Molecular studies and their importance to mussel conservation: A case study of cryptic diversity in central and east Texas

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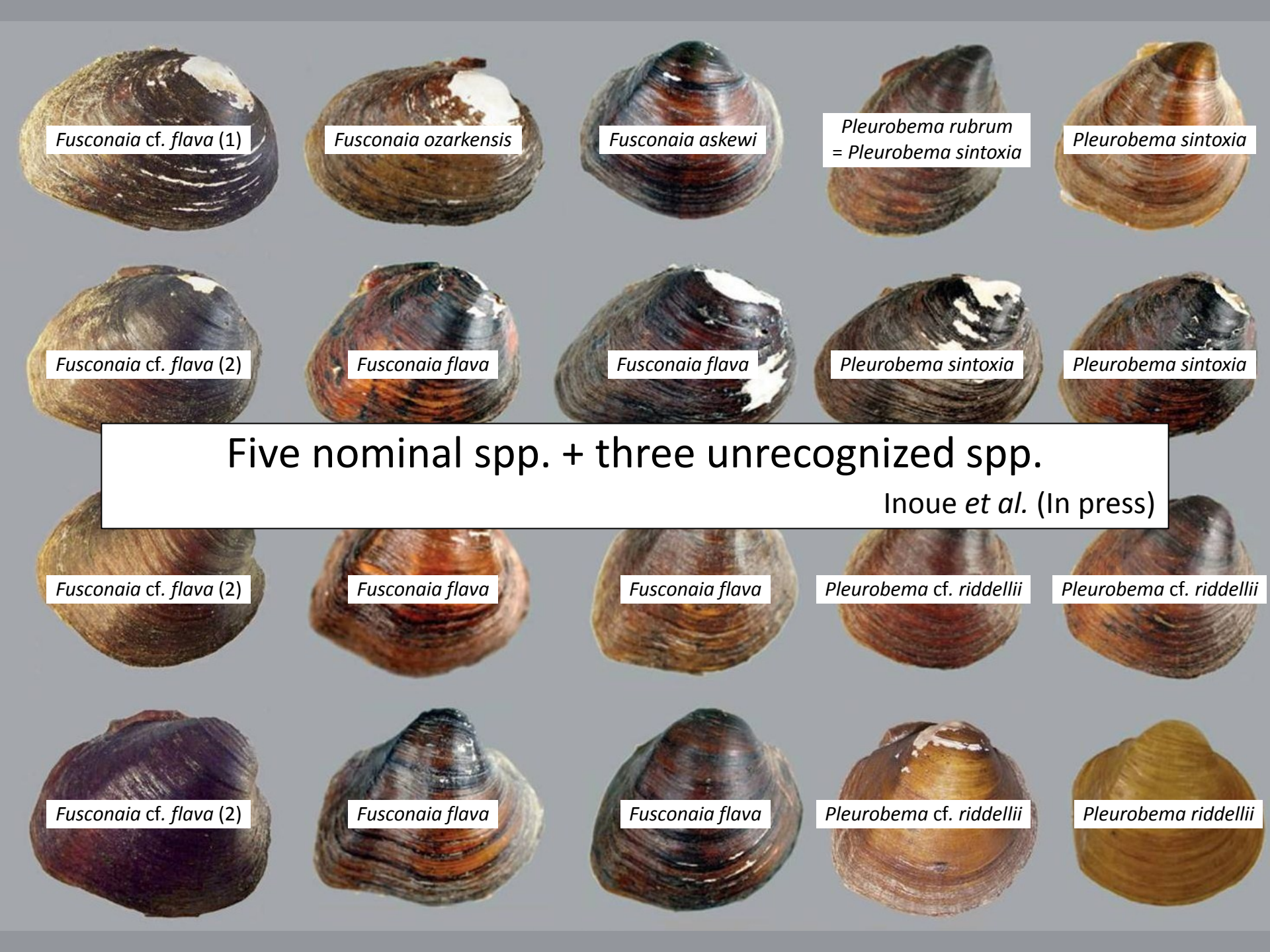

Five nominal spp. + three unrecognized spp.

Inoue *et al.* (In press)

Species identification is problematic

- Morphology- & geographic locality-based identification
  - Plasticity in shell morphologies
  - Taxonomic uncertainties

Correct identification of species is key to conservation

How to correctly identify species and populations?

