water developers have been shopping Val Verde County groundwater to San Antonio, San Angelo, and rural West Texas counties.
- Texas House Natural Resources Committee held a public meeting September 2018 to readdress issue.
- Consensus was that action is needed and science should guide management.

# Barriers to Conservation

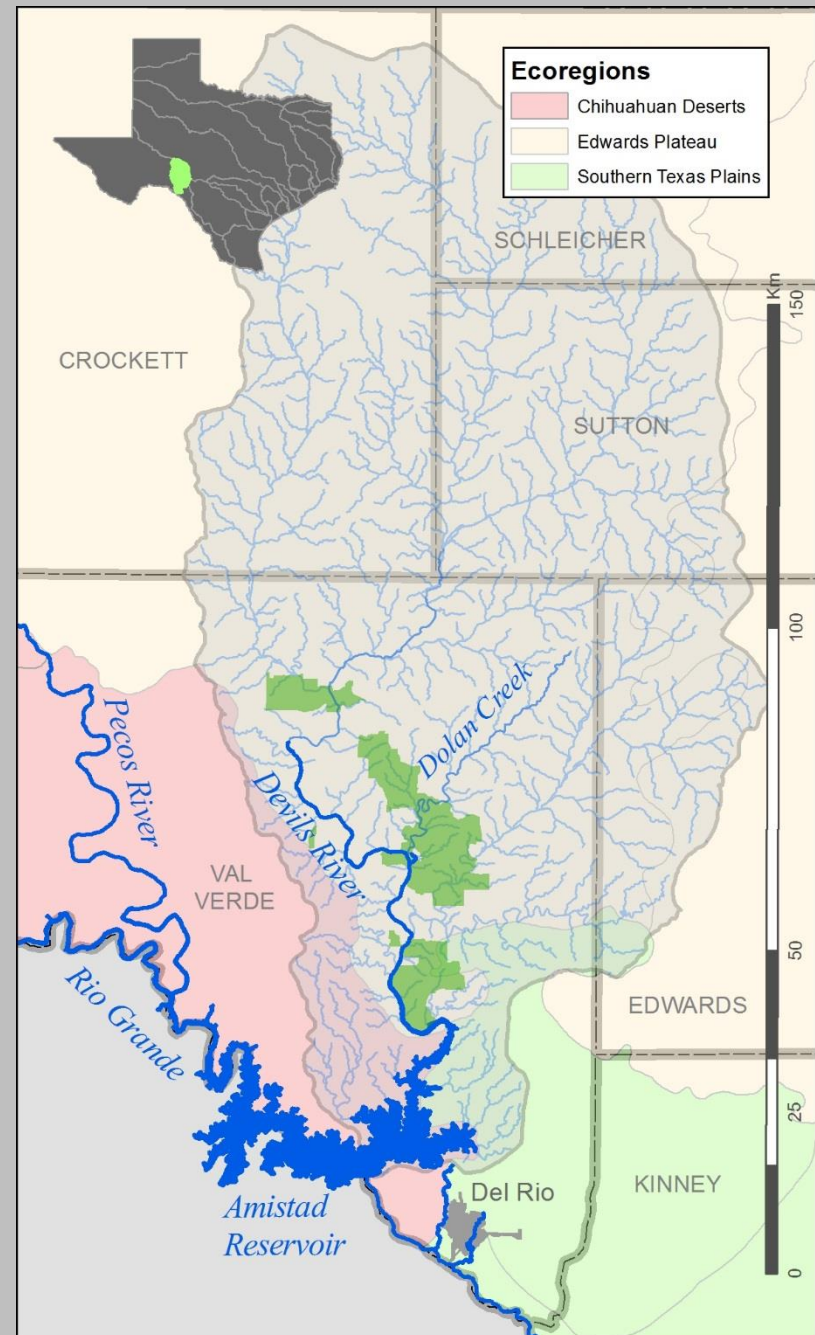
- Devils River Watershed is over 98% privately owned.
- Remote location, limited access.





# Devils River is Ideal for Conservation Investments In Other Ways

- Small watershed with few landowners
- Largely undeveloped
- Over 100,000 acres already under conservation easement
- Local NGO conservation partners



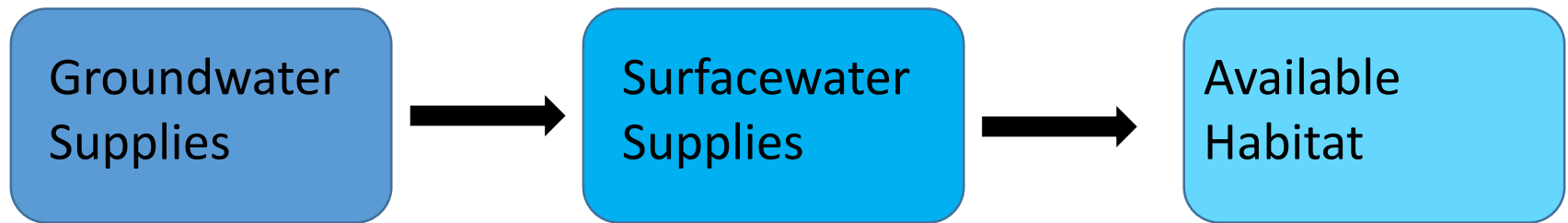


Research



# Research Priorities

- Understand habitat needs of priority species
- Understand relationships between groundwater, surfacewater, and habitats



- Provide groundwater and instream flow recommendations to lawmakers and state agencies

# Devils River Hydrology and Lidar Study

- TPWD is funding 4 years of hydrology data collection by University of Texas-Bureau of Economic Geology
- Measuring groundwater level, spring discharge, stream discharge, precipitation, water temperature, water chemistry



Groundwater  
Supplies



Surfacewater  
Supplies



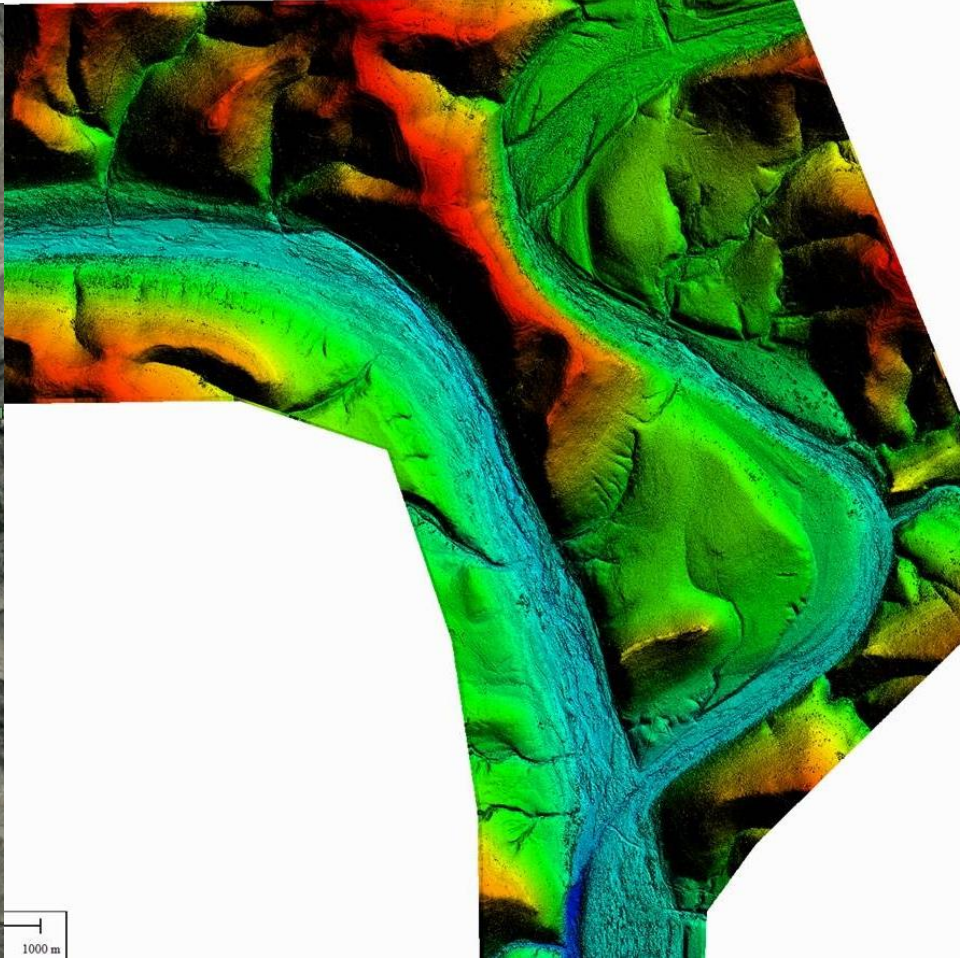
# Devils River Hydrology and Lidar Study

