Fish Host Identification for Selected Freshwater Mussel Species in Texas Currently in Status Review for Listing Under the Endangered Species Act

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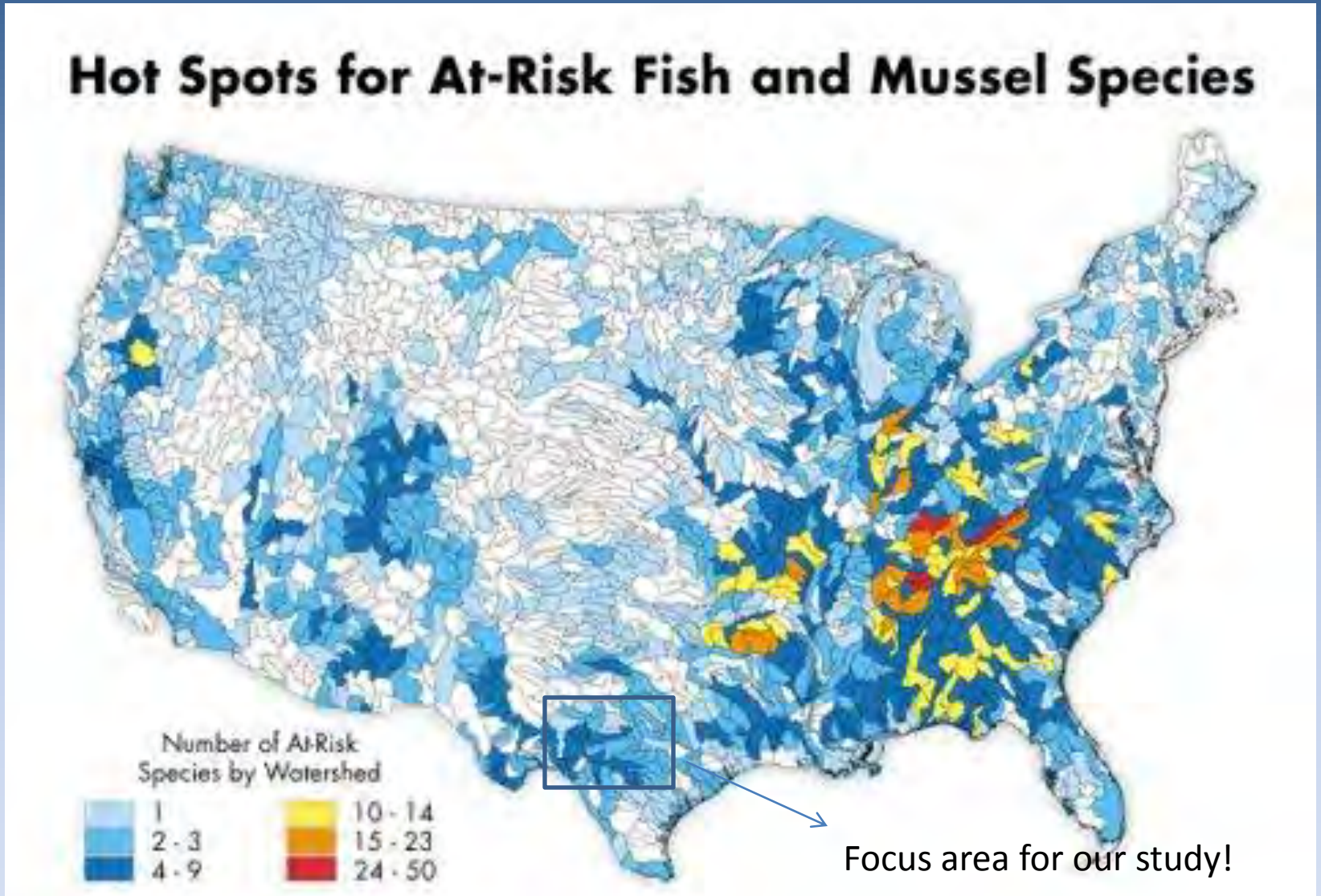


-from NatureServe-Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity, 2011

Watersheds with 10 or more at risk fish and freshwater mussel species.

Status of Freshwater (Family Unionidae) Mussels

- United States has a higher diversity of mussels that any other country on Earth….approx. 300 species!
- Most imperiled faunal group in the United States.
- Of the 297 species known to occur in the U.S. and Canada, 12% are extinct, 23% are considered threatened or endangered, and 43% are in need of conservation status.
- About 52 species of freshwater mussels known from Texas.