- Molecular phylogenetics
  - DNA barcoding
  - Species delimitation
- Population genetics
  - Connectivity (gene flow)
  - Population structure

Conservation Framework

Research Needs for Freshwater Mollusk Conservation:

Priority 1:
- Systematics
- Status & Distribution

Priority 2:
Water Quality Limits
- DO
- pH
- Temperature
- Conductivity
- Toxicology

Priority 3:
Biological Data
- Diet - Feeding
- Reproduction
- Metabolism

Priority 4:
- Habitat evaluation
- Associative ecological data

Fusconaia mitchelli (False spike)

Conservation measures can be taken within current regulatory framework (ESA, CWA, etc.) but DATA ARE REQUIRED

P. Johnson, unpublished data

Few published genetic studies

* = limited genetic markers

Species	Phylogenetics/ Species Delimitation	Population Genetics
Fusconaia askewi	Yes	**No**
Fusconaia lananensis	Yes	**No**
Fusconaia mitchelli	Yes	Yes*
Lampsilis bracteata	**No**	**No**
Lampsilis satura	**No**	**No**
Obovaria arkansasensis	Yes	Yes*
Pleurobema riddellii	Yes	**No**
Potamilus amphichaenus	Yes	**No**
Potamilus metnecktayi	**No**	**No**
Popenaias popeii	Yes	Yes
Quadrula aurea	Yes	**No**
Quadrula houstonensis	**No**	**No**
Quadrula petrina	Yes	**No**
Truncilla cognata	**No**	**No**
Truncilla macrodon	**No**	**No**

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Truncilla spp.

- Four nominal species in Texas
  - *Trun*
    - E
    - C
  - *Trun*
    - N
  - *Trun*
    - E
    - **May occur in the Trinity River**
    - Candidate for listing
  - *Truncilla truncata*
    - Mississippi and Gulf coastal drainages

uncilla donaciformis

Truncilla macrodon

Truncilla truncata

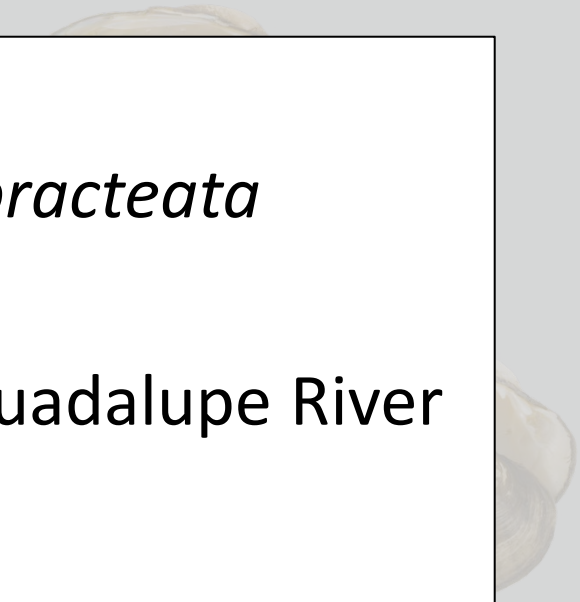
Questions

- Species boundaries within *Truncilla*
  - Taxonomic status of *Truncilla cognata*
- *Truncilla* sp. in the Trinity River
- Population genetic structure

