Comparing eDNA metabarcoding and standardized electroshocking to assess fish assemblages in Texas rivers and streams

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eDNA – What is it?

Mucus membrane

Blood/Injury

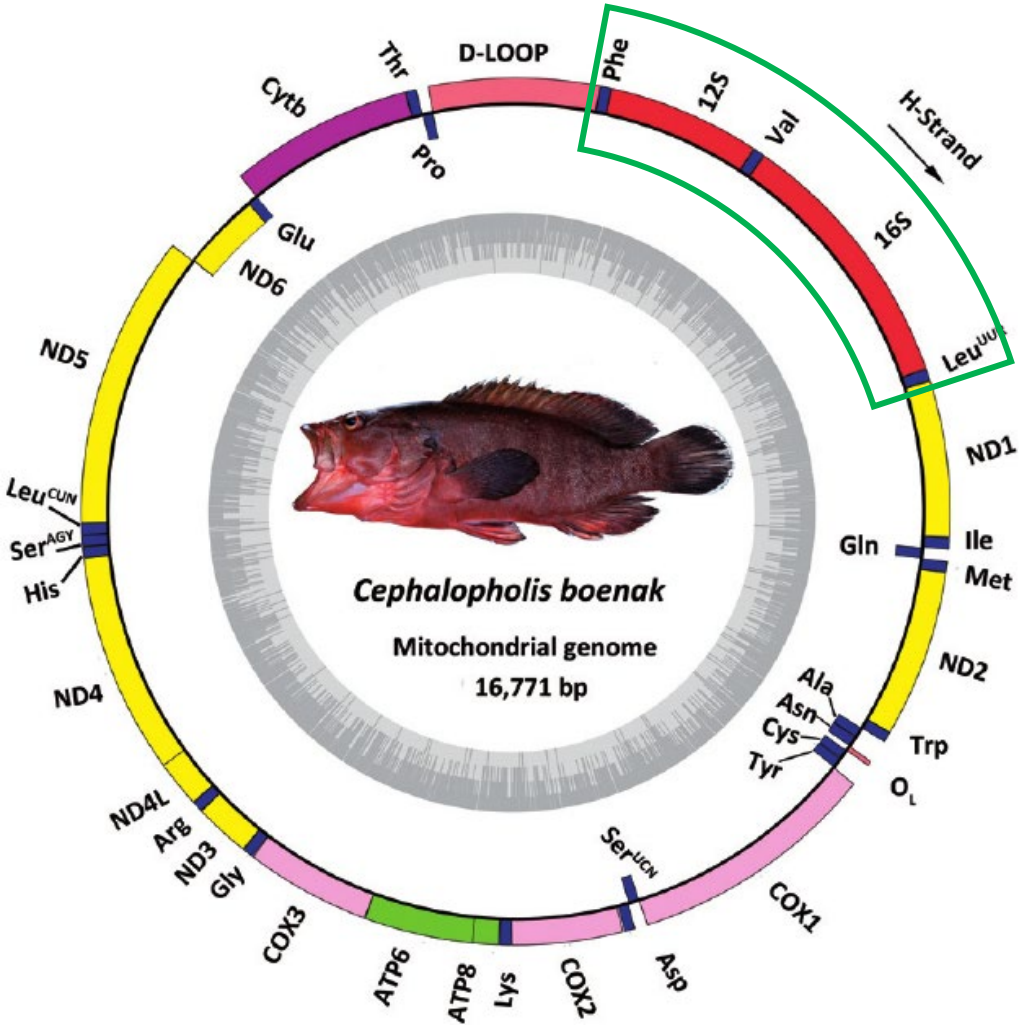
Scales

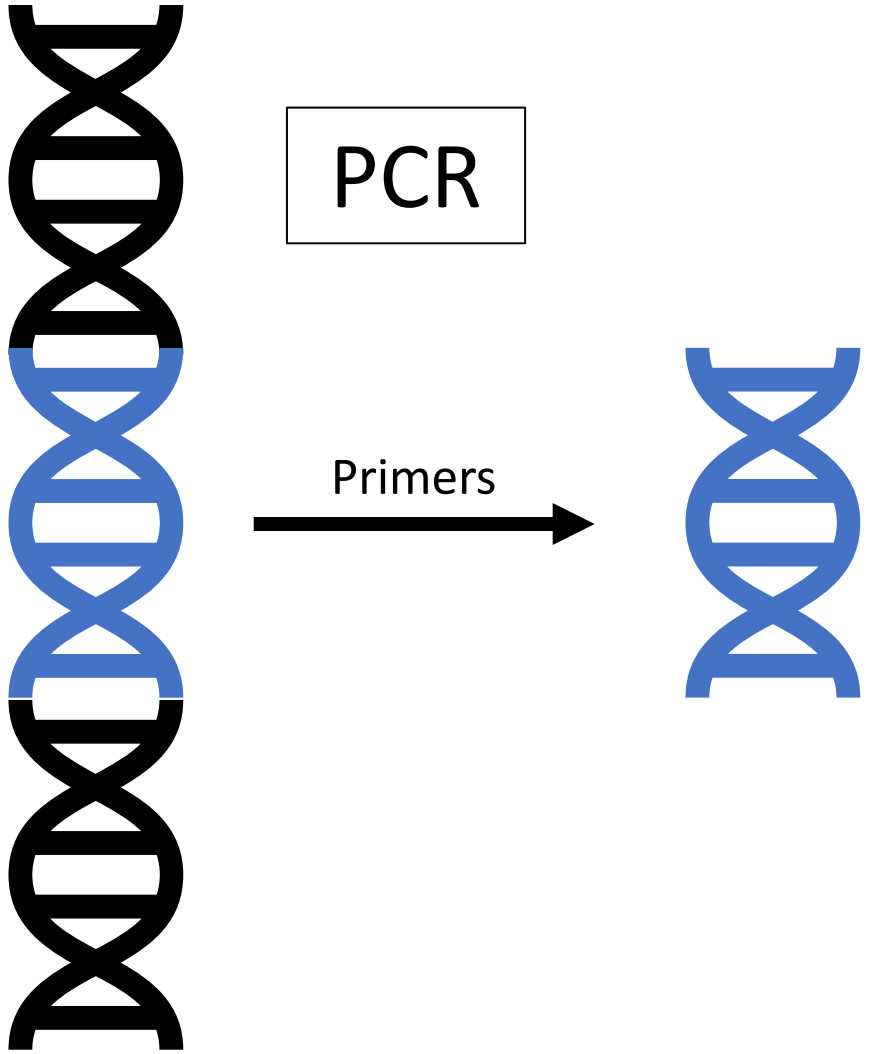
Predation

Excretions

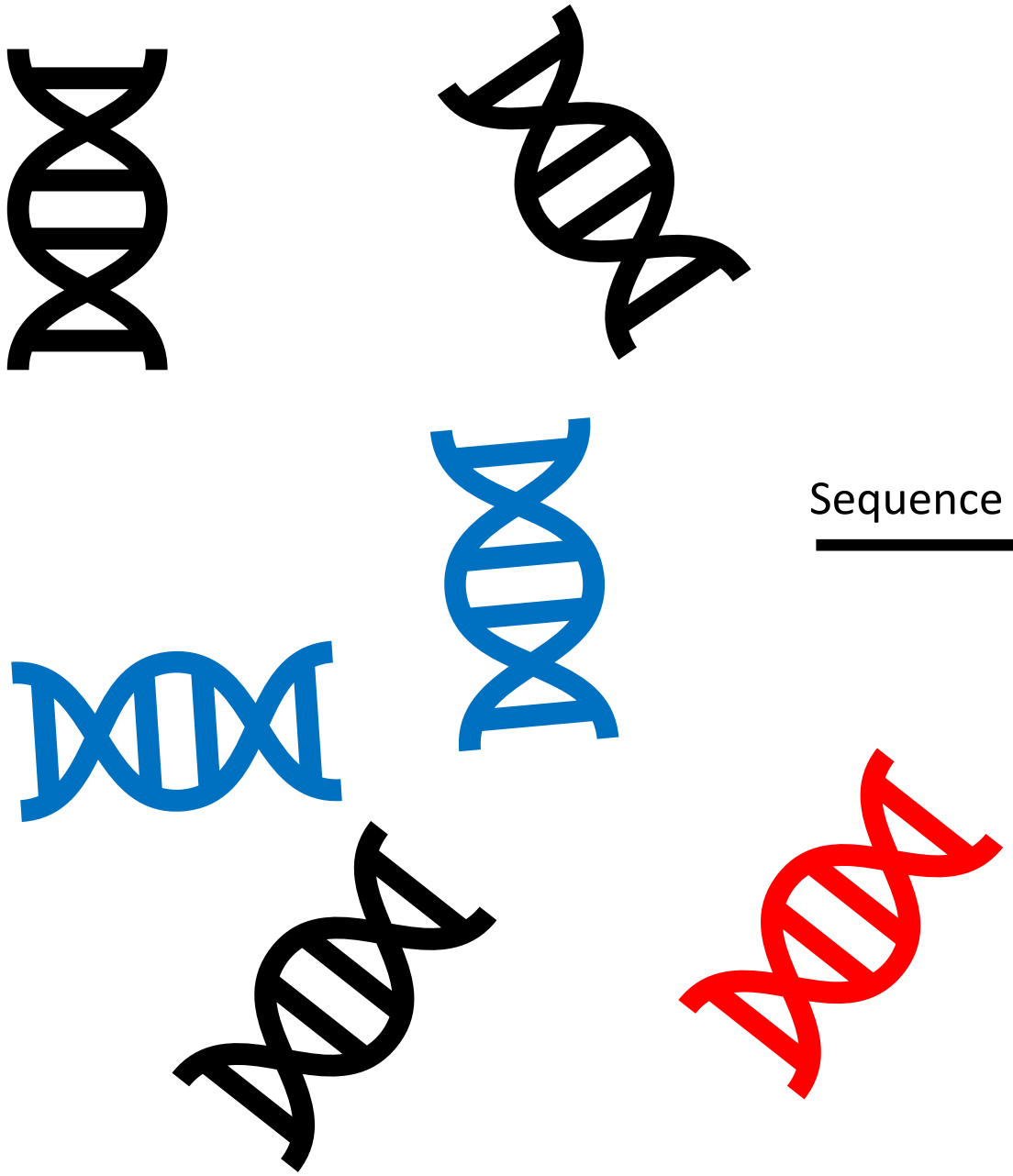
Spawning

eDNA Metabarcoding





Li, J. et.al(2014). Complete mitochondrial genome of the chocolate hind Cephalopholis boenak (Pisces: Perciformes).