- Collection of water-penetrating Lidar for 45 miles of river



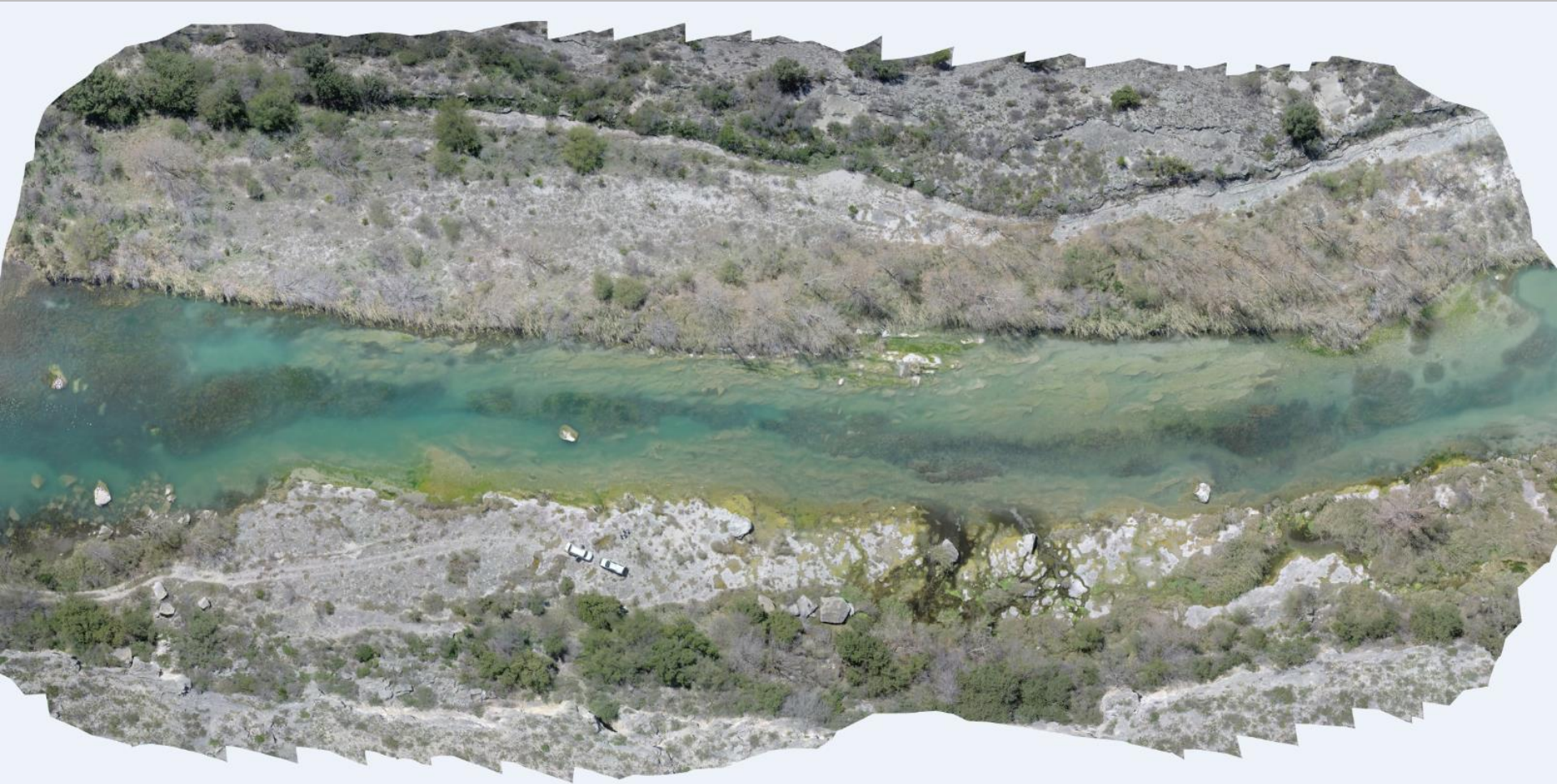


Lidar will be used to produce a digital elevation model which can be used in model development.



