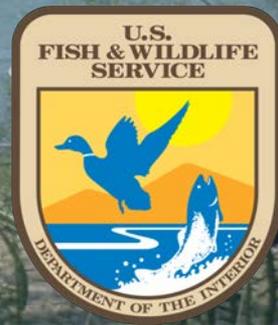


Fifteen years of studying the Texas hornshell: what we know, and what that means

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(University of) **Miami**



Warm winters
Good football

Miami University



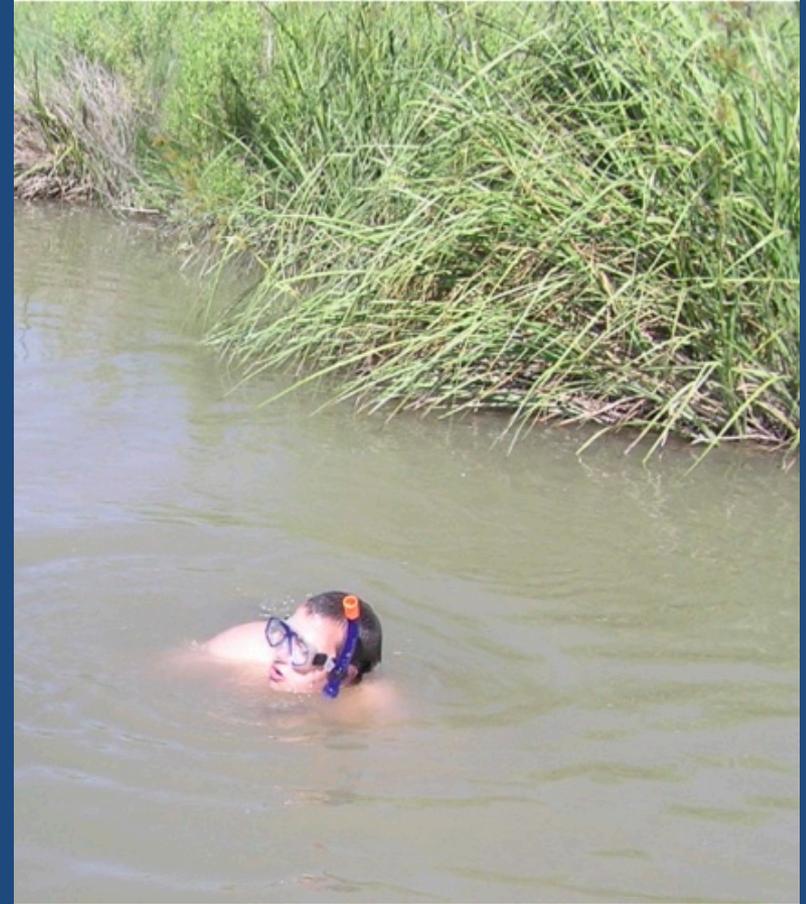
Cold winters
Bad football

Collaborators



Brian Lang

Kentaro Inoue



Todd Levine

THE BIG QUESTION

(in ecology)

Why are organisms where they are, and why aren't they where they aren't?

- Contemporary conditions
- Historical conditions
- Human activity

THE BIG QUESTION

(in conservation)

