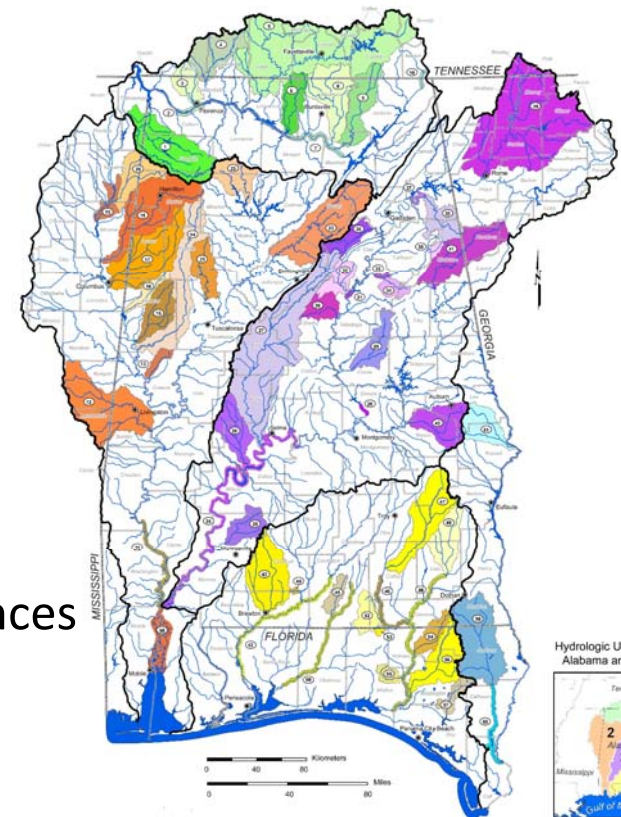


# SHU-Relevant Research at The University of West Alabama 2019



Michael Sandel  
Assistant Professor, UWA  
Biological and Environmental Sciences