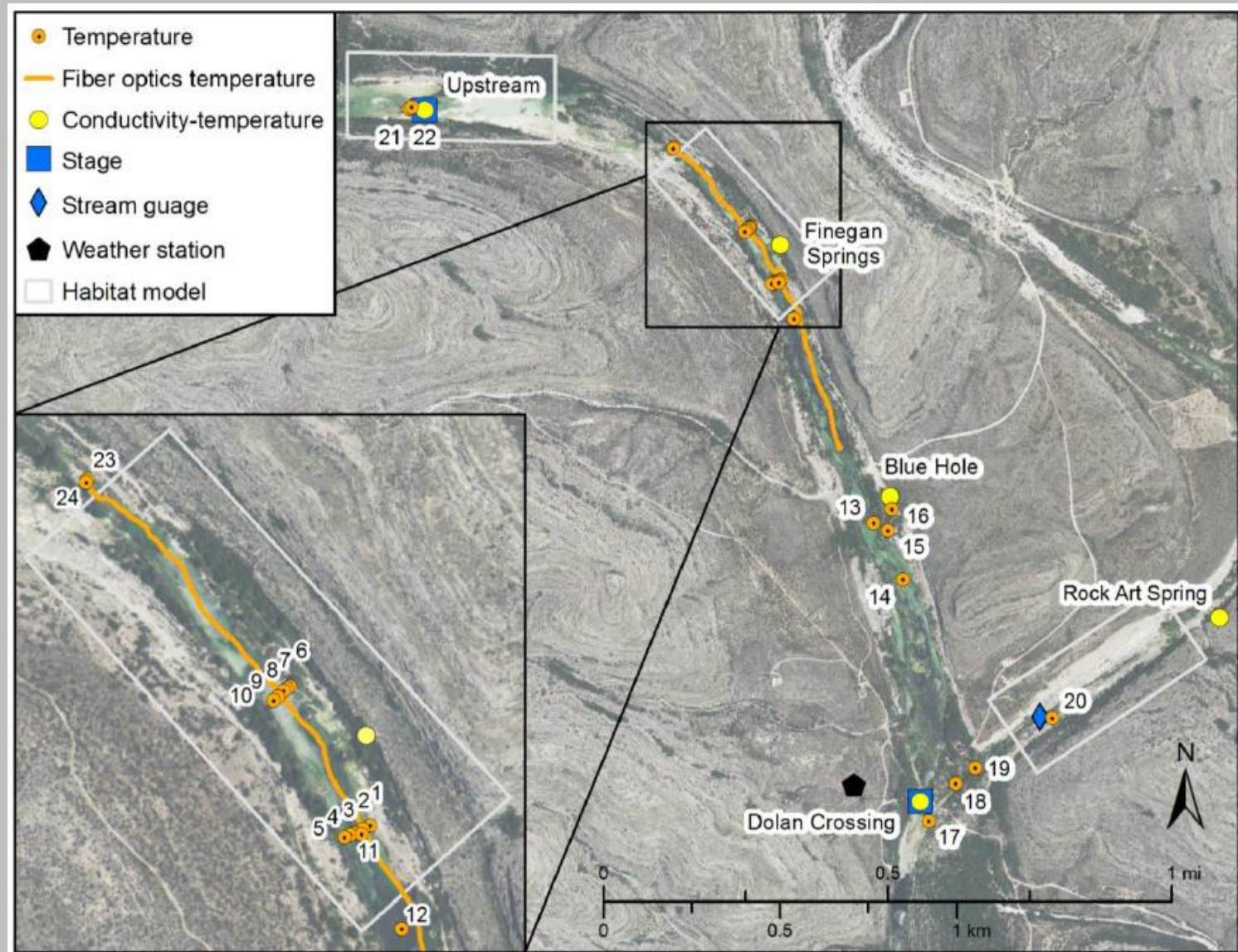


High quality imagery will facilitate habitat mapping



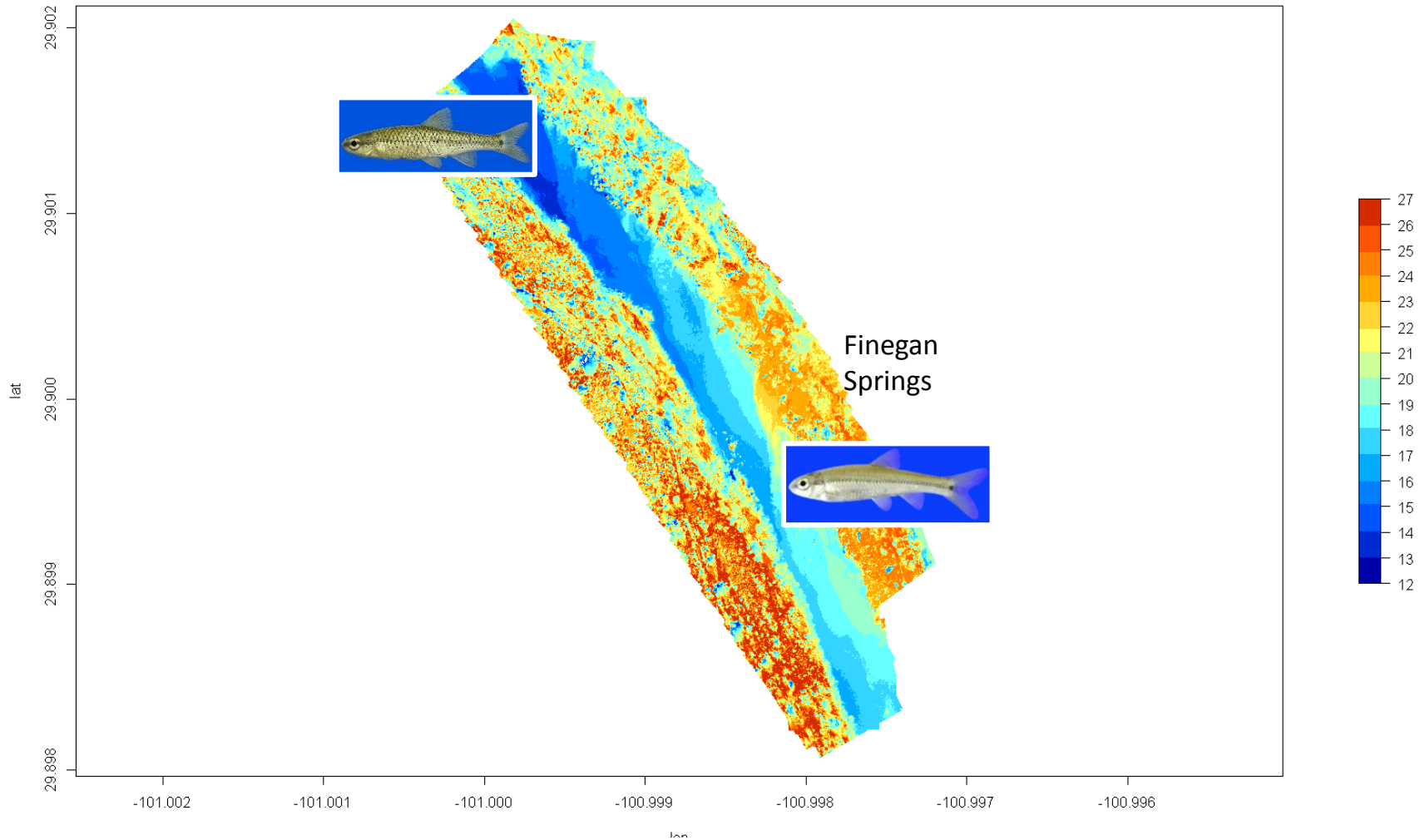


# Collection of temperature data in priority reaches of Devils River and Dolan Creek



# Concurrent collection of temperature and fish assemblage data in priority reaches

Temps (deg C)- Site1, 80m, Feb9 ~11am





# Fish Community Monitoring

- Annual fish community monitoring at 5 sites
- Habitat use data collection
- Sport fish surveys



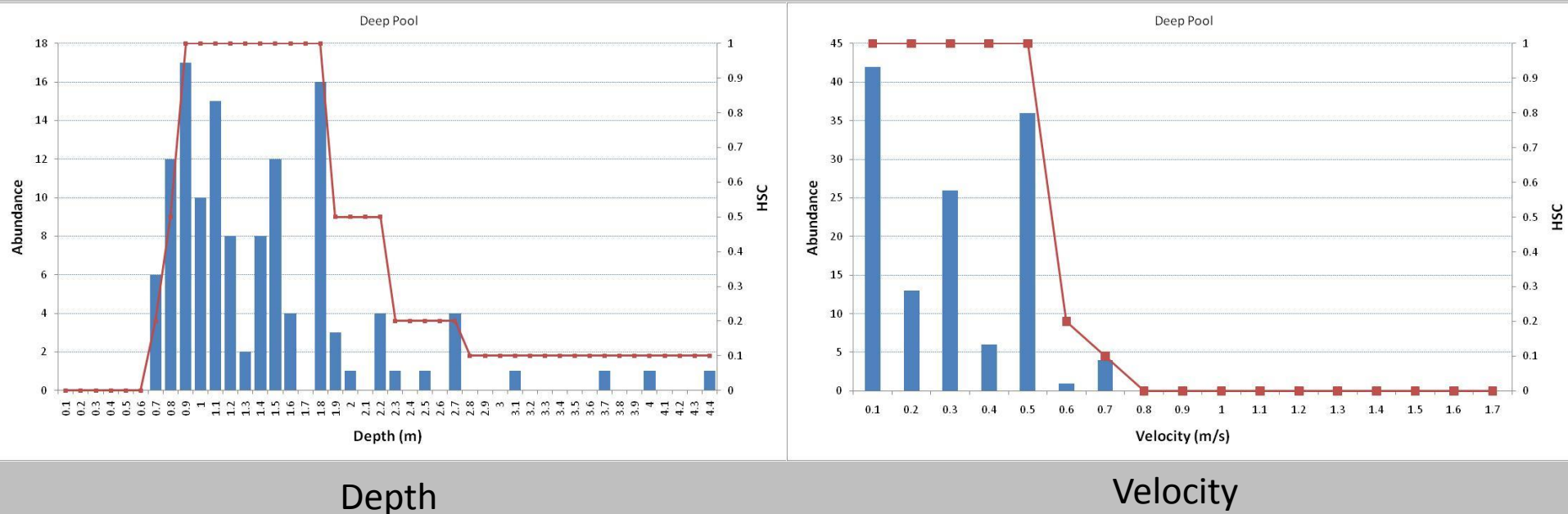
**DEVILS RIVER  
CONSERVANCY**  
Treasure. Preserve. Protect.



Available  
Habitat

# Generating Habitat Suitability Criteria

- What depths and velocities are optimal for different species



Available  
Habitat



# Texas Hornshell Research and Monitoring

- Distribution mapping
- Temperature tolerance research
- Development of habitat suitability criteria



Available  
Habitat





# Create a Hydraulic-Habitat Model

- Create a model to determine how changes in river flow relates to changes in available habitat for priority species