Why are Freshwater Mussels so Imperiled!

- Unionids are long-lived sedentary organisms.

Photo Credit: Marie Fernandez, USFWS

- Many species require an intermediate host to complete their life cycle and for dispersal.

- Because most freshwater mussels require an intermediate host for dispersal, mussel populations are very “patchy” in their distribution.

Mussels populations typically occur as Metapopulations!

Background

- U.S. Fish and Wildlife Service petitioned in 2007-08 by Wild Earth Guardians to consider 12 species for federal listing that occur in Texas and adjacent states.
- Beginning in 2011, 11 of 12 species currently under status review by FWS.
- Texas Parks and Wildlife has listed these 12 and 3 more as threatened in Texas.
- Half of the species occur only in Texas.

State of Texas Listed Species (SL) and Petitioned (P) Species

Texas pigtoe (SL)
Triangle pigtoe (SL, P)
Texas fatmucket (SL, P)
Sandbook pocketbook (SL)
Southern hickorynut (SL)
Louisiana pigtoe (SL, P)
Texas hornshell (SL)
Texas heelsplitter (SL, P)
Salina mucket (SL, P)
Golden orb (SL, P)
Smooth pimpleback (SL, P)
Texas pimpleback (SL, P)
False spike (SL, P)
Mexican fawnsfoot (SL, P)
Texas fawnsfoot (SL, P)

Fish Hosts

Study

Texas fatmucket
(*Lampsilis braceata*)

Golden orb
(*Quadrula aurea*)

Smooth pimpleback
(*Quadrula houstonensis*)

Texas pimpleback
(*Quadrula petrina*)

Texas fawnsfoot
(*Truncilla macrodon*)

Five Texas Endemics

Three congeners (*Quadrula* sp.)

Golden orb

Smooth pimpleback

Texas fatmucket

Texas pimpleback

Texas fawnsfoot

-Mussel photos from University of North Texas Digital Library (http://digital.library.unt.edu/)