# Acknowledgements



**BIRMINGHAM AUDUBON**

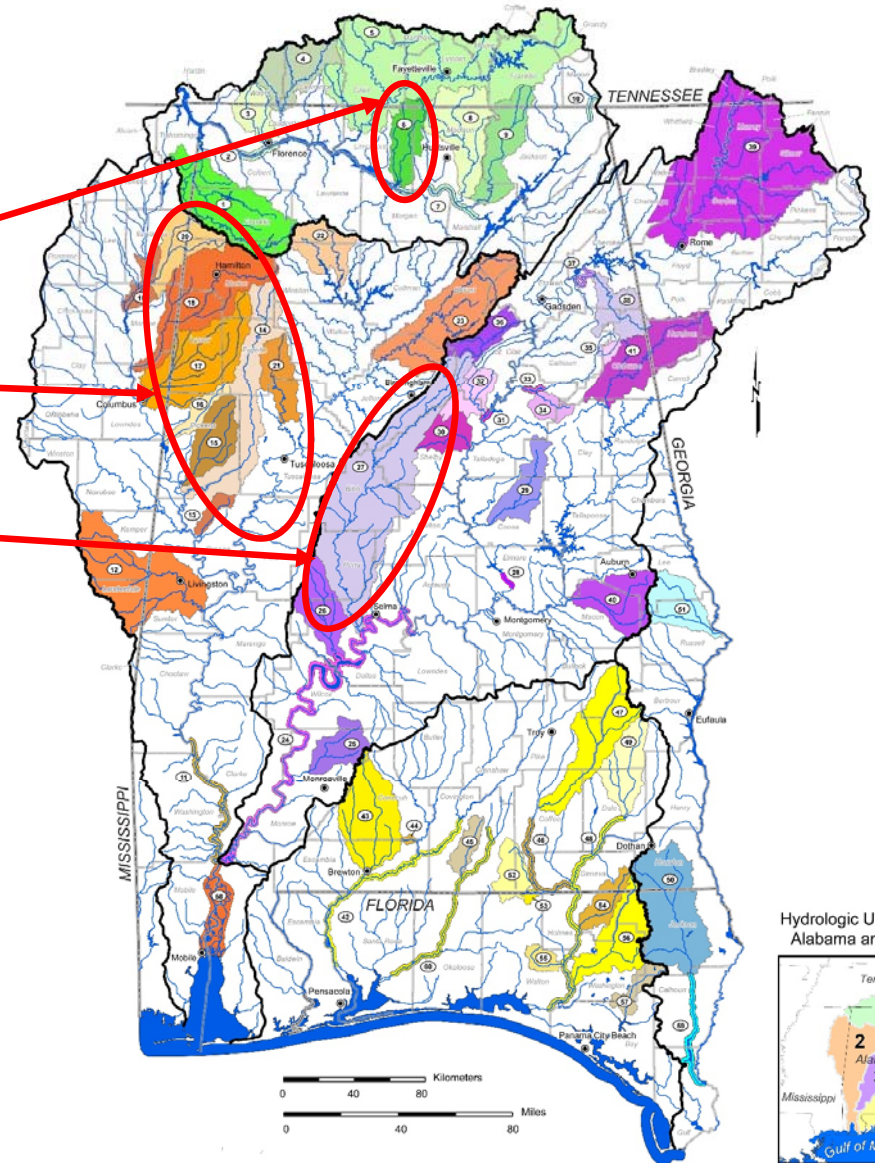


AMERICAN MUSEUM  
OF NATURAL HISTORY

**UWA**  
The UNIVERSITY of  
WEST ALABAMA

# At least 6 SHUs

1. Beaverdam Creek
2. Upper Tombigbee
3. Cahaba
4. Locust Fork
5. Hatchet Creek
6. Big Canoe Creek

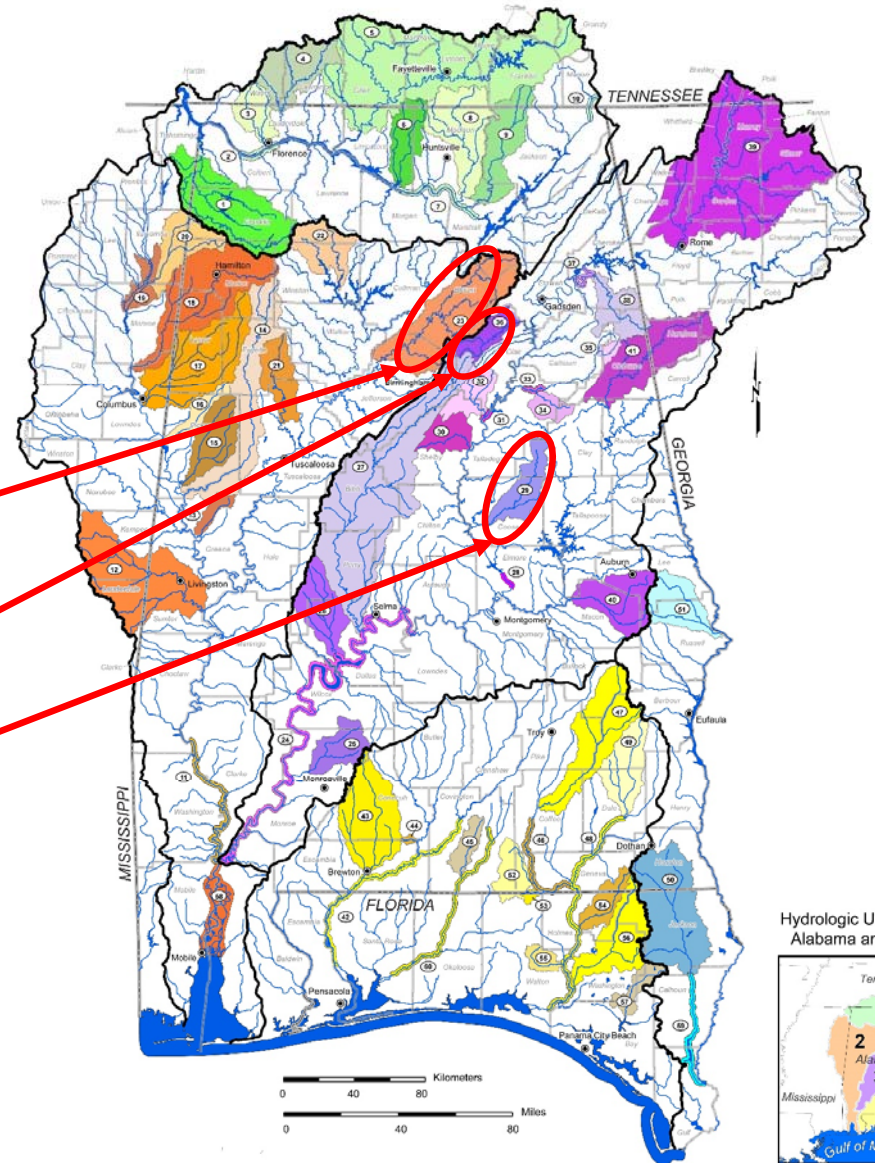