Lampsilis bracteata

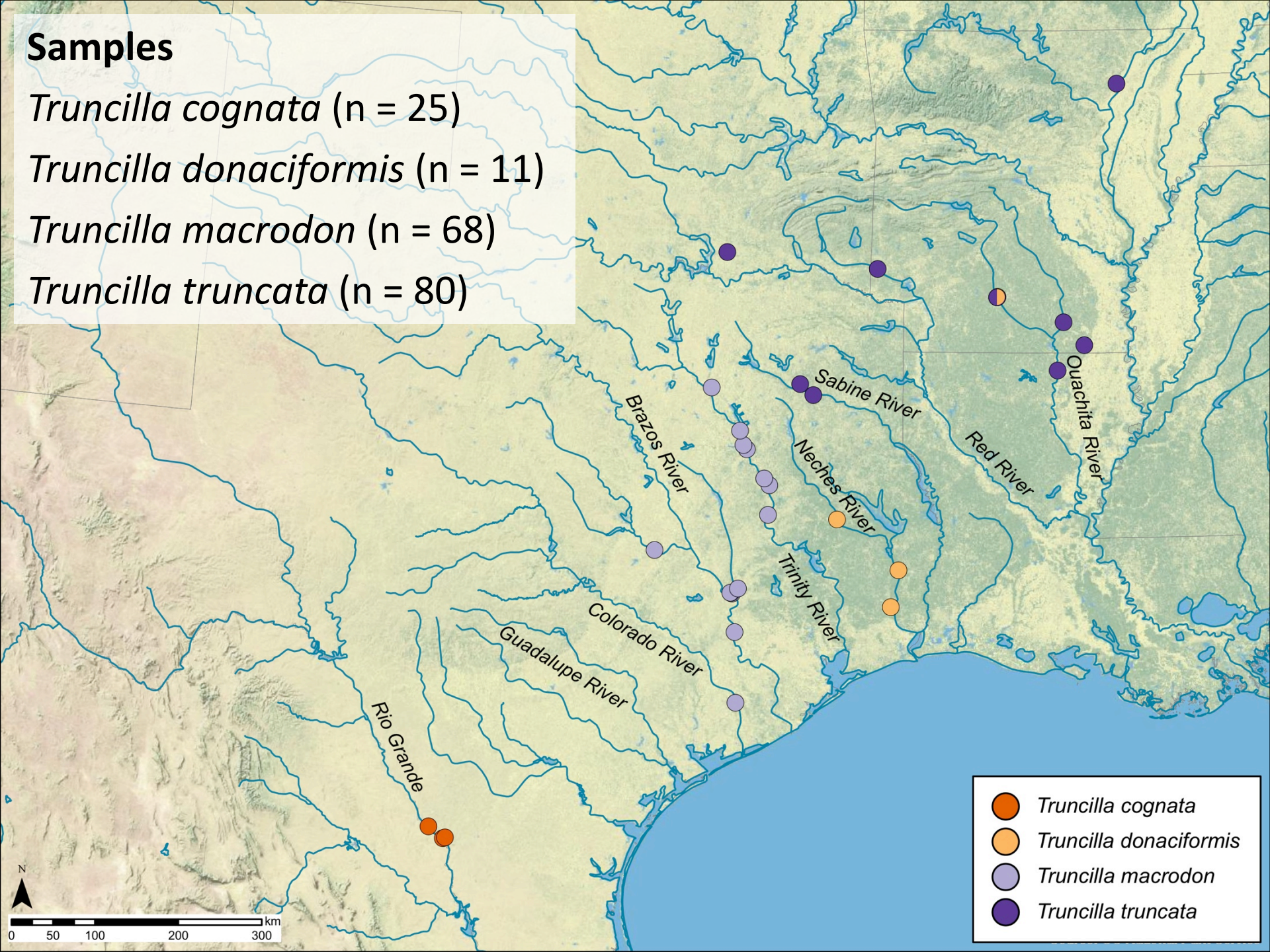
Questions

- Species boundaries within *Lampsilis bracteata*
  - In relation to *Lampsilis hydiana*
- *Lampsilis* cf. *bracteata* in the upper Guadalupe River
- Population genetic structure



Lampsilis cf. *bracteata*
(Guadalupe River)

Lampsilis hydiana
(Sabine River)


Samples
Truncilla cognata (n = 25)
Truncilla donaciformis (n = 11)
Truncilla macrodon (n = 68)
Truncilla truncata (n = 80)
Sabine River
Ouachita River
Red River
Brazos River
Neches River
Trinity River
Colorado River
Guadalupe River
Rio Grande
N
km
0
50
100
200
300
Truncilla cognata
Truncilla donaciformis
Truncilla macrodon
Truncilla truncata

Samples

Lampsilis bracteata (n = 75)

Lampsilis cf. *bracteata* (n = 14)

Lampsilis hydiana (n = 113)