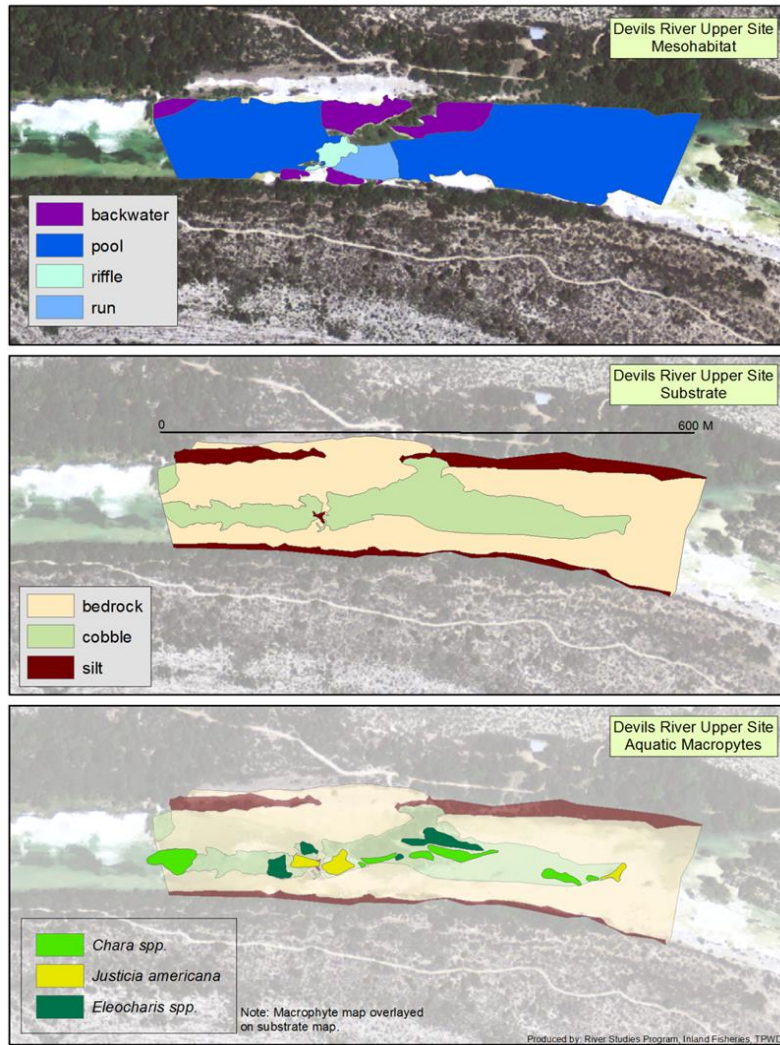


Surfacewater  
Supplies

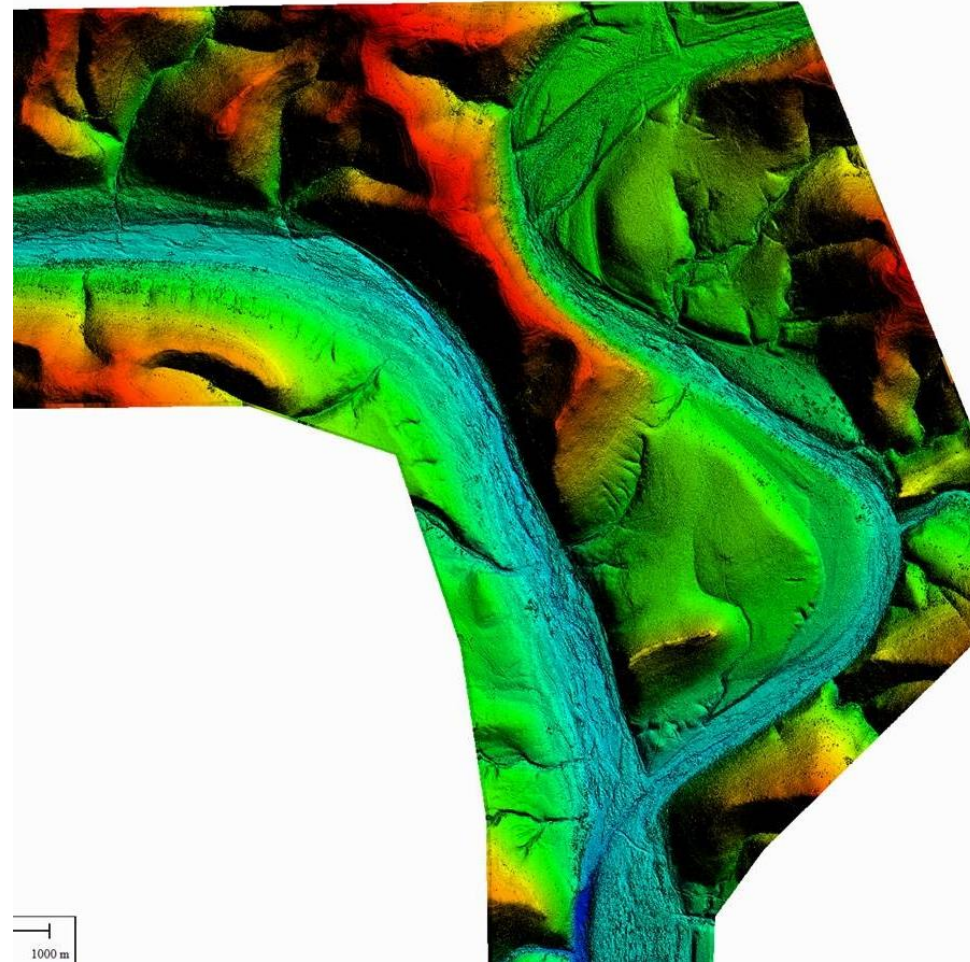


Available  
Habitat

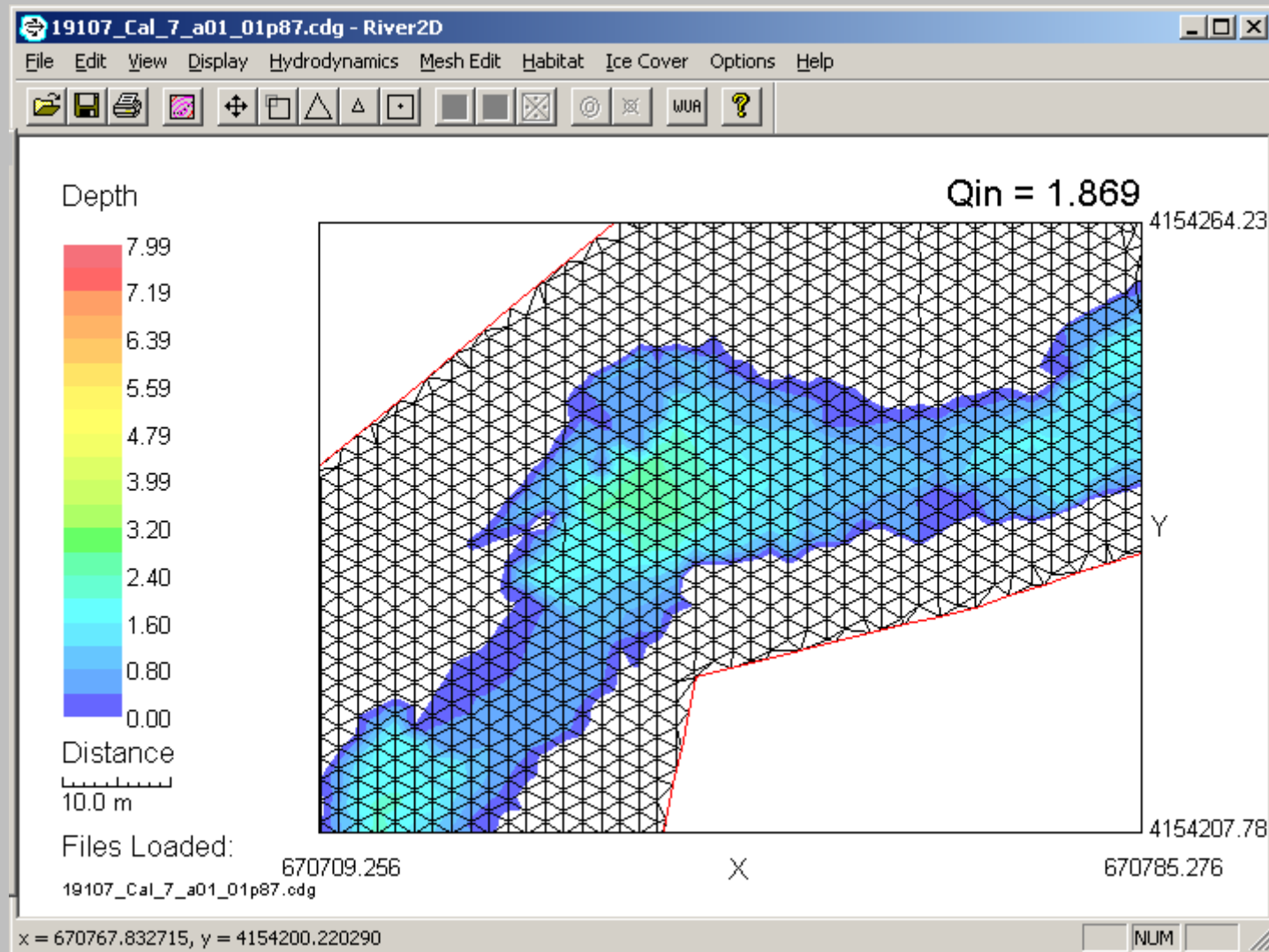
# Map mesohabitats, substrates, aquatic vegetation



+



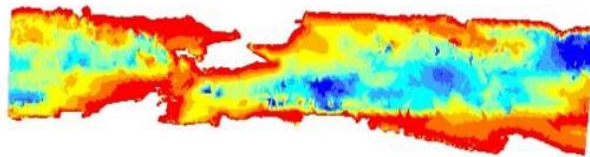
## 2-Dimensional Hydraulic Model





Model how depths and velocities change with changing river flows.