Hydrologic Unit-4 subregions in Alabama and adjacent states



# At least 6 SHUs

1. Beaverdam Creek
2. Upper Tombigbee
3. Cahaba
4. Locust Fork
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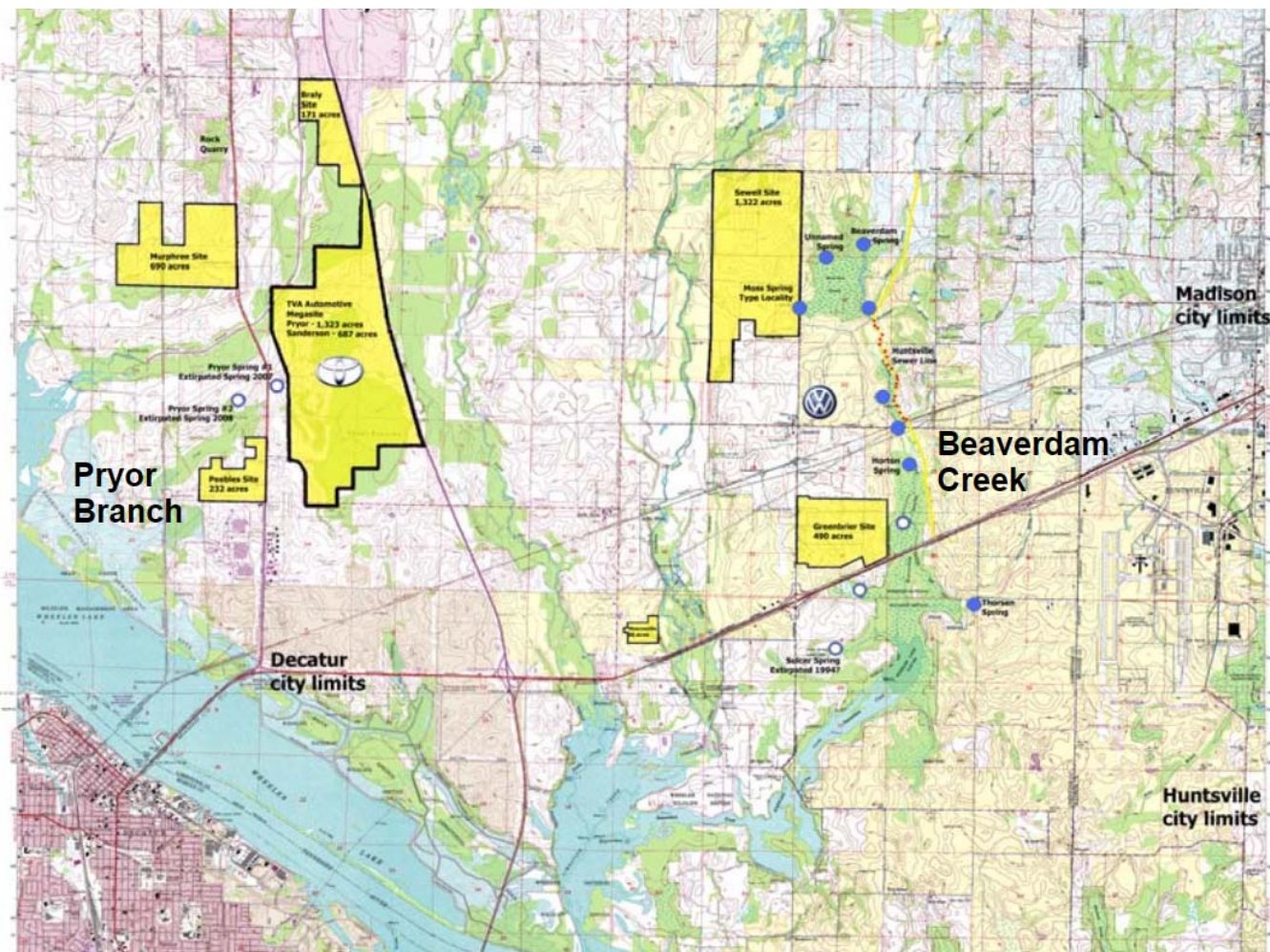
Hydrologic Unit-4 subregions in Alabama and adjacent states