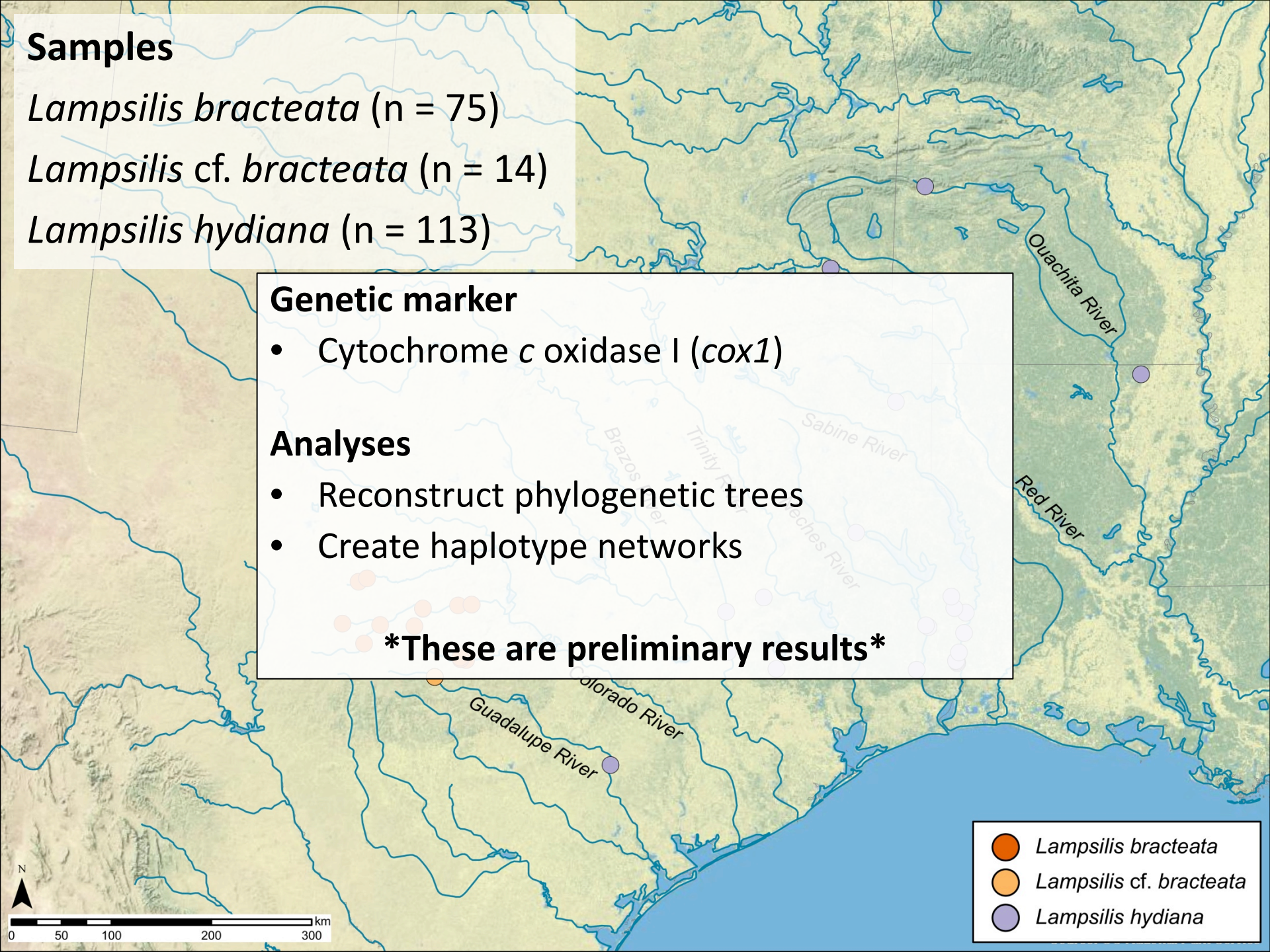
Genetic marker

- Cytochrome *c* oxidase I (*cox1*)

Analyses

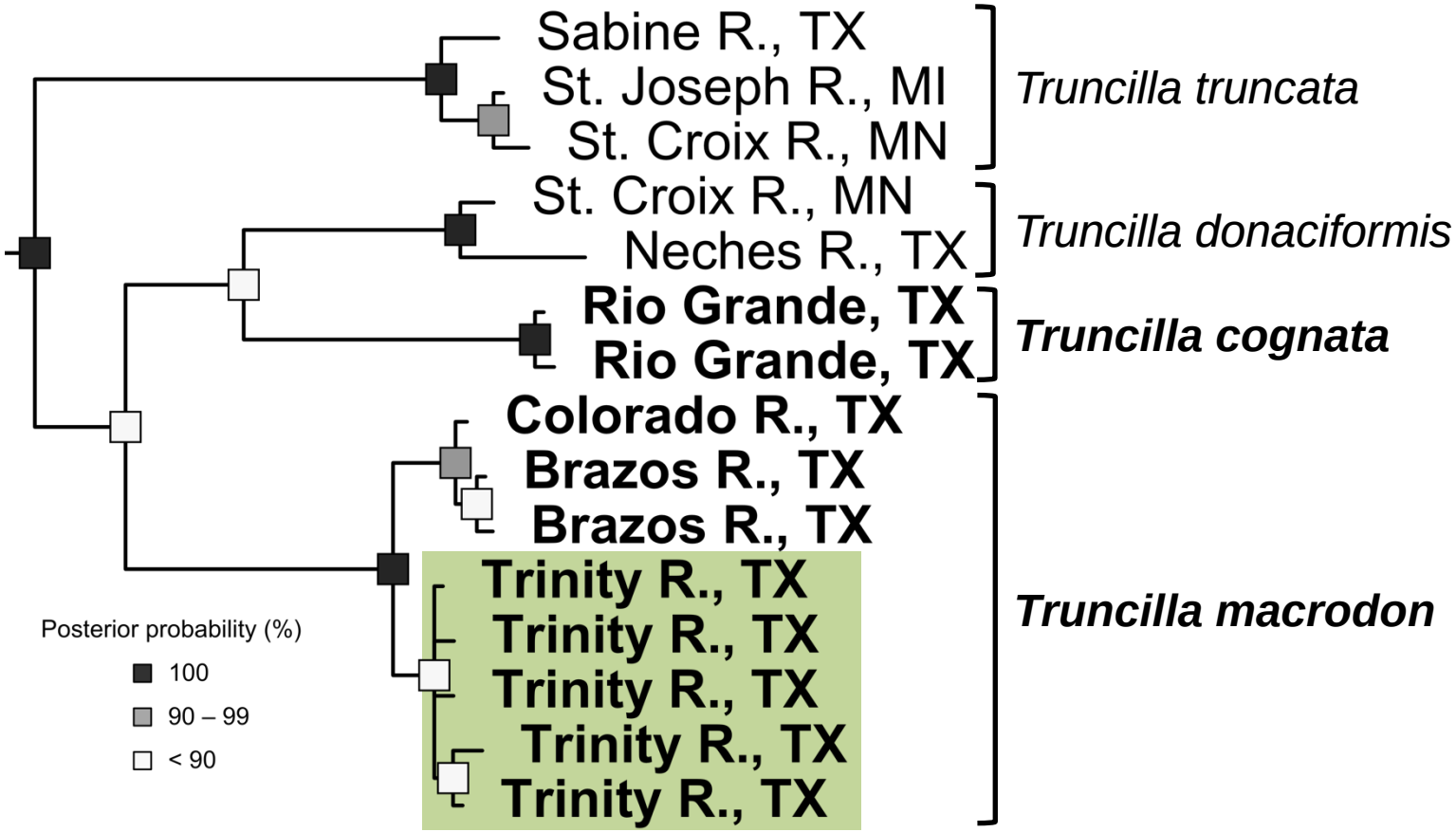
- Reconstruct phylogenetic trees
- Create haplotype networks