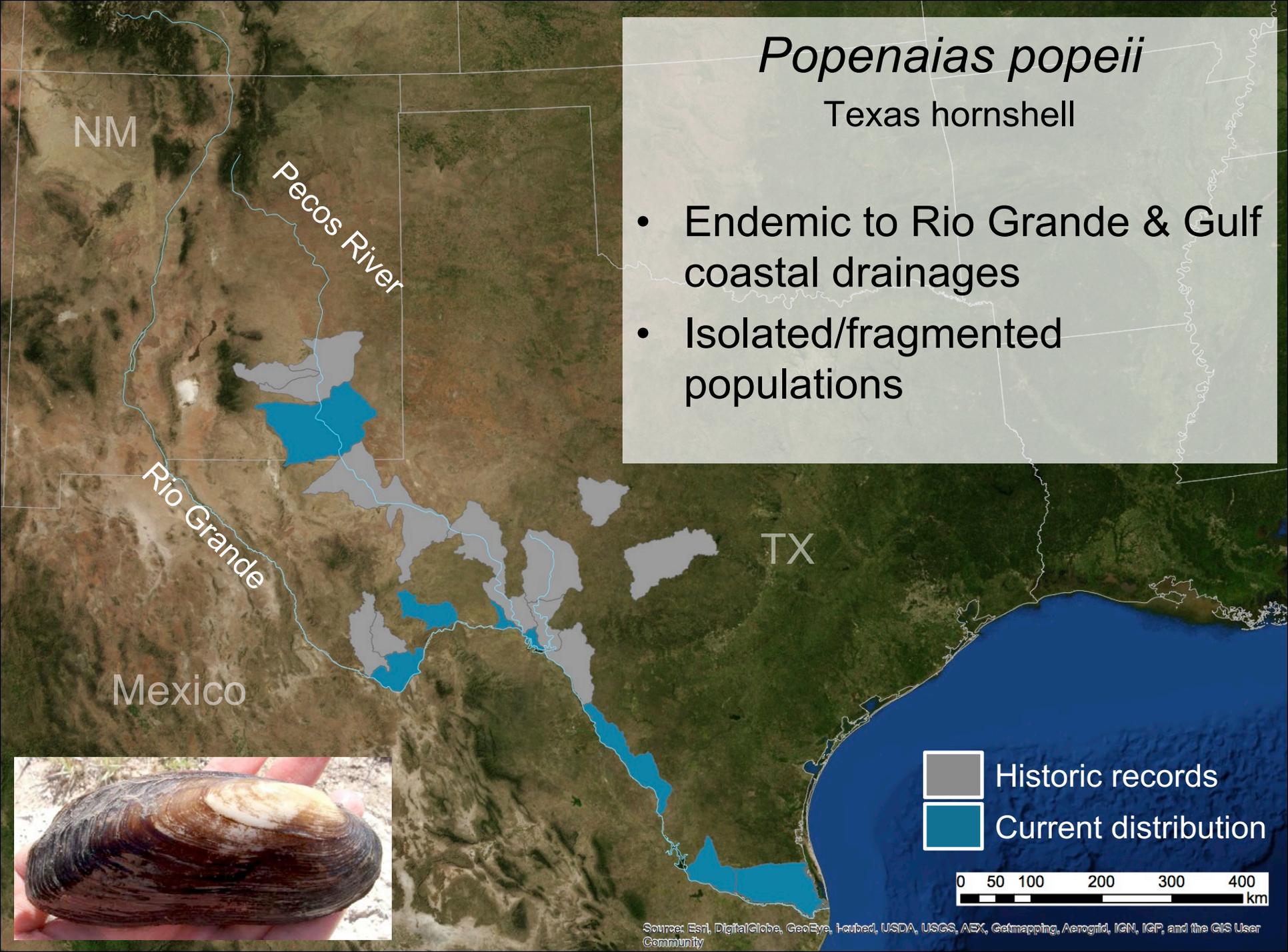
What factors cause populations to decline or disappear?

- Environmental challenges
- Demographic challenges
- Genetic challenges

Popenaias popeii

Texas hornshell

- Endemic to Rio Grande & Gulf coastal drainages
- Isolated/fragmented populations



Source: Esri, DigitalGlobe, GeoEye, Forber, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Black River, New Mexico