# *Elassoma alabamiae* (Spring Pygmy Sunfish)

- Twice thought extinct
  - 1937 – Discovered at Cave Spring, Lauderdale County
  - 1938 – Extirpated due to creation of Pickwick Reservoir
  - 1950's – Discovered at Pryor Branch, Limestone County
  - 1960's – Extirpated at Pryor Branch, Agricultural herbicides
  - 1974 – Rediscovered at Moss Spring
  - 1984 – Reintroduced to Pryor Branch
  - 2005-2011 – ADCNR & USFWS surveys
  - 2007/8 – Re-extirpated at Pryor Branch
  - 2008 – Volkswagen and Toyota Proposals
  - 2009 – Petitioned for ESA protection
  - 2013 – Listed as “Threatened”
  - 2015 – Discovered at Blackwell Swamp, Wheeler NWR
  - 2018 – Mazda/Toyota Announcement
  - 2018 – Mazda/Toyota Agreement

# *Elassoma alabamae* (Spring Pygmy Sunfish)



# *Elassoma alabamae* (Spring Pygmy Sunfish)

- *Campeloma* sp cf. *decampi* (Slender Campeloma)
- *Eurycea* sp cf. *aquatica* (Brownback Salamander)
- *Etheostoma* Tuscumbia (Tuscumbia Darter)
- *Hemitrema flammea* (Flame Chub)
- *Crangonyx* sp. (Amphipod)



# Population Genomics and eDNA

- *Noturus munitus* (Frecklebelly Madtom)
- *Percina brevicauda* (Coal Darter)
- *Etheostoma trisella* (Trispot Darter)
- *Sander* sp. cf. *vitreus* (Southern Walleye)





# 2018 Toyota Agreement

- 1,100 acres in easement or under care of North Alabama Land Trust
  - Possibly going to Forever Wild program
- \$2 million for immediate restoration efforts
- \$4 million for long term conservation endowment
- 6 member scientific advisory board
- Diverse strategies in conservation biology....
  - Clean water is a strategic approach
  - Other approaches can be tactical



# Phylogenomics of the Southernmost Sculpins (Perciformes: *Uranidea*)

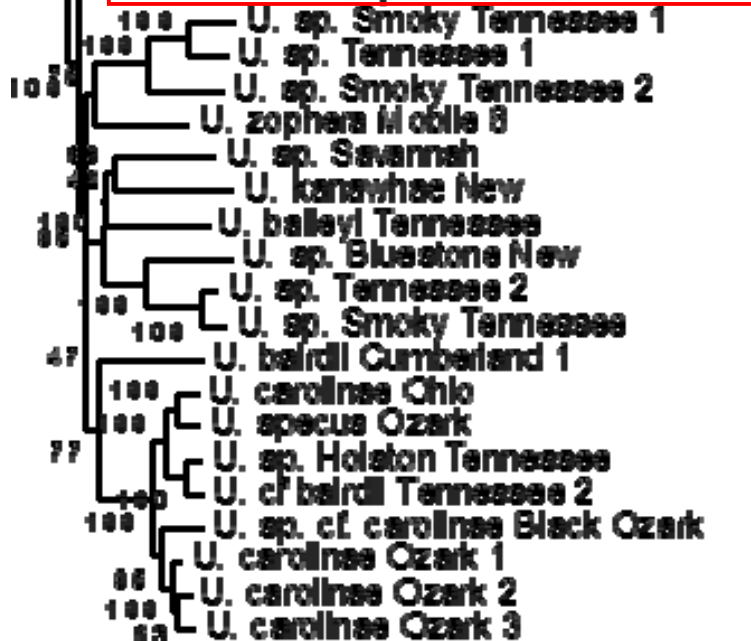
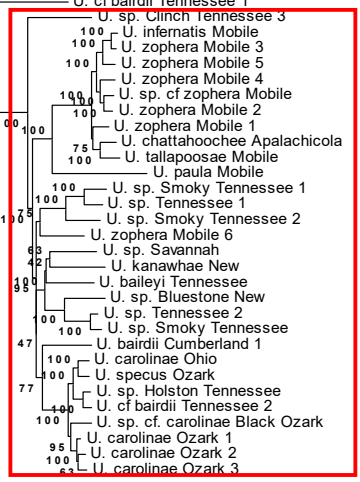
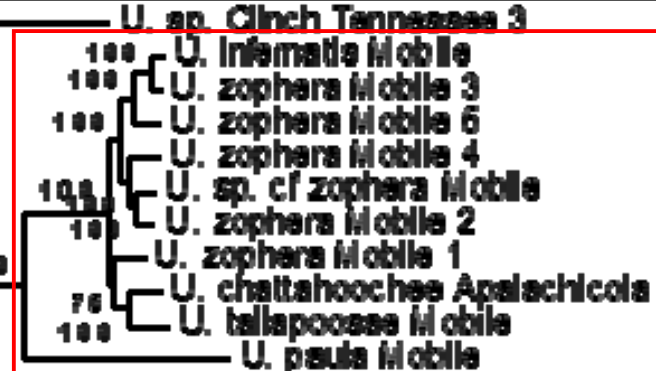