These are preliminary results



Truncilla macrodon in the Trinity River

- *Truncilla cognata* is valid species
- Unique lineages



Truncilla truncata

Truncilla donaciformis

Truncilla cognata

Truncilla macrodon

Colorado R.

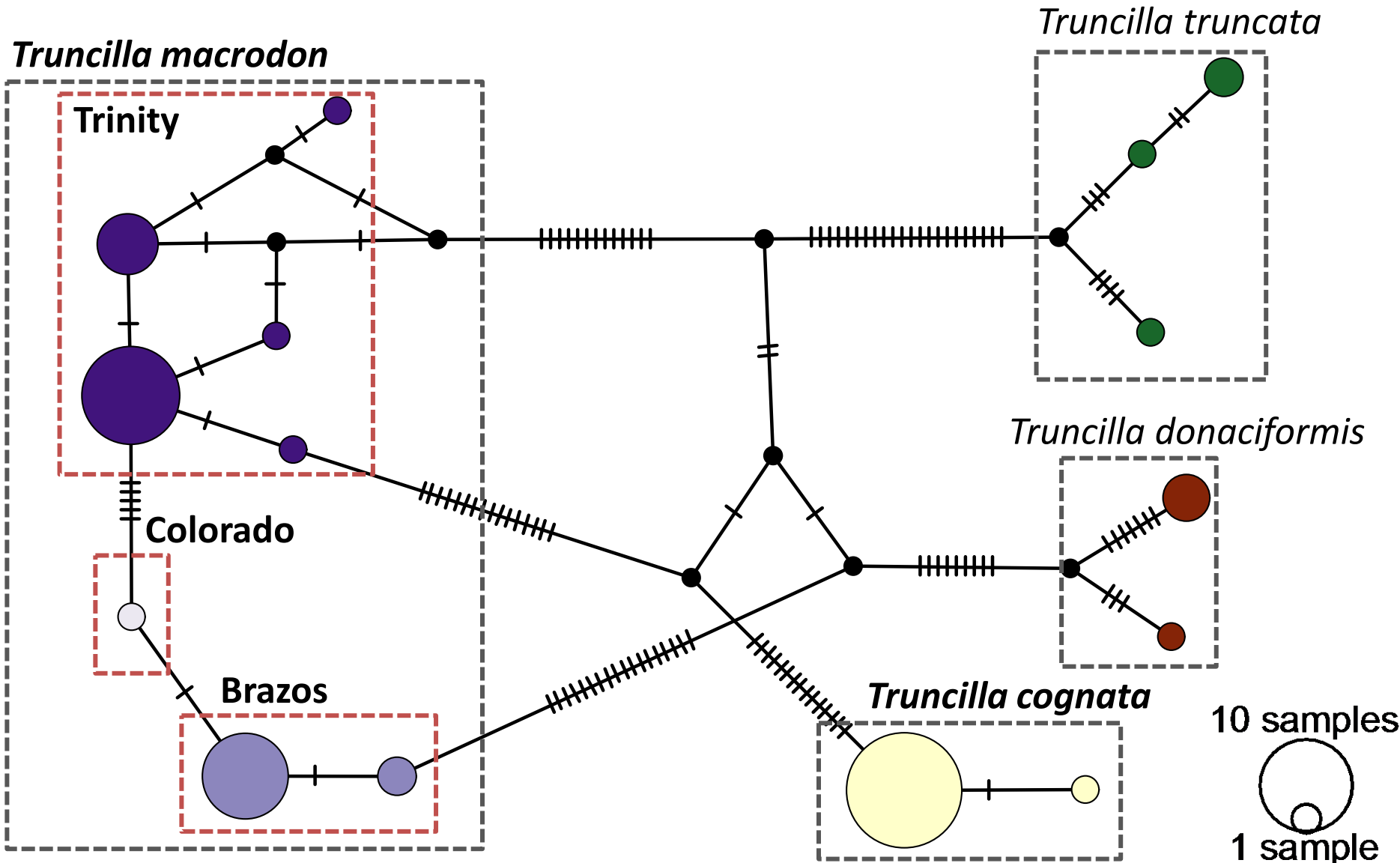
Brazos R.