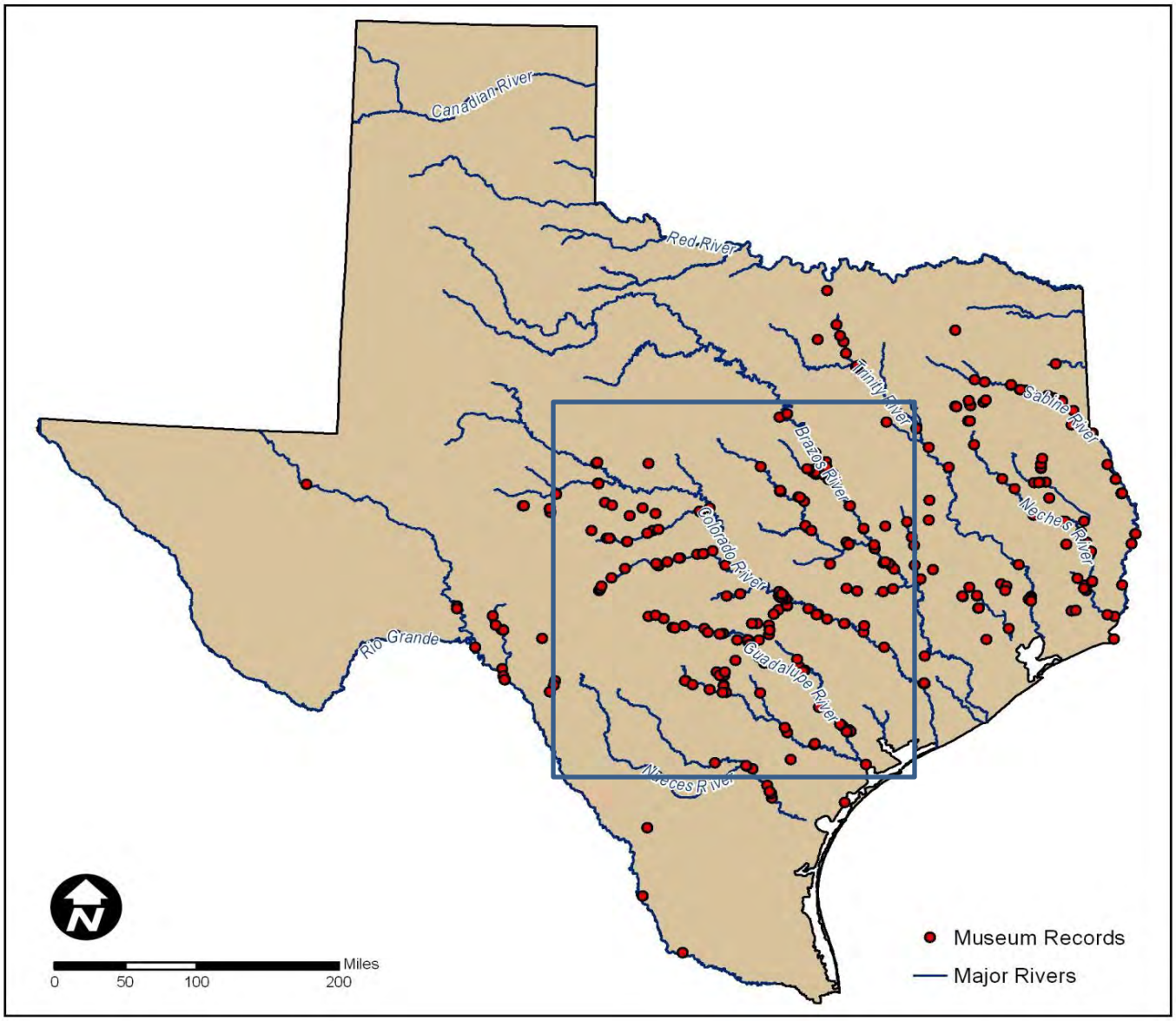
Objectives

- Identify native fish hosts of five Texas endemic freshwater mussels that are currently under status review by U.S. Fish and Wildlife Service (FWS).

- Provide critical information to FWS to help with conservation plans and potentially prevent the listing of species currently under review.

Specific Tasks

- Locate established populations of the five candidate species and complete quantitative surveys of the resident mussel community.
- Develop a DNA identification key for all native mussels from each study site.
- Determine mussel and fish host relations through DNA typing of glochidia from fish hosts.



Distribution of listed species in Texas (From Winemiller and others (Texas A&M), 2010)