Joshua Millwood<sup>a</sup>, Michael Sandel<sup>b\*</sup>, David Neely<sup>c</sup>



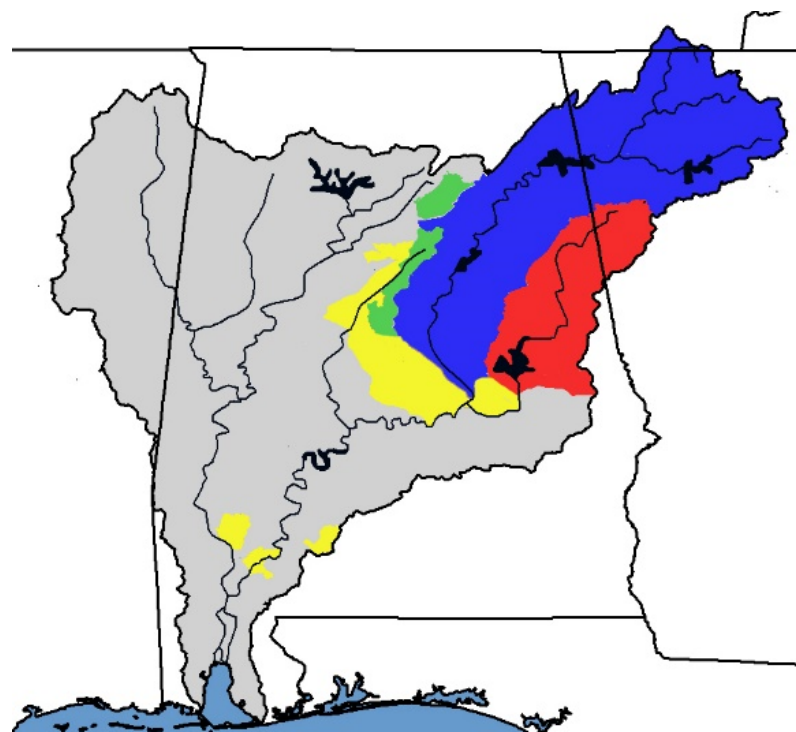
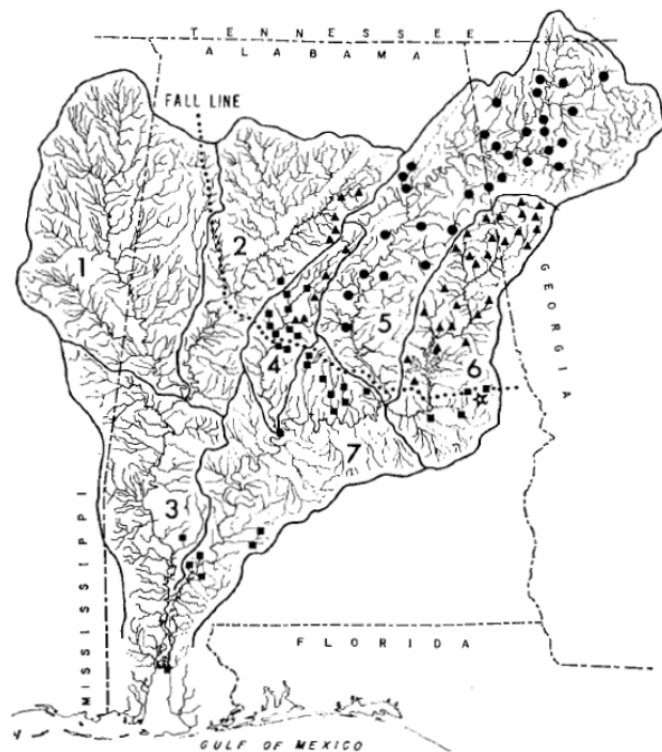
a: The University of Alabama, Department of Biological Sciences, Tuscaloosa, AL  
b: The University of West Alabama, Department of Biological and Environmental Sciences, Livingston, AL  
c: The Tennessee Aquarium Conservation Institute, Chattanooga, TN

# Complete mtDNA exome



# Southernmost Sculpins

Williams and Robins (1970)