Crevice



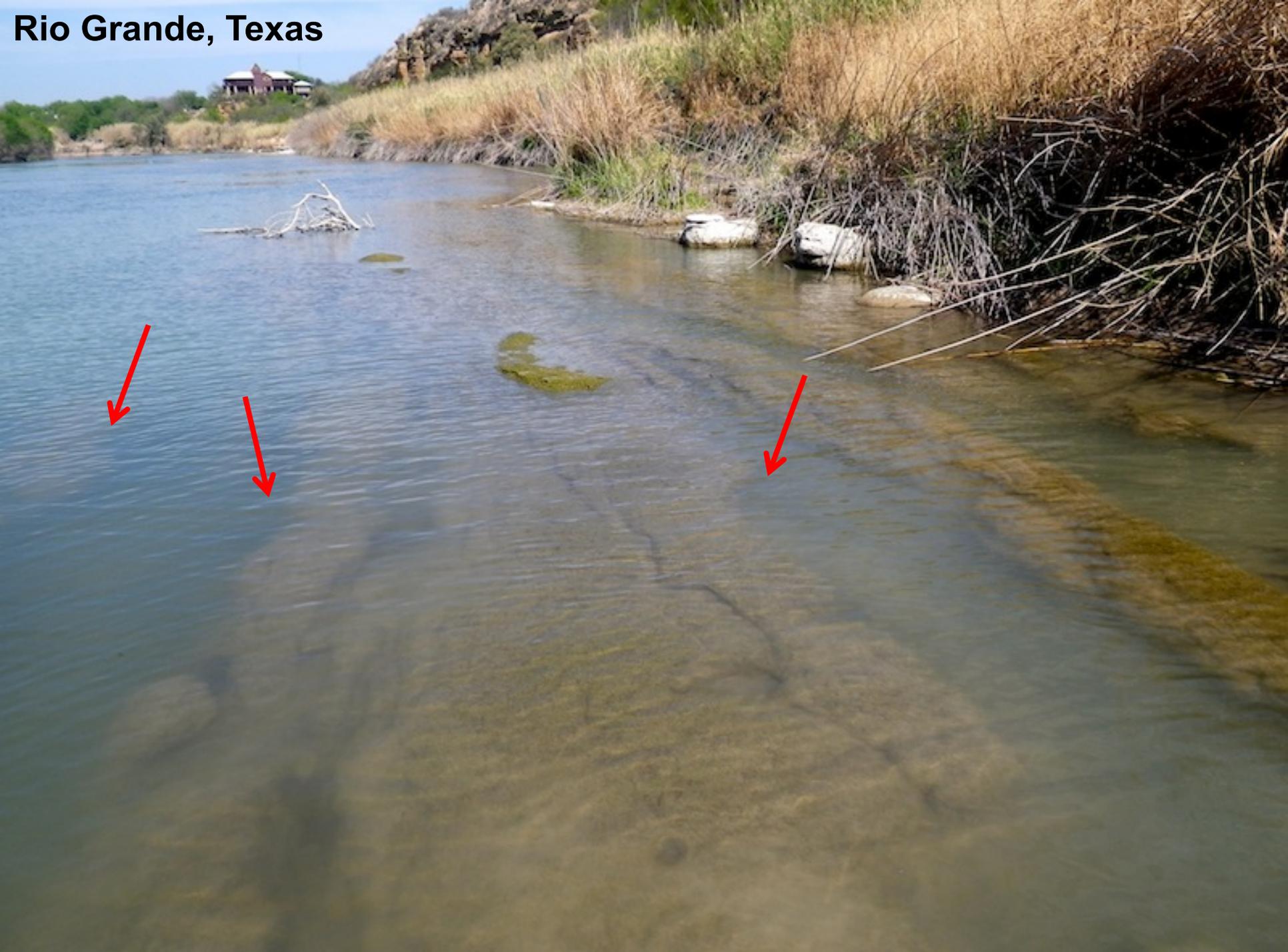
Rock shelf



Undercut bank



Rio Grande, Texas



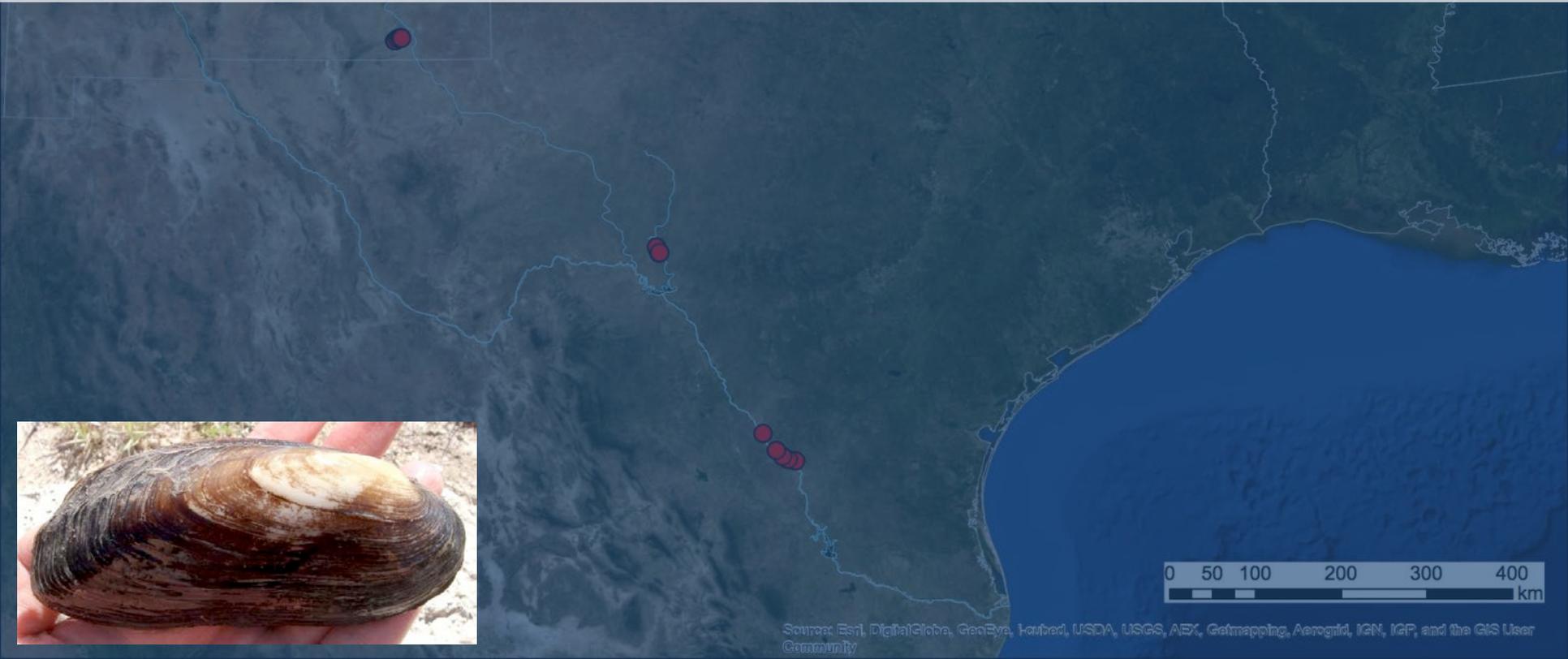
Objectives

- Describe “habitat” use
- Understand demography
- Characterize genetic structure
- Inform conservation efforts of NMDGf



Methods

- Identify ecological hosts and habitat use
- Estimate population size and change
- Partition genetic variation



Study sites: Black River, southeast NM



- Single species system
- 14 km-reach of the stream
- Closed-population



Host Identification

Laboratory trials

- 24 of 33 species were hosts
- 17 native, 7 introduced species

HOST GENERALIST

Host Identification



Host Identification

> 99% of glochidia carried by:

River carpsucker (*Carpionodes carpio*; 84%)

Gray redhorse (*Moxostoma congestum*; 12.9%)

Red shiner (*Cyprinella lutrensis*; 2.5%)