Trinity R.

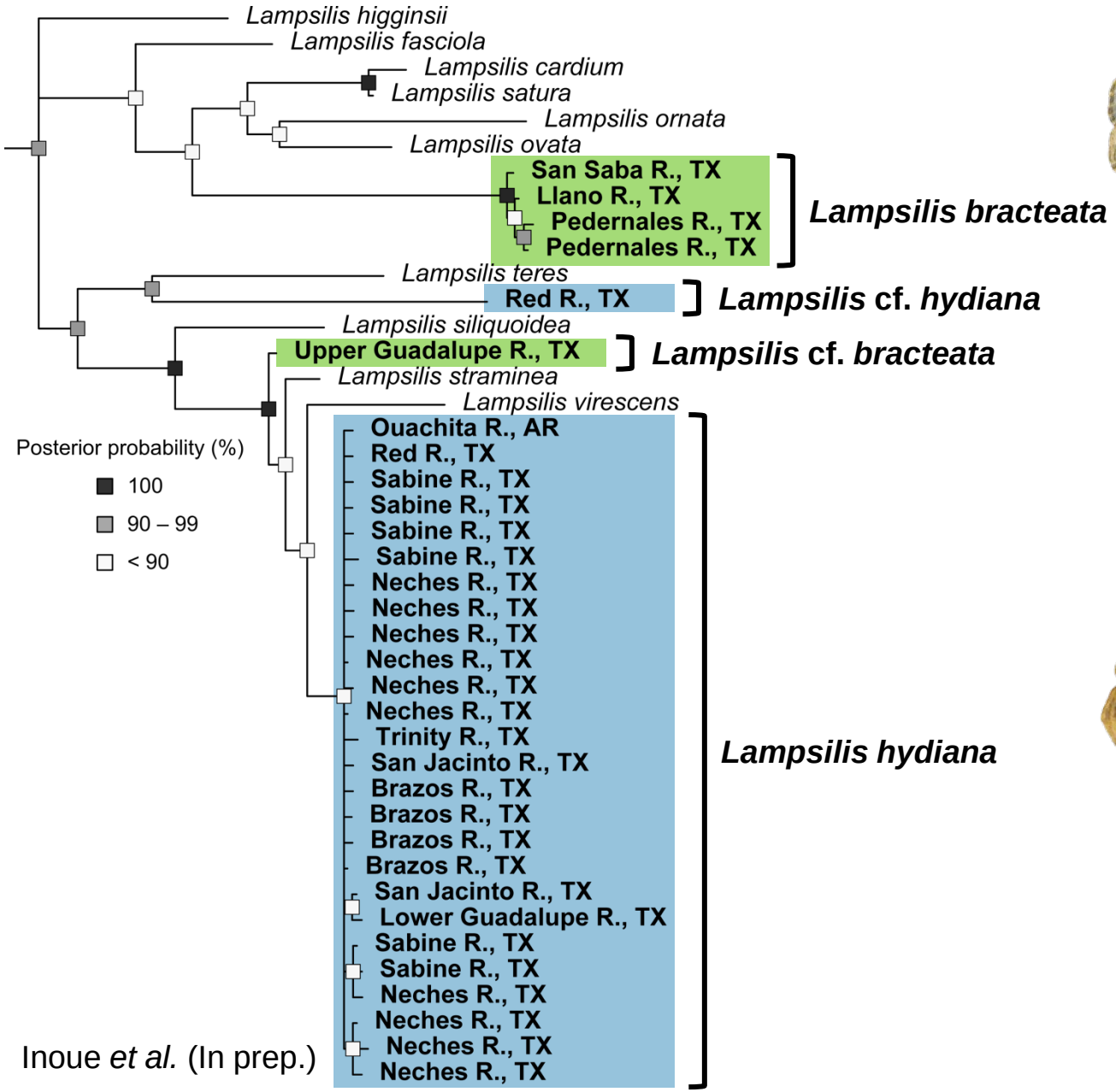
Inoue *et al.* (In prep.)