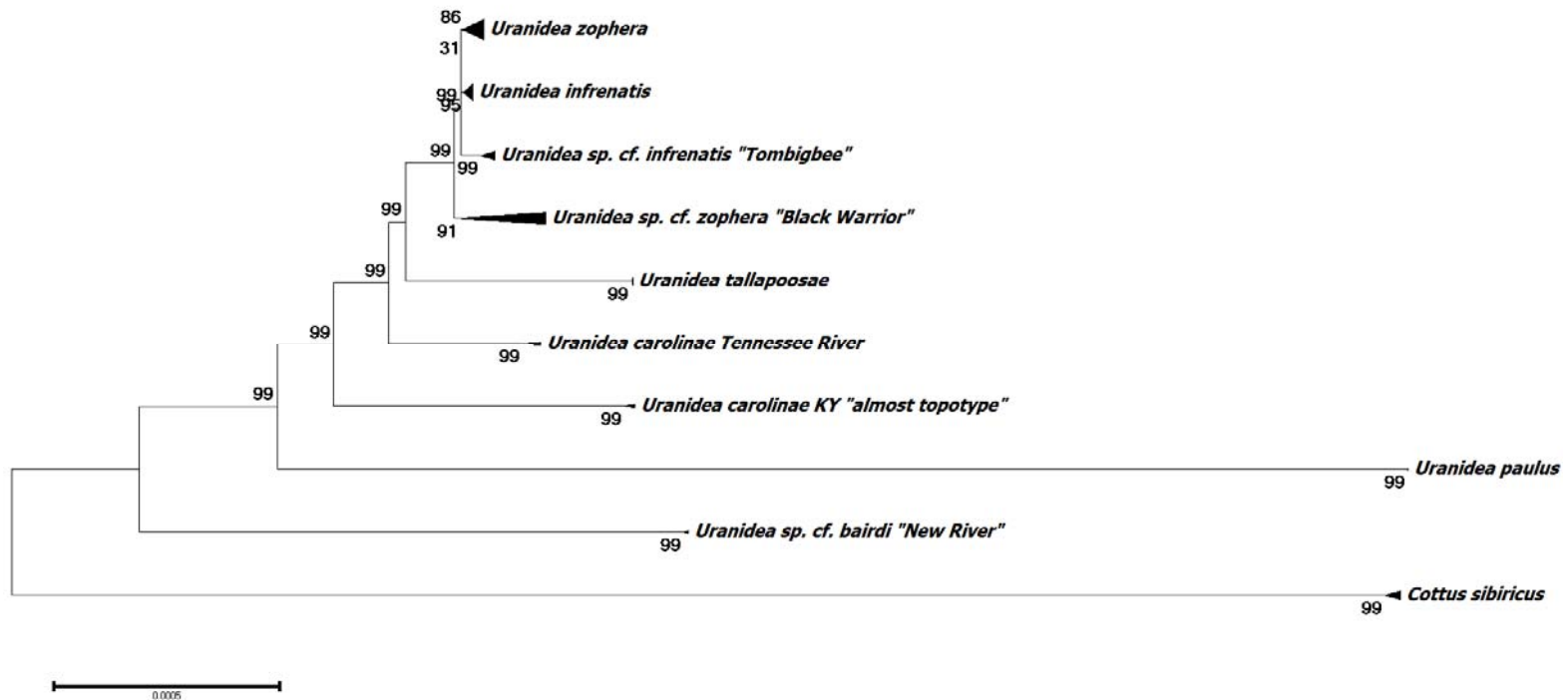


# Southernmost Sculpins

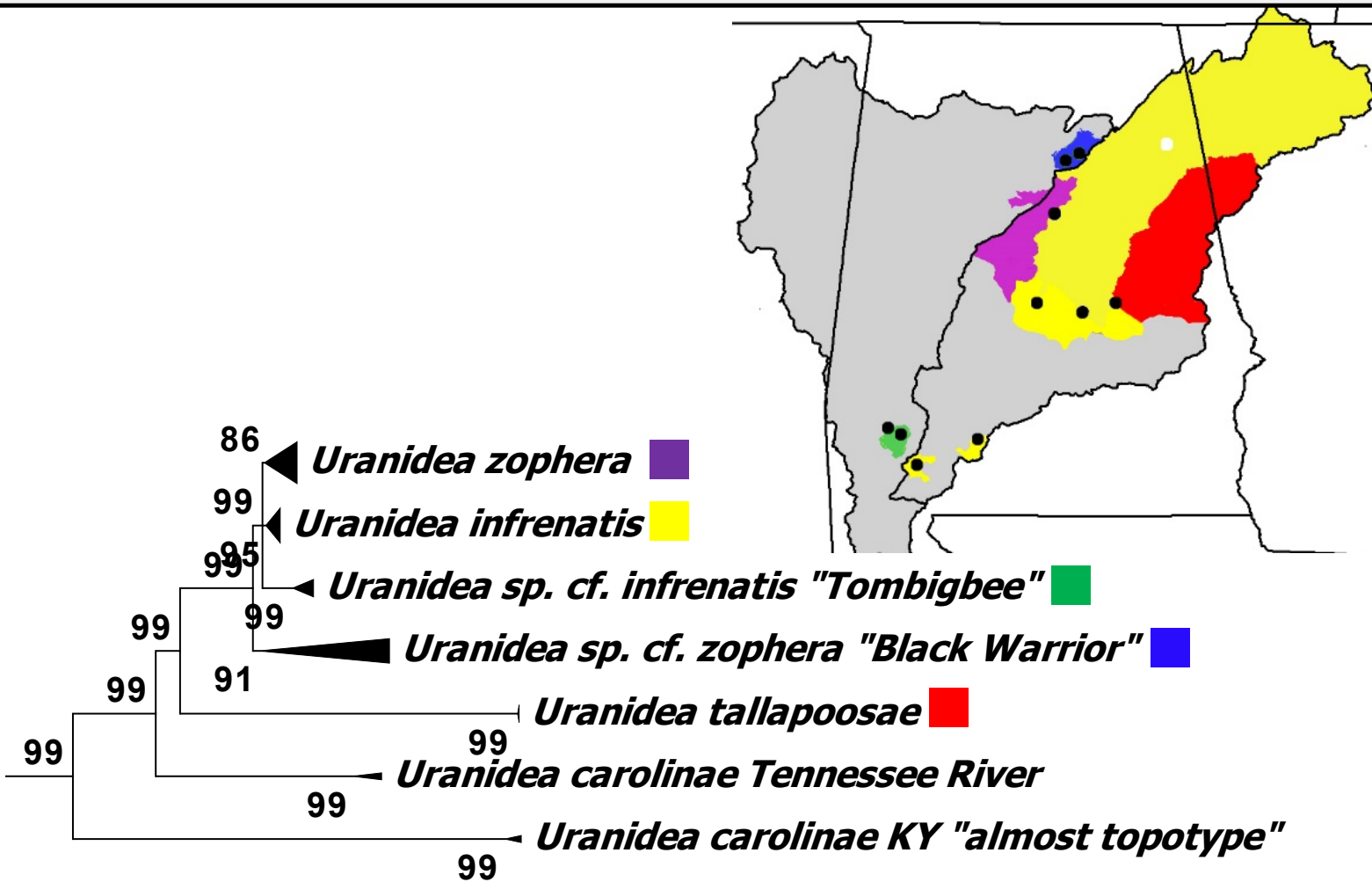
DArTseq – Similar to ddRADseq (but better)