Texas fatmucket
- Upper Colorado, Guadalupe, and San Antonio

Golden orb
- Guadalupe, San Antonio, Nueces, and Frio

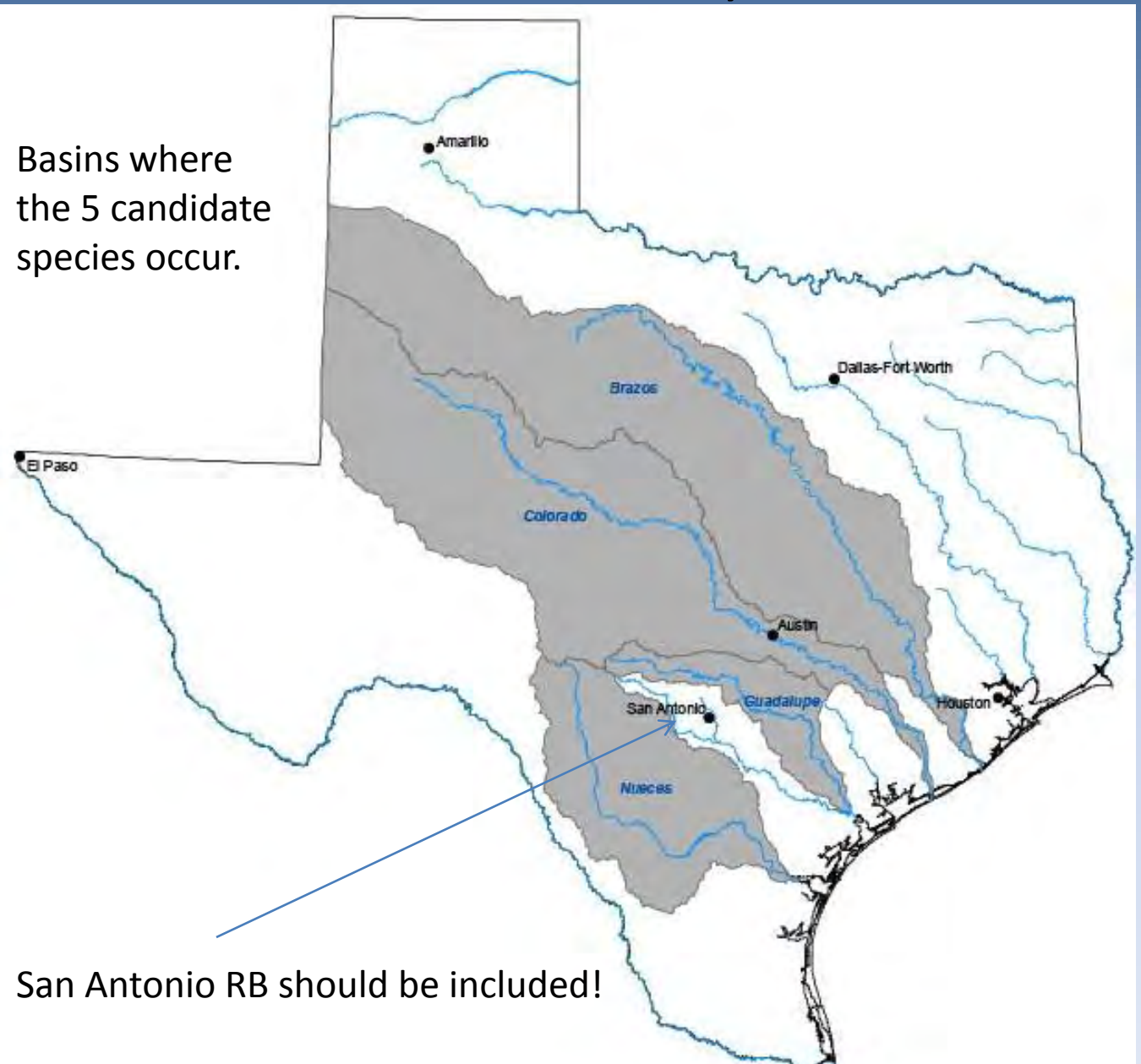
Smooth pimpleback
- Brazos and Colorado

Texas pimpleback
- Colorado, Guadalupe, and San Antonio

Texas fawnsfoot
- Brazos and Colorado

Locate Study Sites

Basins where the 5 candidate species occur.



San Antonio RB should be included!

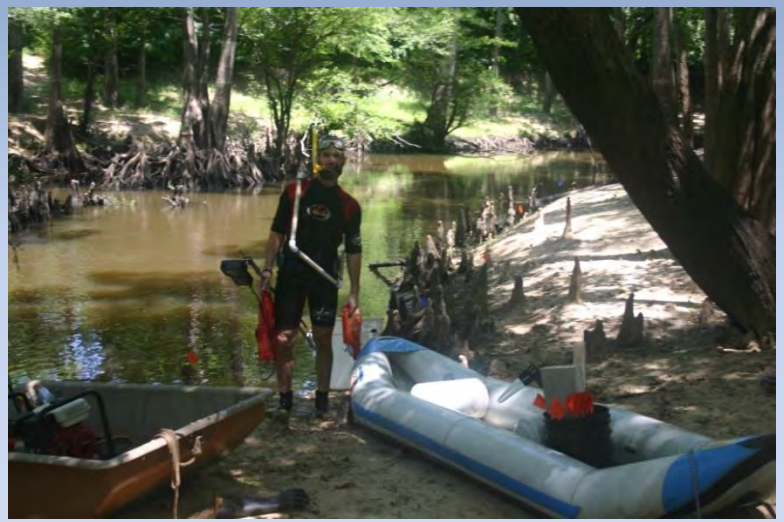
-Locate sites where two or more of the candidate species are collocated.

-Collaborate with others (TX A&M, TPWD, TXDOT, UNT, Bob Howells) who are currently doing mussel surveys.

-Locate sites with diverse age structure and other indications of good recruitment.

Mussel Surveys (Spring and Summer, 2012)

- Systematic and quantitative surveys to determine community composition, population structure, and habitat use (Strayer and Smith, 2003).



Experience doing mussel surveys in Cypress Basin(s)

- Collect tissue from adult mussels for development of DNA key.