Genetic diversity in *Truncilla* species

- Low genetic diversity in *T. cognata*
- Isolation among drainages



Two nominal species = four distinct lineages



Inoue *et al.* (In prep.)

Lampsilis bracteata

Llano R. Pedernales R.

Lampsilis cf. *bracteata*

Upper Guadalupe R.

Lampsilis hydiana

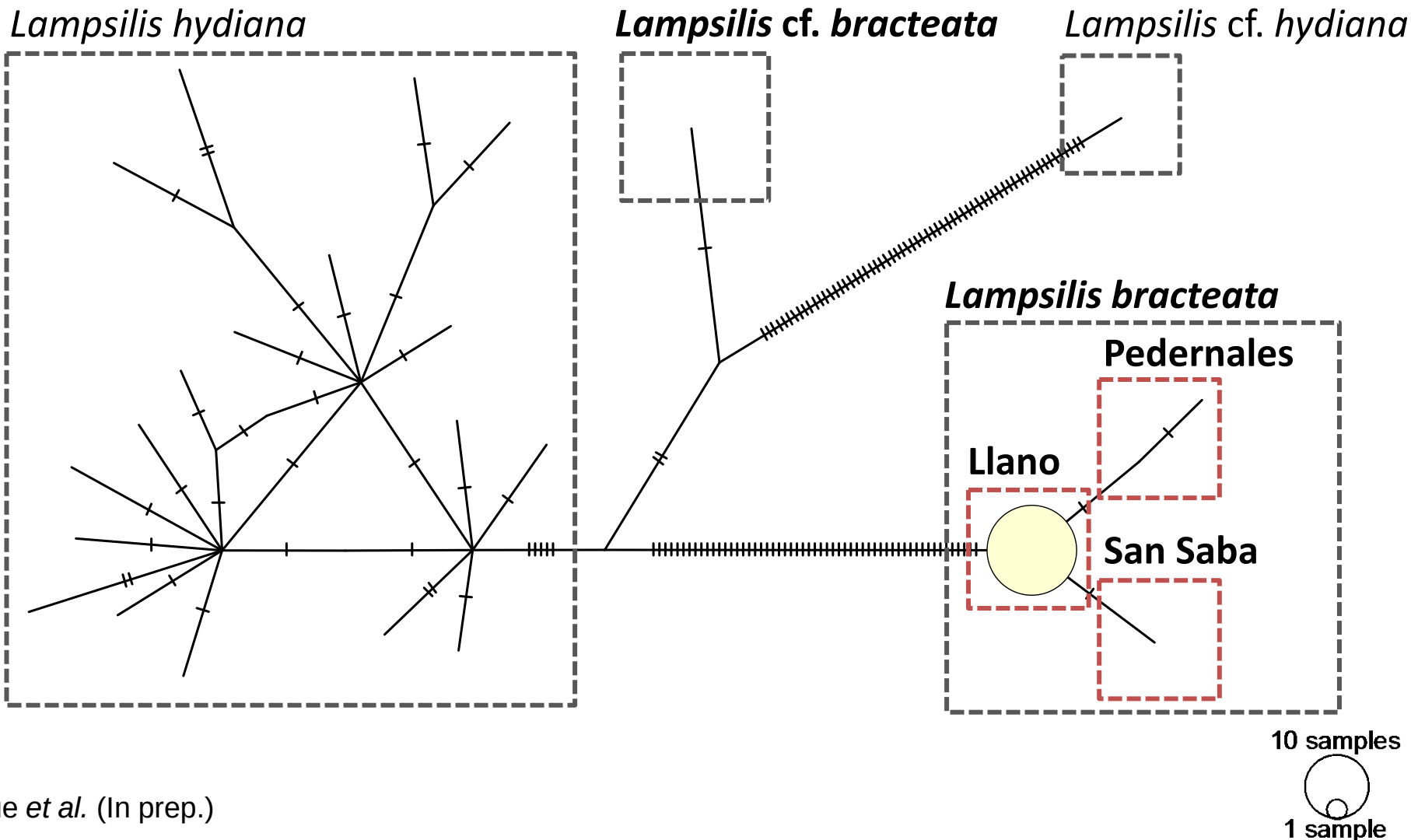
Lower Guadalupe R. Sabine R.

Lampsilis cf. *hydiana*

Red R.