Levine *et al.* 2012

Mussel Demography



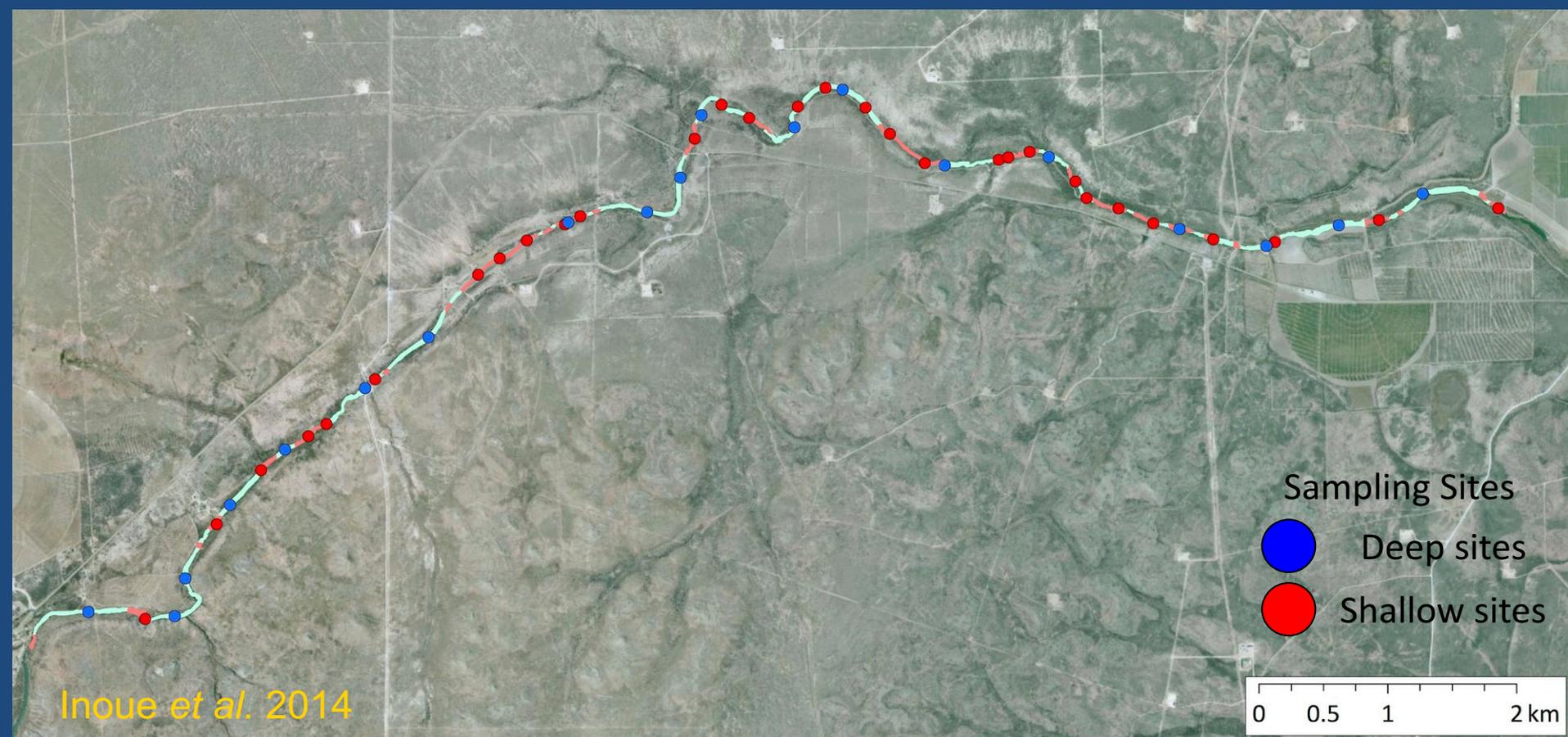
Mark-and-recapture

- Surveyed from 1997 to 2012
 - Three sites; two microhabitats (riverbanks and river channels)
 - Tested hydrological cycles on demographic parameters
- Program MARK
 - Recapture probability
 - Survival
 - Finite rates of population growth (λ)



Distance Sampling

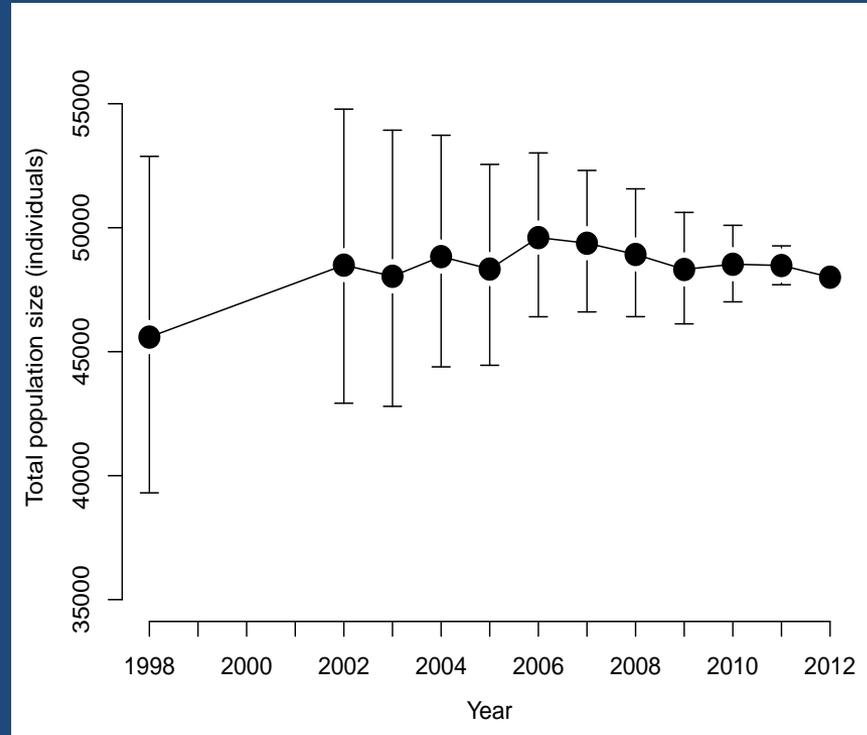
- Shallow habitats (every 250 m)
- Deep habitats (every 500 m)