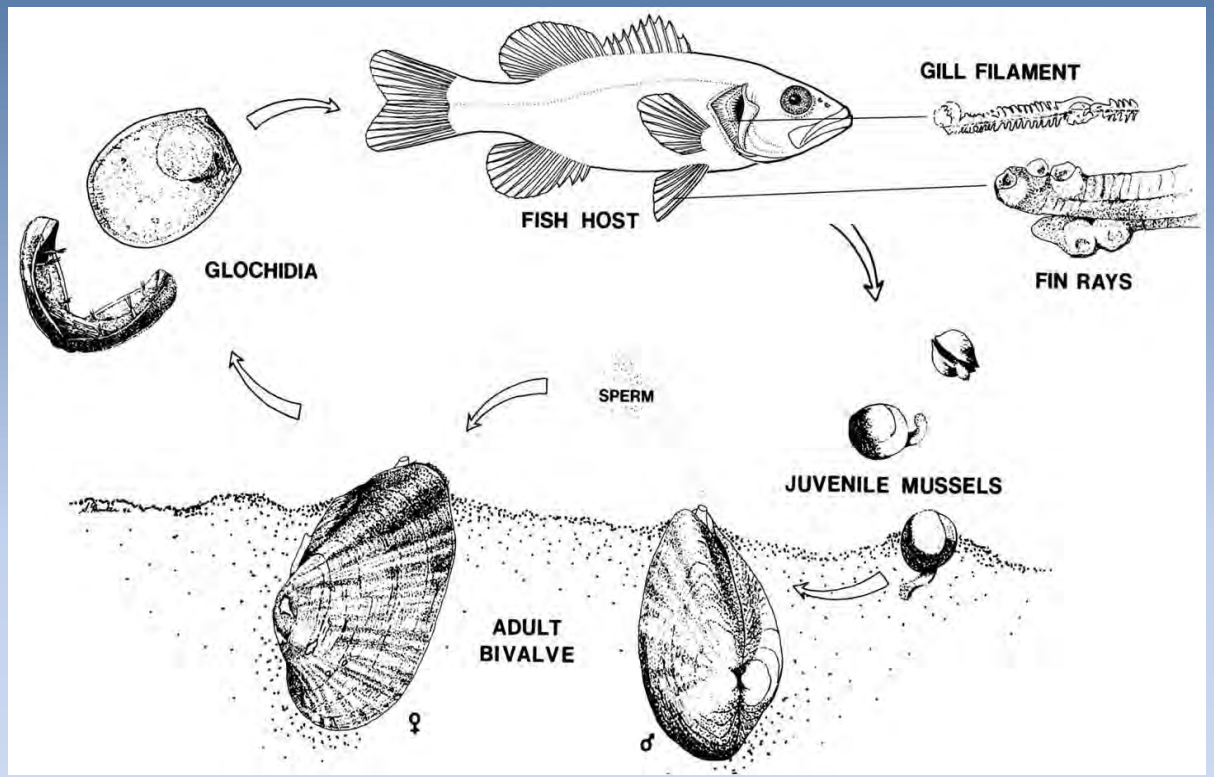
Glochidia and Fish Hosts (2013)

- Collect glochidia from gravid adult mussels and additional adult tissue as needed.

- Collect fish and hold parasitized fish hosts (by species) at the San Marcos National Fish Hatchery to allow glochidia to release for collection and subsequent DNA typing.

- Each glochidia will be sent to the USGS SE Ecol. Center for DNA-based molecular identification and matching with adult DNA.

Typical Life Cycle of Freshwater Mussel



Fleshy structure on muscular foot of mussel to attract fish!