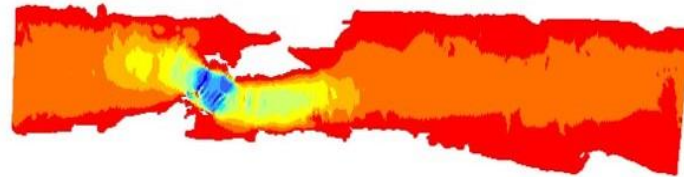
35 cfs – Depth (m)



Depth

- 0.005000 - 0.147305
- 0.147306 - 0.254844
- 0.254845 - 0.369492
- 0.369493 - 0.483945
- 0.483946 - 0.597461
- 0.597462 - 0.714492
- 0.714493 - 0.831602
- 0.831603 - 0.975000
- 0.975001 - 1.203670
- 1.203671 - 2.384800

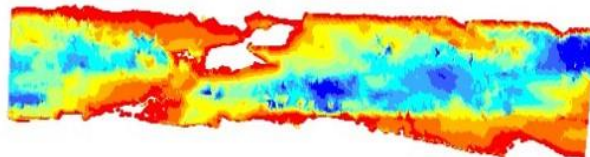
35 cfs – Velocity (m/s)



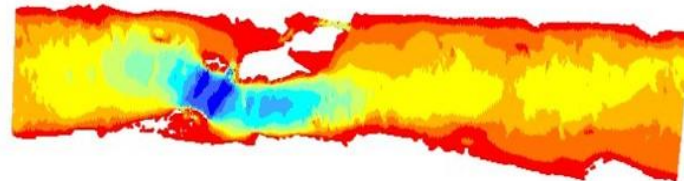
Velocity

- 0.000000 - 0.014093
- 0.014094 - 0.028702
- 0.028703 - 0.040643
- 0.040644 - 0.055147
- 0.055148 - 0.075054
- 0.075055 - 0.099830
- 0.099831 - 0.130144
- 0.130145 - 0.184595
- 0.184596 - 0.259861
- 0.259862 - 0.371389

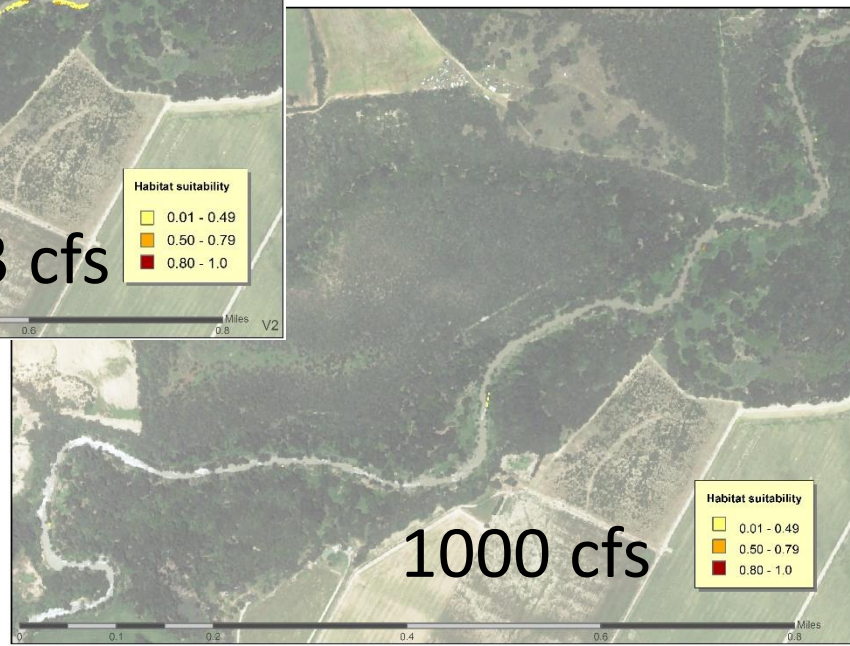
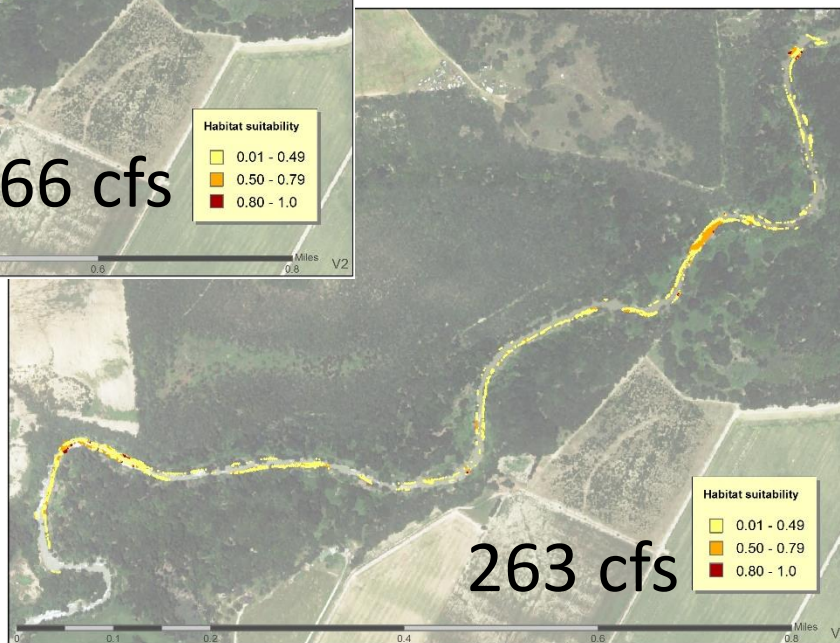
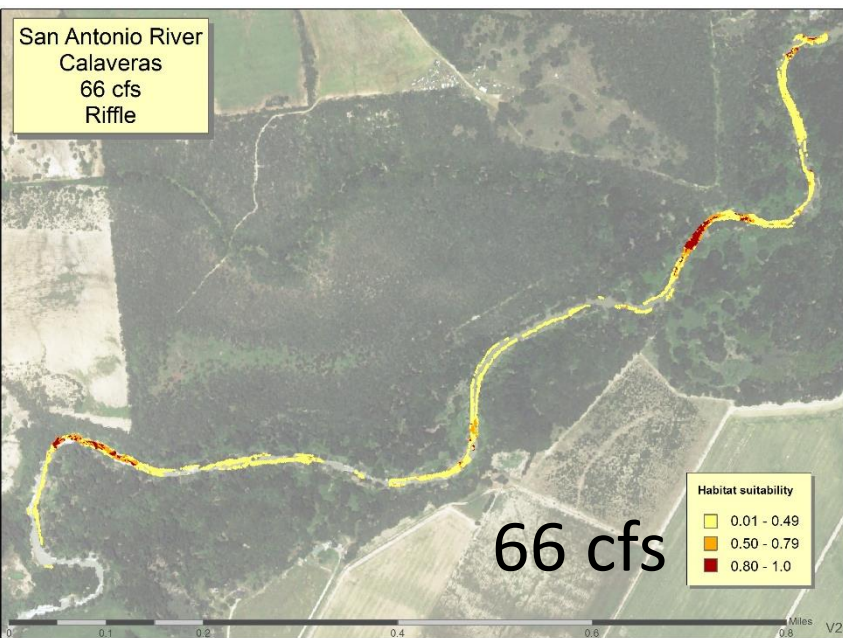
75 cfs – Depth (m)