Mussel Demography

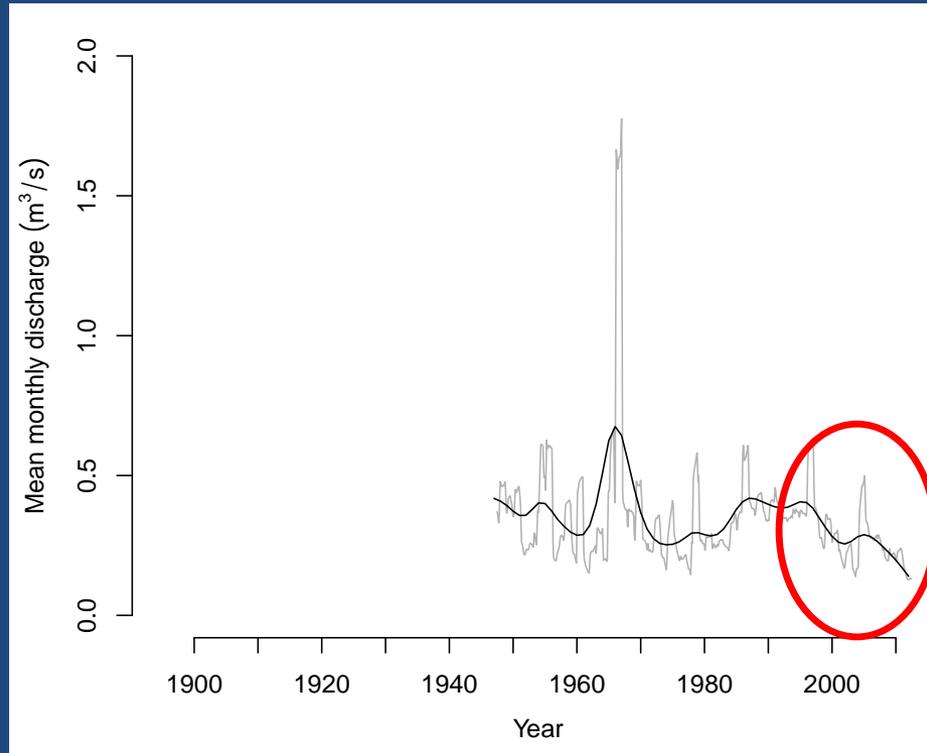
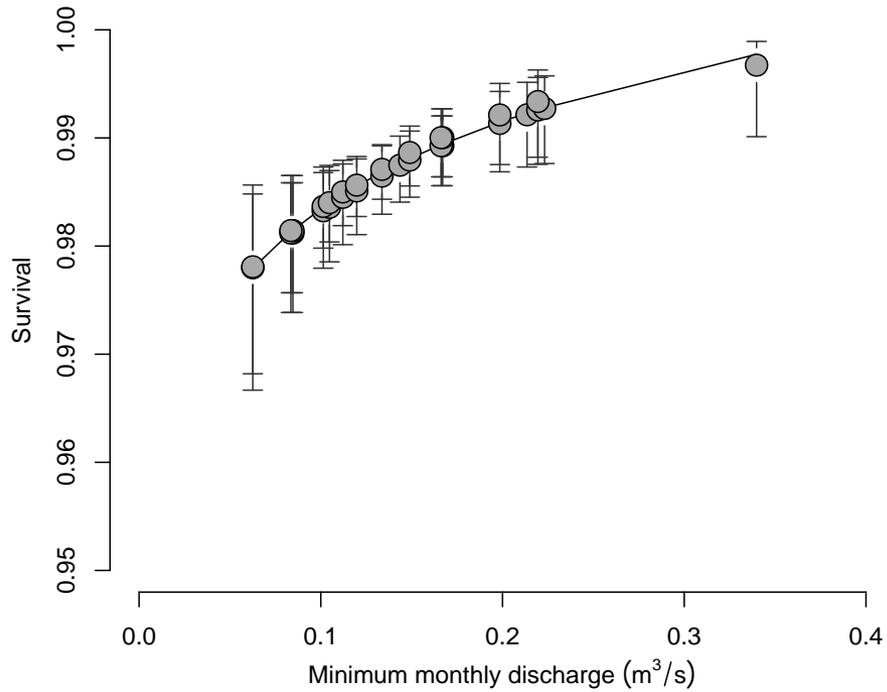
- Recapture probability higher in river channels (80% vs. 70%)
- Survival similar between habitats

- Avg. annual survival = 98.6%
- $\lambda = 0.999$ (range = 0.988 – 1.064)



- Black River in 2012
N = 48,006 individuals (95% CI: 28,849-74,127)
60% in “good” habitat, 40% in “bad” habitat

Mussel Demography



Genetic Analyses

- mtDNA sequences

 - COI (~ 800 bp)