Texas fatmucket — Bradytictic spawners

Golden orb
Texas and smooth pimplebacks
Texas fawnsfoot
— Tacytictic spawners

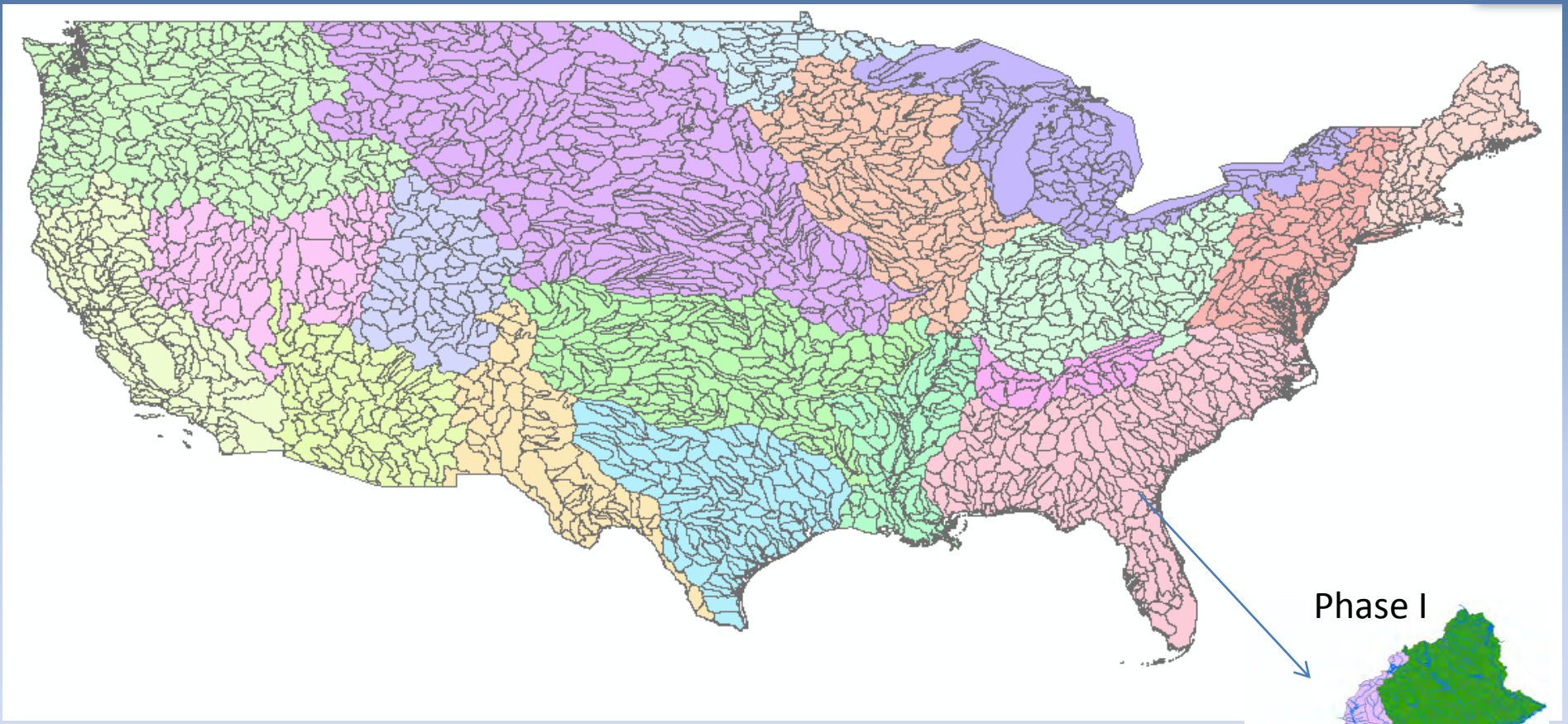
DNA Typing (DNA Barcoding!)

- Genetic method for identifying unknowns.
- Use short DNA sequences to compare to database of “referenced” DNA sequences.

DNA Barcoding: Required Info. for DNA Reference Specimen

- Museum voucher (photographs)
- Locality info., collectors, data of collection.
- Valid taxonomic ID.
- Standard gene region (75% of targeted gene = min. of 500 nucleotides in length).
- 3 or more reference specimens per species.

Project UnioBarcode



Leading Phase I of UnioBarcode
- USGS Southeast Ecological Center
- University of Florida
-Florida Museum of Natural History

Products of Texas Fish Hosts Study

- Yearly progress reports to FWS.
- DNA reference database for adult mussels in publically accessible database (Sept 2012).
- DNA reference database for glochidia (Sept 2013).
- USGS Scientific Investigations report (2014)
- Journal article with focus on DNA barcoding results.
- Presentations of results at professional meetings.

Other Ongoing Freshwater Mussels Studies by the USGS Texas Water Science Center

- Community Composition and Habitat Use by Freshwater Mussels at Selected Environmental Flows Study Sites in the Cypress Basin(s).

- North Texas Zebra Mussel Monitoring Program.

Questions?

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