75 cfs – Velocity (m/s)

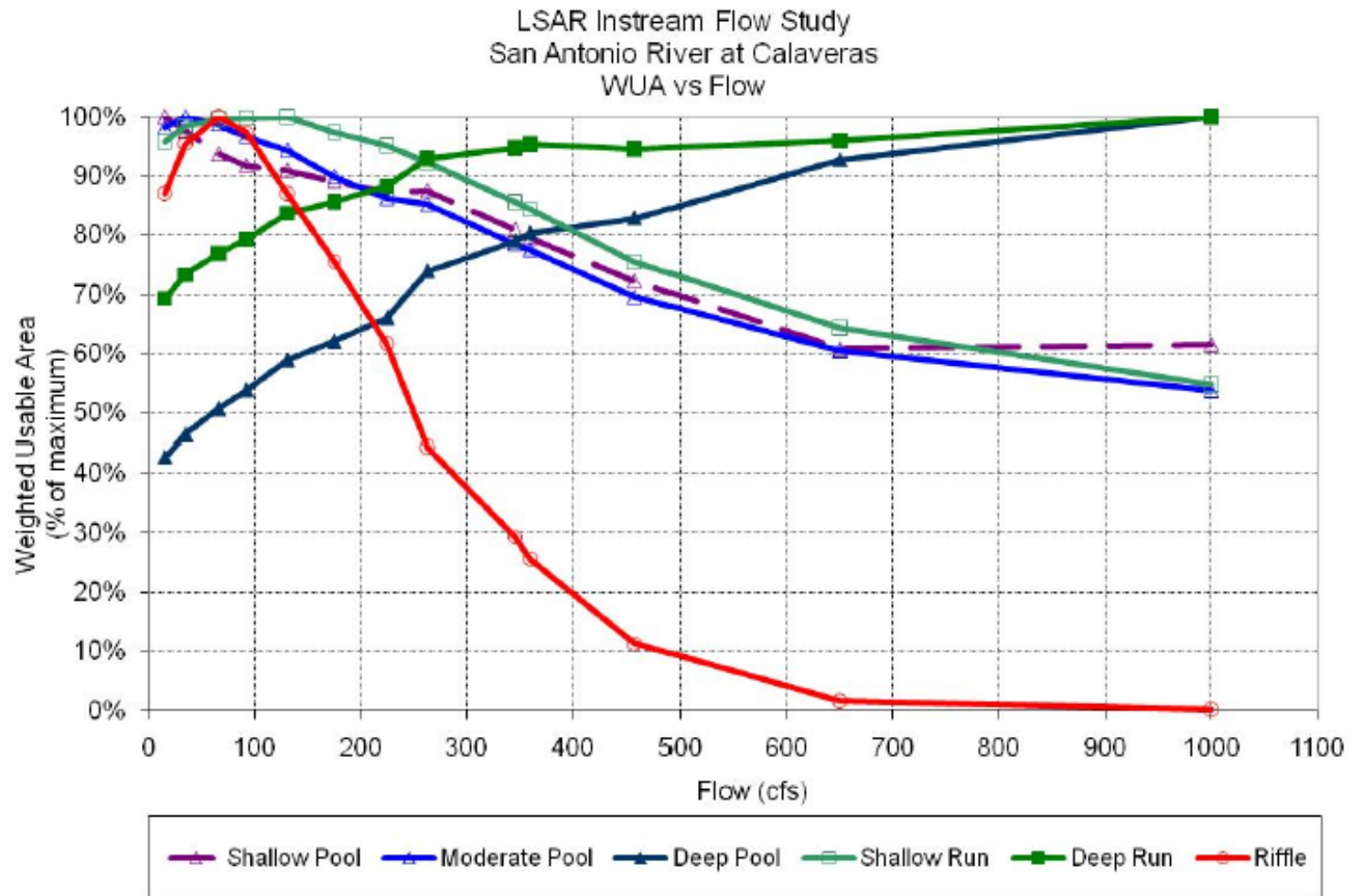


Quantify how available suitable habitat changes with changing river flow.





At what river flows are habitats for all species maintained?



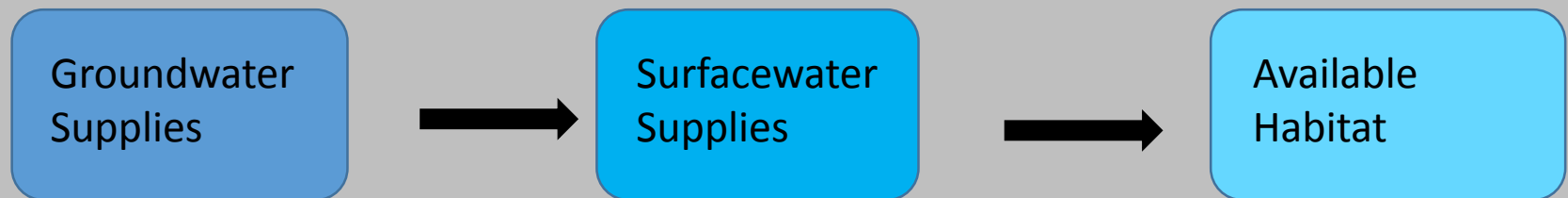
# Recommended Flow Regime

CALAVERAS												
Overbank Flow	<div> <p>Magnitude = 11,500 cfs Frequency = 1 event Duration = 2 days</p> <p><i>Key Indicators:</i> Riparian: Inundates approx. 90% of hardwood forest community Sediment transport: Channel maintenance</p> </div>											
	<div> <p>Magnitude = 8,000 cfs Frequency = 1 event Duration = 2 days</p> <p><i>Key Indicators:</i> Riparian: Inundates approx. 75% of hardwood forest community Sediment transport: Channel maintenance</p> </div>											
High Flow Pulses	<div> <p>Magnitude = 4,000 cfs Frequency = 2 events Duration = 2-3 days</p> <p><i>Key Indicators:</i> Cottonwood</p> </div>											
	<div> <p>Magnitude = 4,000 cfs Frequency = 2 events Duration = 2-3 days</p> <p><i>Key Indicators:</i> Green Ash / Box Elder</p> </div>											
	<div> <p>Magnitude = 3,000 cfs Frequency = 3 events Duration = 2-5 days</p> <p><i>Key Indicators:</i> Riparian - Black Willow</p> </div>											
BASE FLOWS (cfs) - Aquatic Habitat protection (intra- and interannual variability)						Key Indicators: Aquatic Habitat, Water Quality						
Base Wet	319	336	329	338	372	382	384	303	336	357	390	355
Base Average	264	268	256	235	259	216	177	160	195	220	226	225
Base Dry	119	113	114	109	113	98	90	90	107	90	91	101
SUBSISTENCE FLOWS (cfs) - Water quality protection and maintenance of limited aquatic habitat						Key Indicators: Water Quality, Aquatic Habitat						
Subsistence	80	80	80	80	80	80	80	80	80	80	80	80
MONTH	January	February	March	April	May	June	July	August	September	October	November	December



# Tie Instream Flow Recommendations to Groundwater

- Make connections between instream flow recommendations and groundwater levels
- Inform legislative action on groundwater management (flow triggers, groundwater management zones)



# Potential Groundwater Management Zones







# Partnerships

# Partnership with the Devils River Conservancy

- Help TPWD connect with landowners in the basin
- Expand TPWD's research footprint
- Conduct landowner workshops
- Working Days Events- biannual TPWD-DRC-landowner paddle trips



**DEVILS RIVER  
CONSERVANCY**  
Treasure. Preserve. Protect.



# Paddler manual bandana



# Devils River Database Project



- Compile and organize all available publications, raw data, historical documents, and gray literature associated with the Devils River watershed.
- Design and implement a database and web-platform to house resources and make them publically-available.
- Make it easier to compile long-term datasets for population analysis
- Help resource managers prioritize data gaps

*Environmental Biology of Fishes* 65: 478, 2002.  
© 2002 Kluwer Academic Publishers. Printed in the Netherlands.