 - haplotype diversity

- Microsatellites

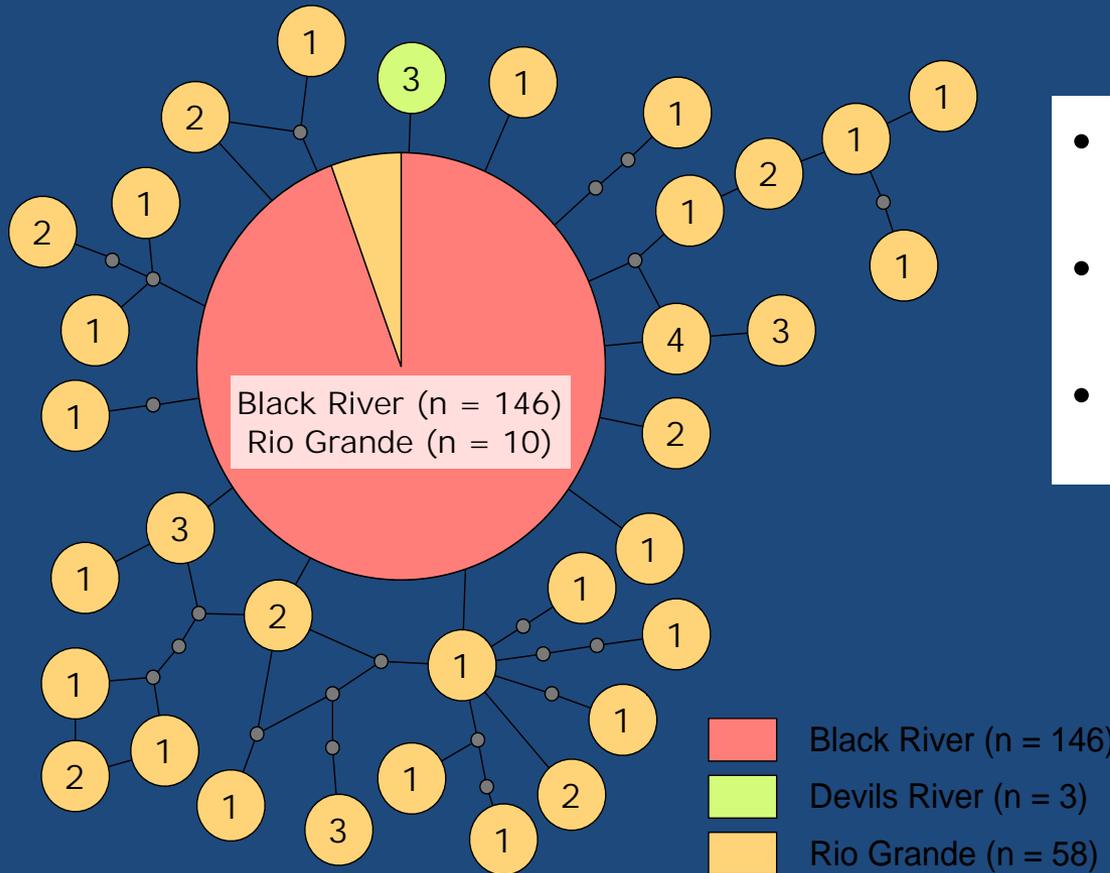
 - 20 loci

 - population genetic structure

 - Approximate Bayesian computation (divergence time, N_e , habitat connectivity)