120,000 markers -> 13,000

52 individuals



# Southernmost Sculpins



# Southernmost Sculpins

*Uranidea* sp. cf. *zophera* "Black Warrior"



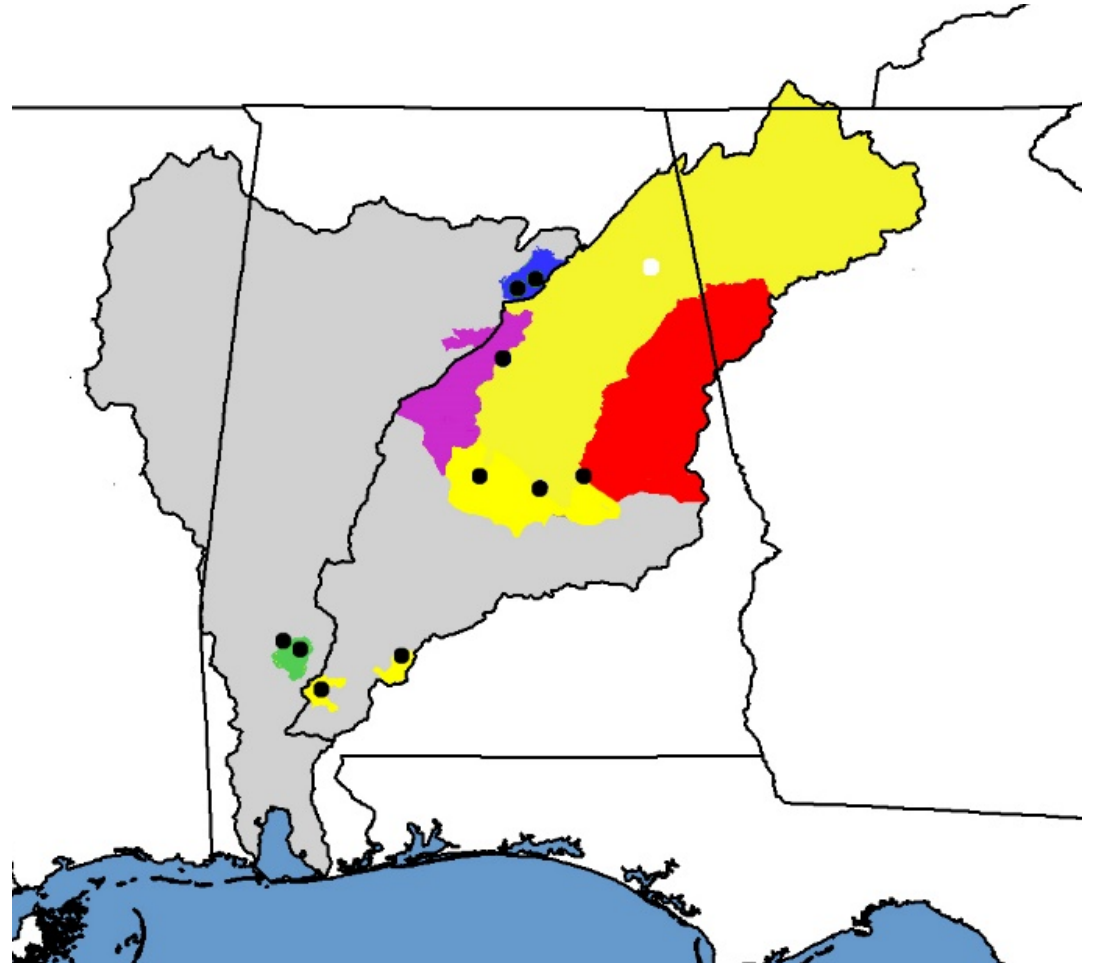
Five Mile Creek



Locust Fork

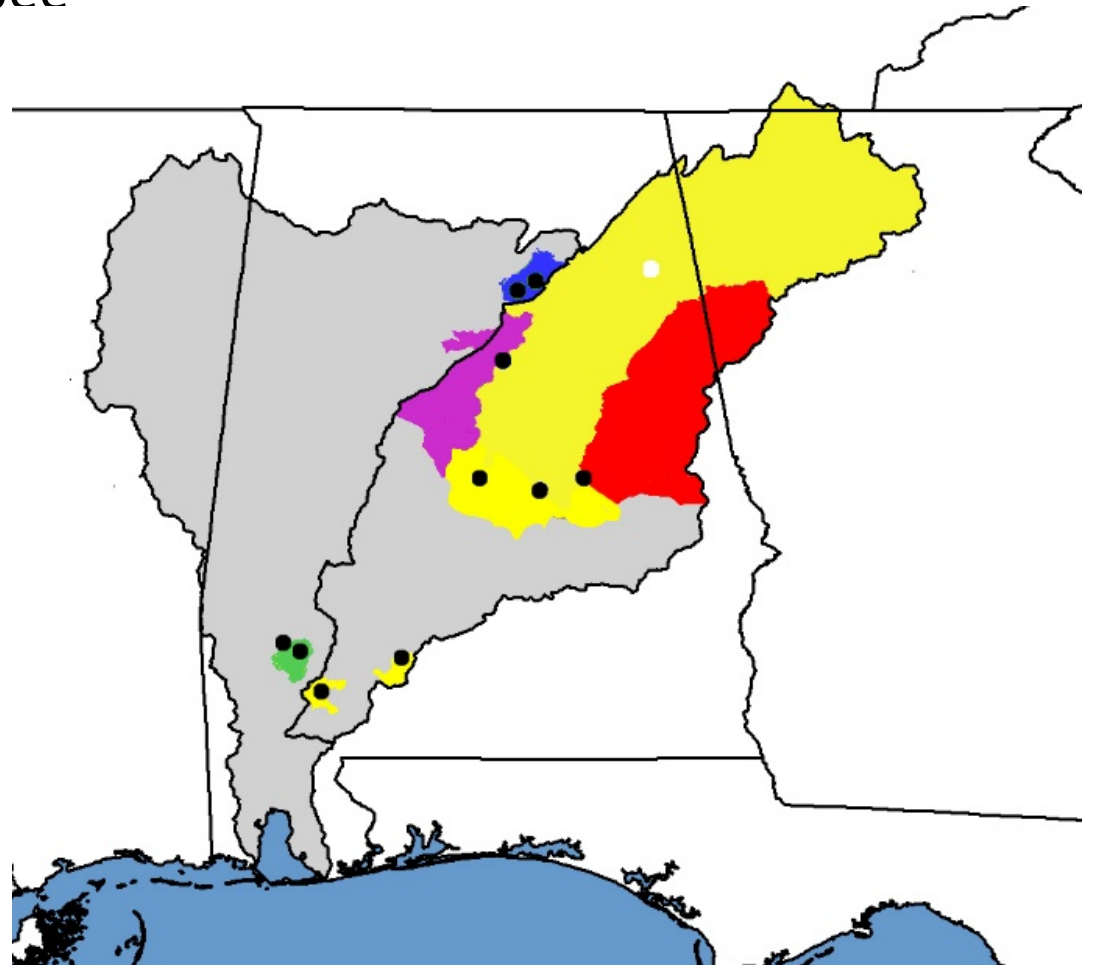


Mulberry Fork



# Southernmost Sculpins

*Uranidea* sp. cf. *zophera* "Tombigbee"





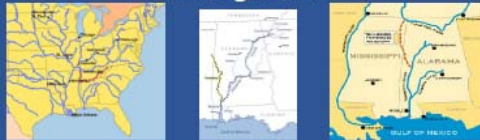
# An Aquatic Melting Pot: Mapping Genetic Homogenization Among Fish Populations of the Tenn-Tom Waterway

Patricia K. Schellhammer\* and Michael W. Sandel  
The University of West Alabama, Livingston, AL

## Abstract

The Tennessee and Mobile River Basins represent the two most biodiverse watersheds in North America, unfortunately, the same rivers are now recognized for their imperilment, as they are home to a number of threatened and endangered species. Many fish populations of the Mobile River Basin are recognized as distinct endemic species. Genetic homogenization, therefore, represents a threat to native biodiversity in Alabama by the loss of heritable variation. In 1984, with the completion of the Tenn-Tom waterway, the Mobile and Tennessee River basins united hydrologically, providing an opportunity for gene flow between fish populations that had been separated for at least 5 million years. Examining mitochondrial DNA variation in the Bullhead Minnow (*Pimephales vigilax*) across in the Tennessee River, Mobile River, and neighboring watersheds along the Gulf Coast we find evidence for distinct native haplogroups with genetic exchange along the Tenn-Tom waterway.

## Background

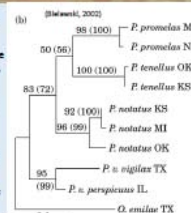


The Tennessee River is the biggest tributary of the Ohio River, the confluence of the two is at Paducah, Kentucky. The Tennessee River runs from the northeastern quarter of Tennessee southward to the Tennessee, Mississippi, Alabama border at Pickwick Dam, then continues eastward toward Decatur and Huntsville, Alabama, at which point it meanders northeast to Knoxville, Tennessee. The Tenn-Tom waterway starts just south of luka, MS in Bay Springs, MS and flows southward through Aberdeen and Columbus, MS at which point it transitions from Mississippi to Alabama at Aliceville, and continues south to Demopolis, AL. The Tombigbee River continues to Mobile, AL.