## Threatened fishes of the world: *Dianda diaboli* Hubbs & Brown, 1956 (Cyprinidae)

Gary P. Garrett\*, Clark Hubbs<sup>b</sup> & Robert J. Edwards\*  
\*HOH Research Station, Texas Parks and Wildlife Department, Ingram, TX 78025, U.S.A. (e-mail: gpg@hoh.com)  
\*Section of Integrative Biology, University of Texas at Austin, Austin, TX 78712, U.S.A.  
\*Department of Biology, University of Texas–Pan American, Edinburg, TX 78539, U.S.A.

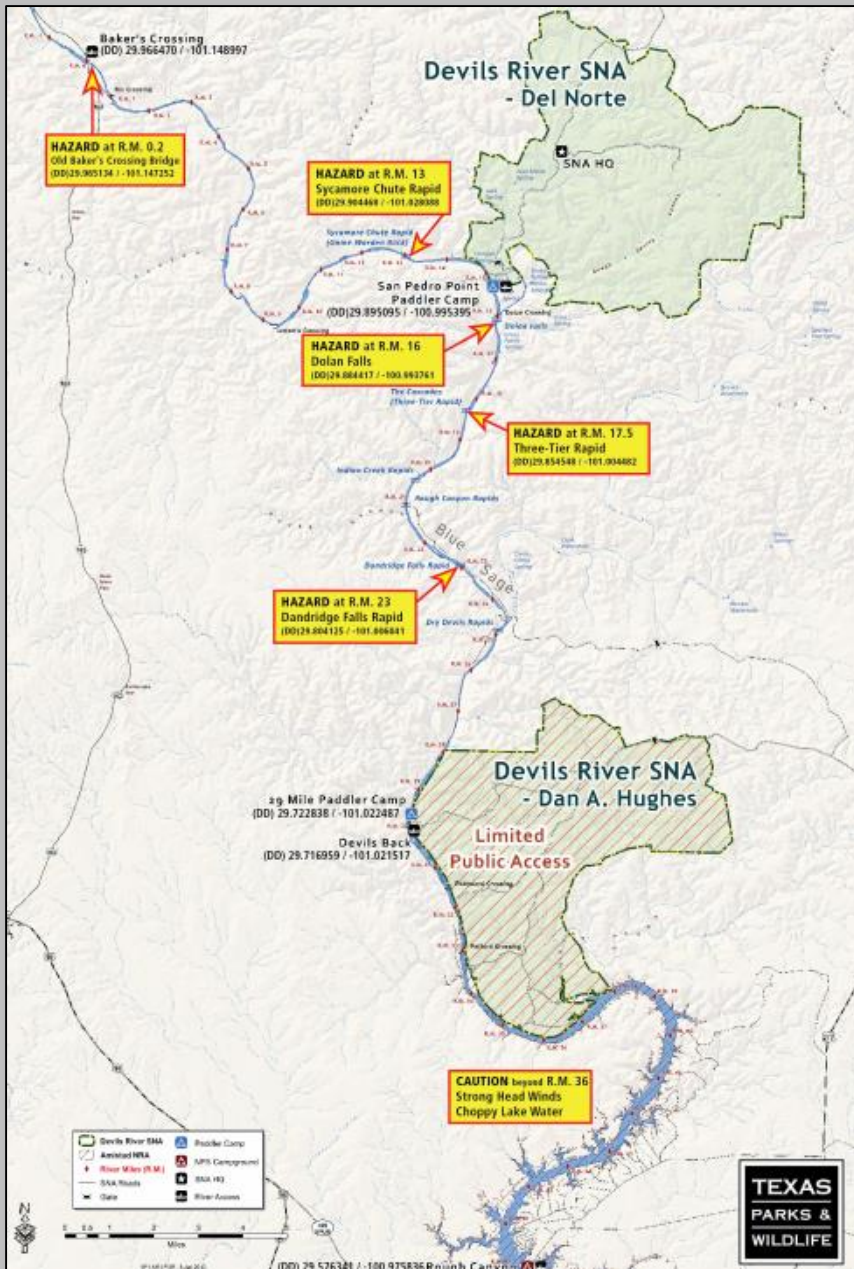
**Common name:** Devils River minnow. **Conservation status:** Listed as threatened by the U.S. Fish and Wildlife Service 1999. **Identification:** Darkly outlined scales above the lateral stripe give a cross-hatched appearance. Also with a black spot on the caudal fin base that is often wedge-shaped, a black lateral stripe through the eye and onto the snout, and double dashes along the lateral line. Adults typically 30–40 mm SL. Drawing by Robert G. Howells. **Distribution:** Type locality is Baker's Crossing on the Devils River, Val Verde County, Texas (Hubbs & Brown 1956). It is known to occur in Texas in the Devils River, San Felipe Creek and Sycamore Creek, Val Verde County. Extirpated from Las Moras Creek, Kinney County (Garrett et al. 1992). There are also historic records of occurrence in two small streams in Coahuila, Mexico, the Rio San Carlos and Rio Sabina. Because no collections have been made there since the early 1970s, their current status in Mexico is unknown but, at best they are thought to be rare (Miller 1978). **Abundance:** The Devils River minnow has a spotty distribution within its range. At various times it has been relatively abundant (Hubbs & Brown 1956, Harell 1978), yet at other times exceedingly rare (Garrett et al. 1992). **Habitat and ecology:** Little is known of the life history of the species and habitat specificity is not known. Often found in association with spring outflows and adjacent to aquatic macrophytes and may inhabit a microhabitat associated with the interface between spring runs and the river (Hubbs & Garrett 1990). **Reproduction:** Likely to spawn in the spring with non-adhesive and demersal eggs, similar to traits reported for *D. arroyo* (Hubbs 1951). **Threats:** Populations appear to have become reduced in number and size in recent history (Garrett et al. 1992). Reasons for this decline are not known, although remaining populations are potentially threatened by loss of habitat through reduced spring flows, reduction in water quality and predation and competition with exotic species. However, since little is known of the life history requirements or the ecological interactions of the Devils River minnow, it is difficult to properly assess threats or fully implement recovery actions. **Conservation action:** A Conservation Agreement was developed in 1998 among the Texas Parks and Wildlife Department, the City of Del Rio and the U.S. Fish and Wildlife Service and is designed to foster research to 'eliminate or significantly reduce the probability that potential threats to the minnow will actually harm this species and to recover populations of the minnow to viable levels'. A critical subset of the range of *D. diaboli* is now owned by the Texas Parks and Wildlife Department and the Nature Conservancy of Texas. **Conservation recommendation:** The conservation actions and recommendations listed in the Conservation Agreement should be fully implemented in order to ensure survival of the species. Further research on the ecological requirements of this species is especially warranted.