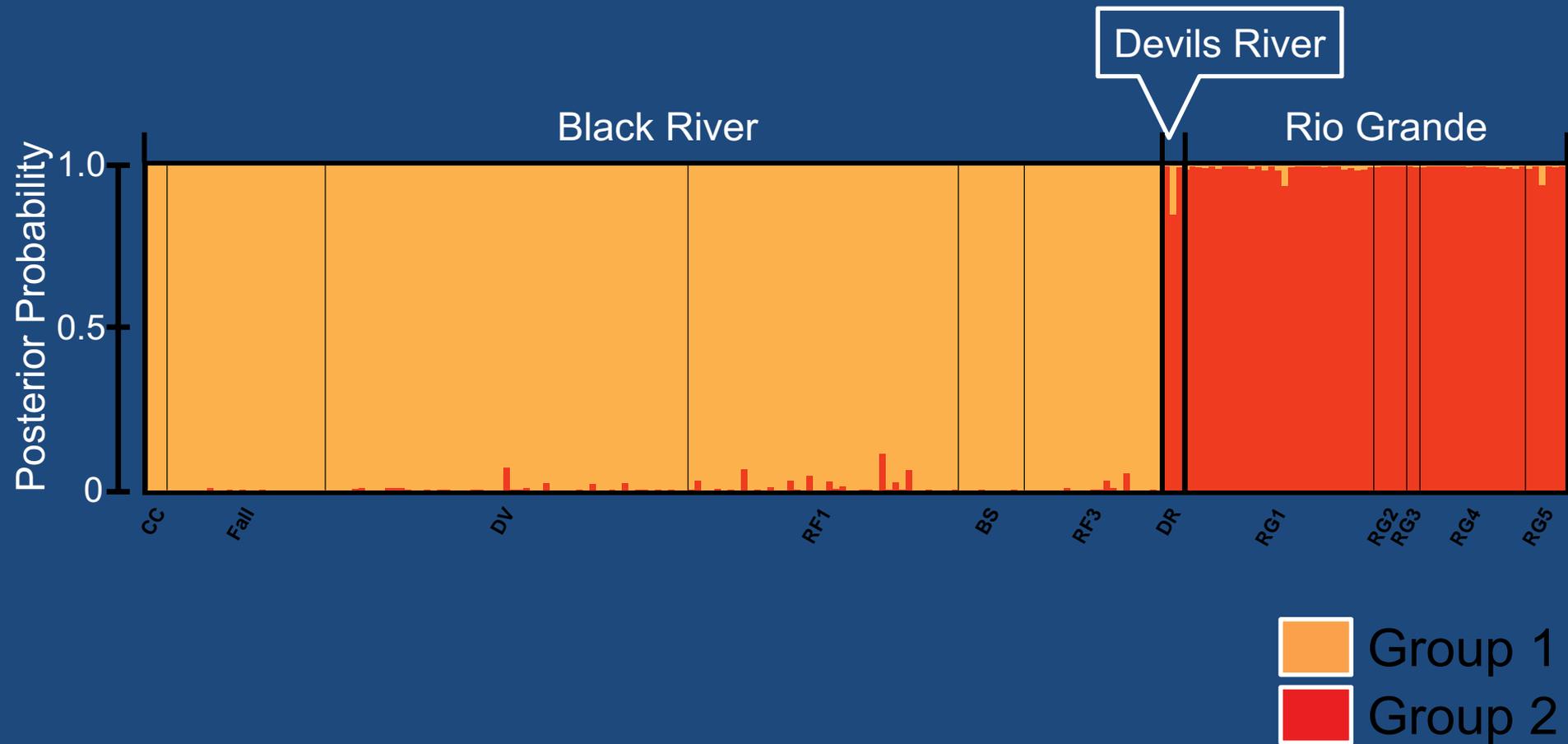


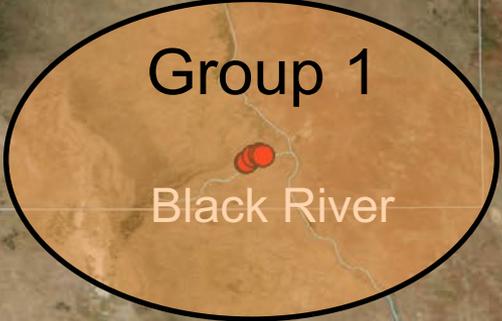
Genetic Variation –COI sequences



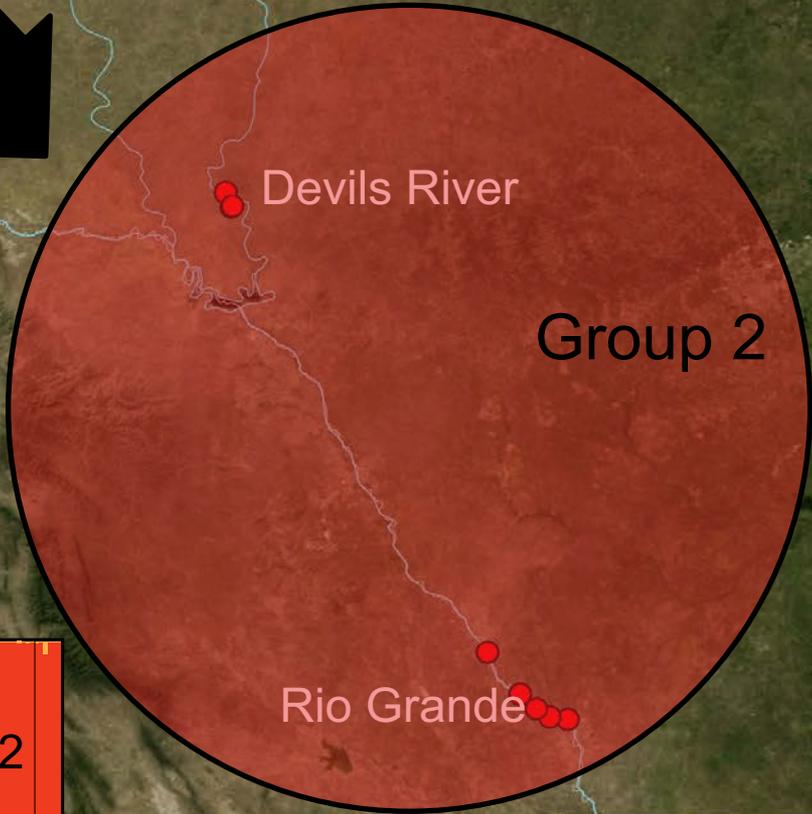
- 34 haplotypes
- “star” pattern
- 1 BR haplotype

Genetic Variation – 18 microsatellites





Parameters	Median	95% credible interval
Black River N_e	5870	(3654 – 9,210)
Rio Grande N_e	70,300	(41,600 – 91,900)
Divergence Time (yr)	80,270	(21,093 – 168,210)



Conclusions

1. Three fish species are the ecological hosts
Manage hosts
2. Black River population is stable but threatened by declining discharge
Ensure minimum flow, monitor demography
3. Black River and Rio Grande are genetically distinct
Manage as separate units

Inoue *et al.* 2014. *Freshwater Biology* 59: 1872-1883.

Inoue *et al.* 2015. *Molecular Ecology* 24: 1910-1926.

Levine *et al.* 2012. *Freshwater Biology* 57: 1854-1864 (*Corrigendum* 57: 2762)

Next Steps

1. Population viability analysis (in progress)
2. Re-introduction into Delaware River (in progress)
3. Genetic/genomic analyses of additional populations (in preparation)

Ultimate Goal:

*Quality habitat
supporting demographically robust populations
with sufficient genetic variation*