Genetic diversity within *L. bracteata/L. hydiana*

- Low genetic diversity in *L. bracteata*
- Unique lineages in each drainage



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Cryptic diversity is common among TX mussels

- Four *Truncilla* species in TX
  - *Truncilla cognata* = valid species
  - *Truncilla macrodon* occurs in the Trinity River
    - Distinct from the Brazos/Colorado populations
    - Unique lineage in each drainage
- Cryptic diversity within *L. bracteata*/*L. hydiana*
  - *L. bracteata* is endemic to the Colorado River drainage
  - Upper Guadalupe River = potential new species
  - Red River = potential new species

Each drainage = unique genetic structure

- No apparent gene flow between drainages
  - Each drainage = separate conservation unit
- Low genetic diversity
  - *Truncilla cognata* & *Lampsilis bracteata*

Reproductive biology should recognize current genetic diversity and structure

Future directions

- Increase sample size and geographic coverage
- Additional genetic markers
- Species delimitation analyses
- Population genetic analyses
- Morphometric analyses

Special Thanks

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- Texas Department of Transportation

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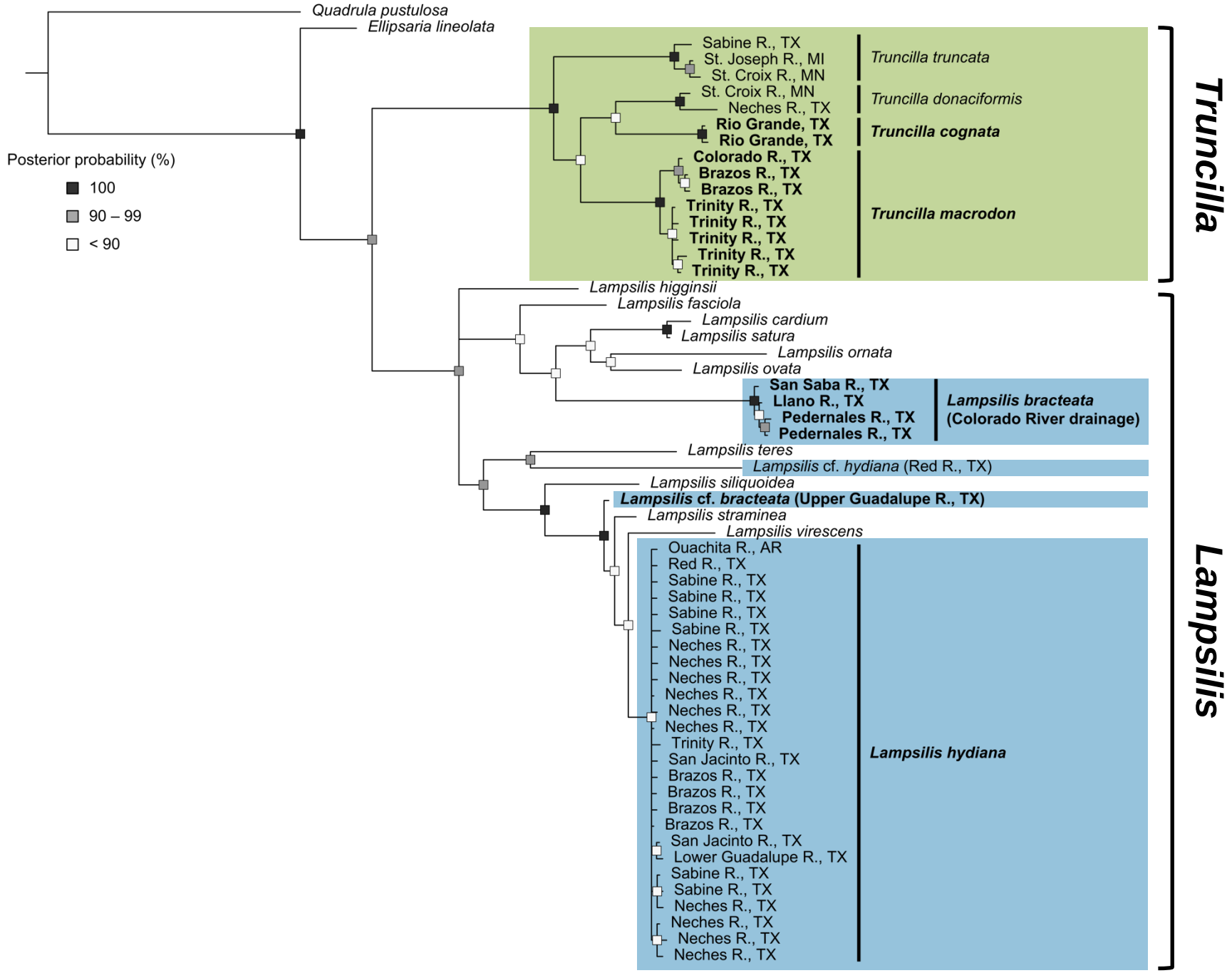
- Michael Hart (TAMU)



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