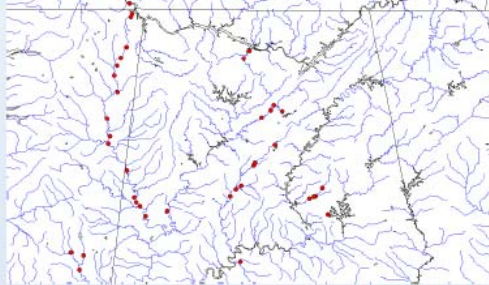
## *Pimephales vigilax*



The Bullhead Minnow, *Pimephales vigilax*, is commonly found in large rivers, occasionally in lakes, and rarely in small rivers; they prefer clear water with sand, mud, or fine gravel substrate. During their spawning season May-August, the male selects a cave-like pocket such as the underside of a fallen log, the hollowed out crevasse of a rock, and, in artificial conditions, pipes, flower pots, and tiles. The female will then lay her adhesive eggs in the shelter and the male will: clean, aerate, and usually continue to guard the nest up to a day after all the eggs hatch. *Pimephales vigilax perspicuus* has been classified as a subspecies, morphologically the breeding males have more tubercles, and "...the degree of exposure of the jaws..." (Cross, 1953) Genetically there is a 5.31% difference between *Pimephales vigilax vigilax* and *Pimephales vigilax perspicuus* (Schmidt, 1994).



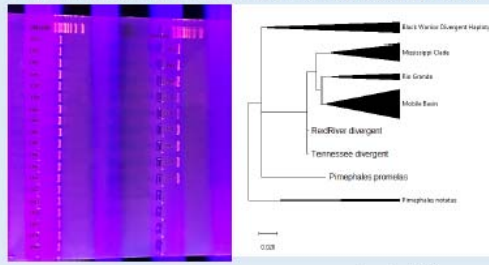
## Methods



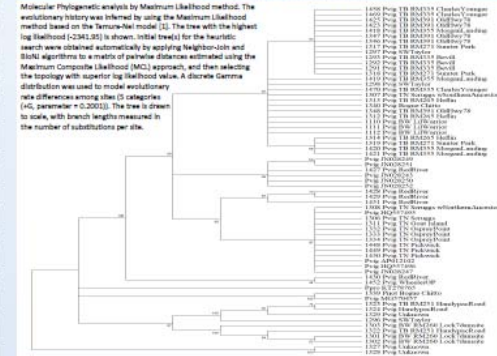
**Finding Localities:** The website: <http://www.fishnet2.net/> was used to find sources where *Pimephales vigilax* had been previously collected. Google Earth was used to confirm access to the water, and Google Maps was used to receive directions to the various localities.  
**Collecting:** At the destinations, the methods of capture used were seining and dip netting.  
**Field Identification:** The Bullhead Minnow is somewhat green/yellow dorsally, and silver ventrally. Bullheads have a distinct lateral line, with a well contrasted spot on the dorsal and caudal fins.  
**Preserving:** To preserving the Bullhead Minnow acetone was used in 50ml tubes.

## DNA Extraction and Sequencing

**QIAGEN:** DNA extraction kit, DNeasy protocol.  
**PCR:** Polymerase Chain Reaction, the method used to amplify DNA, GE Healthcare illustra™ PuReTaq Ready-To-Go™ PCR Beads.  
**Gel Electrophoresis:** DNA samples mixed with loading dye and put into wells to see how long the DNA sequences are.  
**Spectrophotometry:** A machine that assess the concentration of DNA in solution.  
**EXOSAP-IT:** This process chemically removes the fragmented sequences from PCR product.

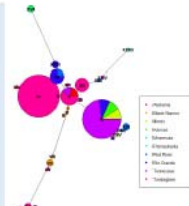


## Results & Discussion



The Maximum Likelihood phylogeny of COI haplotypes (above) indicates transfer of haplotypes from the Tombigbee River Watershed into the Tennessee River.

The Minimum Spanning Network (right) was generated with the Pegas package in the R computing environment. This network indicates sharing of haplotype "X" among the Tombigbee and Tennessee watersheds.



- Our results indicate that mitochondrial haplotypes for *Pimephales vigilax* do not form a monophyletic clade.
- Samples from the Black Warrior River are highly divergent from all conspecifics.
- Some haplotypes from the Tennessee River near the Ten-Tom connection are also widespread throughout the Tombigbee watershed.
- We tentatively interpret these results as evidence of gene flow between Tennessee and Tombigbee River populations, specifically upstream migration of Mobile Basin haplotypes into the Tennessee Watershed.
- Additional population samples and molecular markers are needed to fully address gene flow facilitated by the Tenn-Tom waterway.

### References and Acknowledgments

Bielewski JF, Brault A, Gold JR. Phylogenetic relationships within the genus *Pimephales* as inferred from ND4 and ND4L nucleotide sequences. *Journal of fish biology*. 2002 Jul;61(1):293-7.  
Cross FB. Nomenclature in the Pimephalini, with special reference to the bullhead minnow, *Pimephales vigilax perspicuus* (Girard). *Transactions of the Kansas Academy of Science* [1903-]. 1953 Mar 1;56(1):92-6.  
Schmidt TR, Dowling TE, Gold JR. Molecular systematics of the genus *Pimephales* (Teleostei: Cyprinidae). *The Southwestern Naturalist*. 1994 Sep 1:241-8.  
This experiment could not have been conducted without the help of: The University of West Alabama Office of Student Affairs, Kenny Jones, John Lammore, Meagan E. Machholz, and Sophie M. Thompson.

## Tenn-Tom Timeline