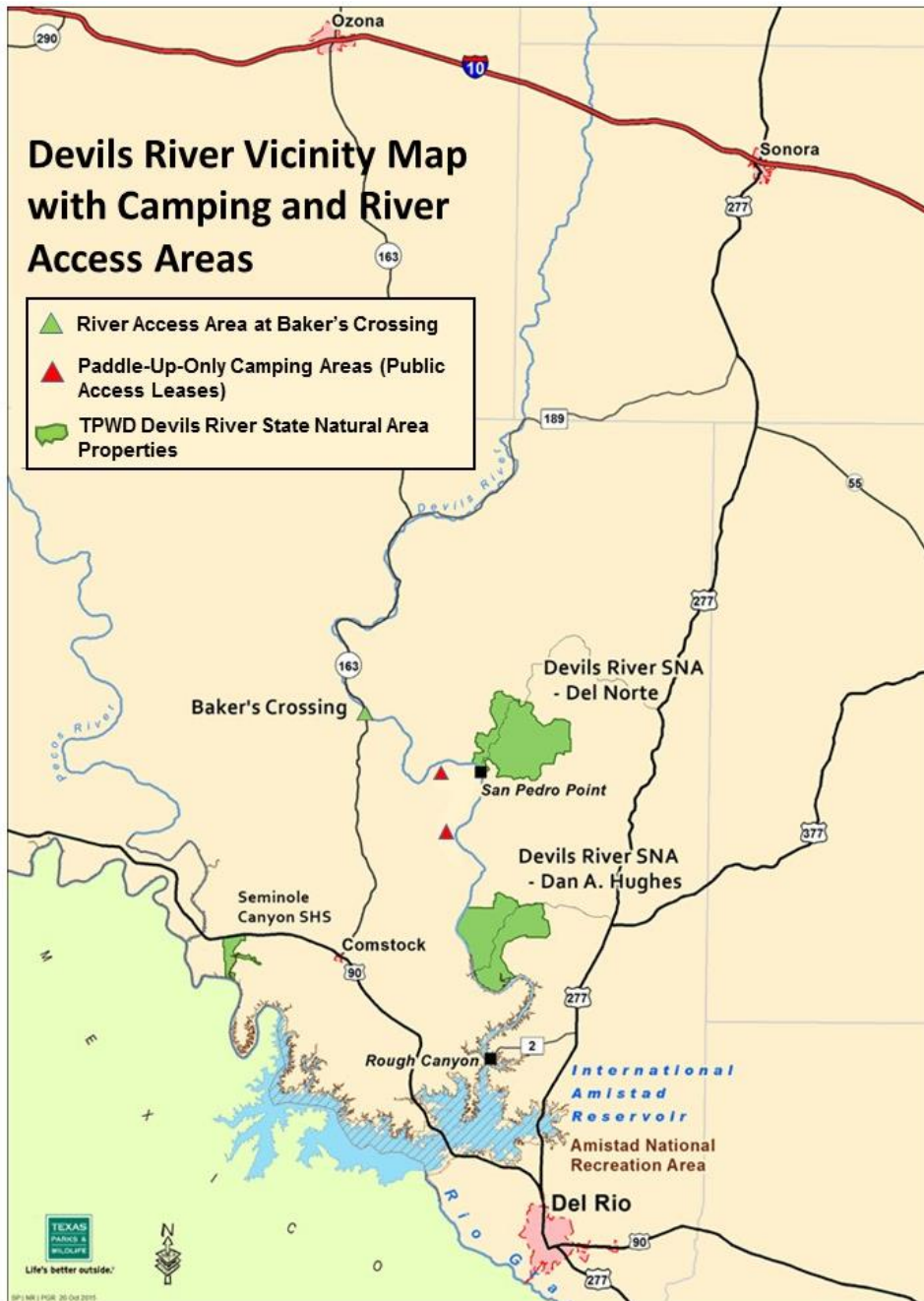
# Partnership with Devils River SNA

- Manage for sustainable recreation
- Preserve wilderness experience
- Limit the number of paddlers per day through permit process
- Problems:
  - Long distances between SNAs
  - Litter
  - Trespassing
  - Poor relations between paddlers and landowners



## Devils River Vicinity Map with Camping and River Access Areas

- ▲ River Access Area at Baker's Crossing
- ▲ Paddle-Up-Only Camping Areas (Public Access Leases)
- TPWD Devils River State Natural Area Properties



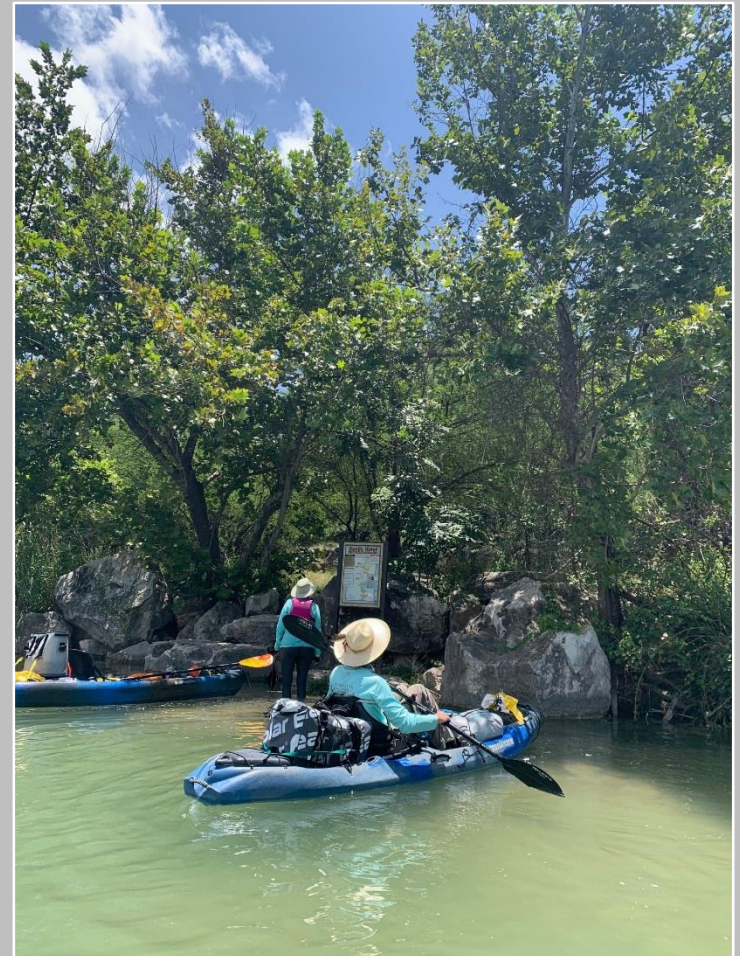
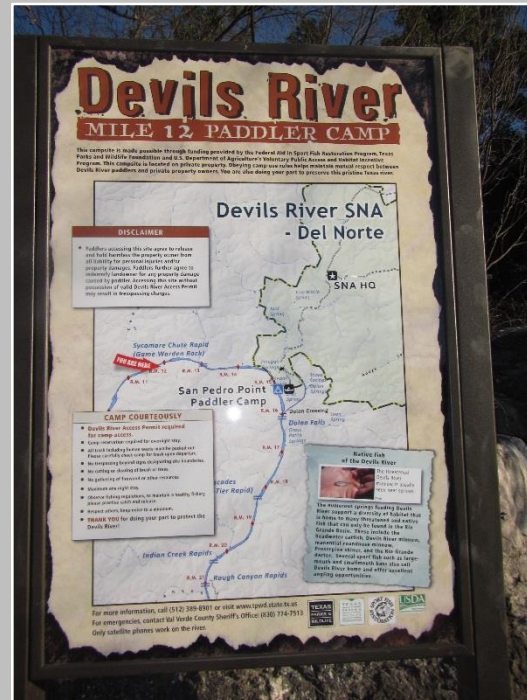
## River Access and Conservation Areas Program

- Expand angler access to Texas rivers through public-private partnerships
- Funded via federal grants and TPWD Rivers License Plate funds
- Added two paddle-up campsites on the Devils River to break up long paddles

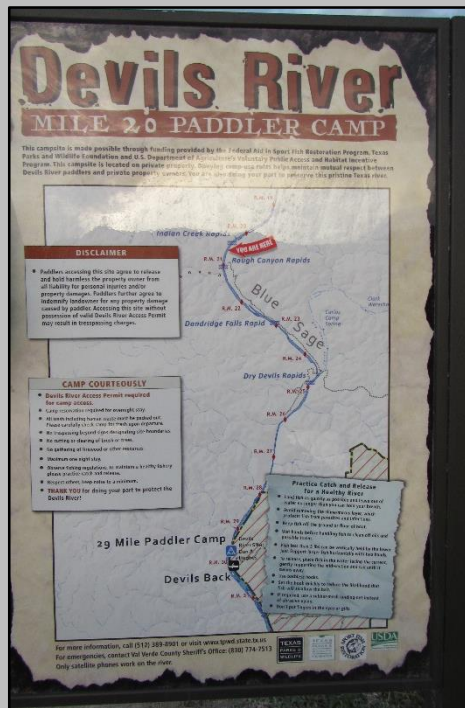




## Mile 12 Campsite







# Mile 20 Campsite





Devils River Recreational Use Assessment: Evaluation of River  
Stewardship Outcomes Achieved through Establishment of the  
Mile 12 and Mile 20 Paddler Camps



Sarah Robertson

Inland Fisheries Division  
Texas Parks and Wildlife Department  
Austin, Texas  
March 2018



*“Overall the trespassing went down drastically. I think the campsites are working really well.”* – Ali Hatten, Game Warden

*“There are fewer active campsites and less litter. It is clear the sanctioned paddler campsites are aiding majorly in condensing recreational impacts and trespassing.”*  
– Devils River Conservancy

# Holistic approach to Devils River Conservation

- Building partnerships with landowners and local advocacy groups to expand footprint of conservation efforts in invaluable
- Conduct research to fill data gaps and establish baseline data
- Provide science to policy-makers, stakeholders







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