Sequence + Bioinformatics

Read count	Fish
1	Red fish
2	Blue Fish
3	Black Fish

Motivation

Habitats are degrading and changing quickly.

Tracking widespread species assemblages regularly and easily could play an important role in future management decisions.

eDNA could help in those processes.

Objectives

- Compare fish assemblage from eDNA metabarcoding to fish assemblage from electroshocking
- Discover efficacy of using eDNA across a wide variety of stream/river sizes and classes, watersheds, substrate types, and other environmental variables
- Compare methods of of eDNA collection and processing to retrieve the most DNA

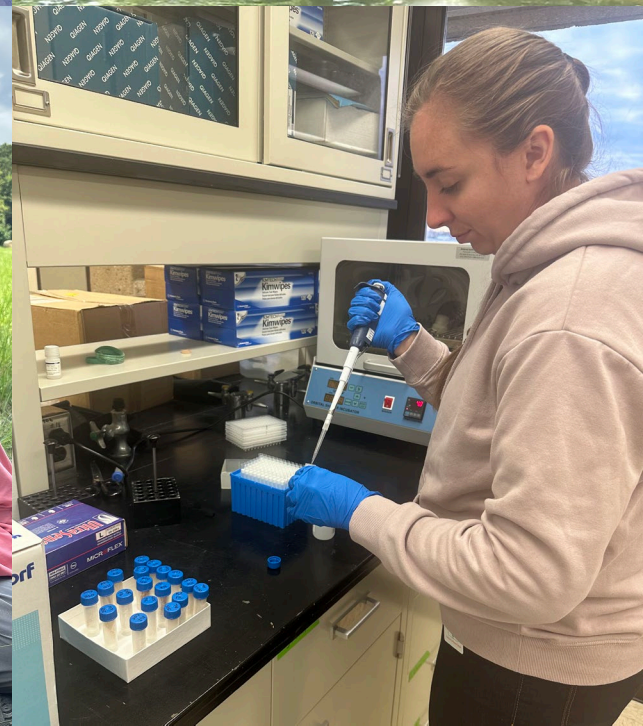
Methods

Electrofishing

- Follows a standardized protocol from the National Rivers and Streams Assessment Field Operations Manual

eDNA processing

- 2 samples taken
  - FIL: 1 L at a single location
  - COM: ~100 mL taken at 11 evenly spaced transects
- Samples filtered same day
- Processed and sequenced later in EPA lab



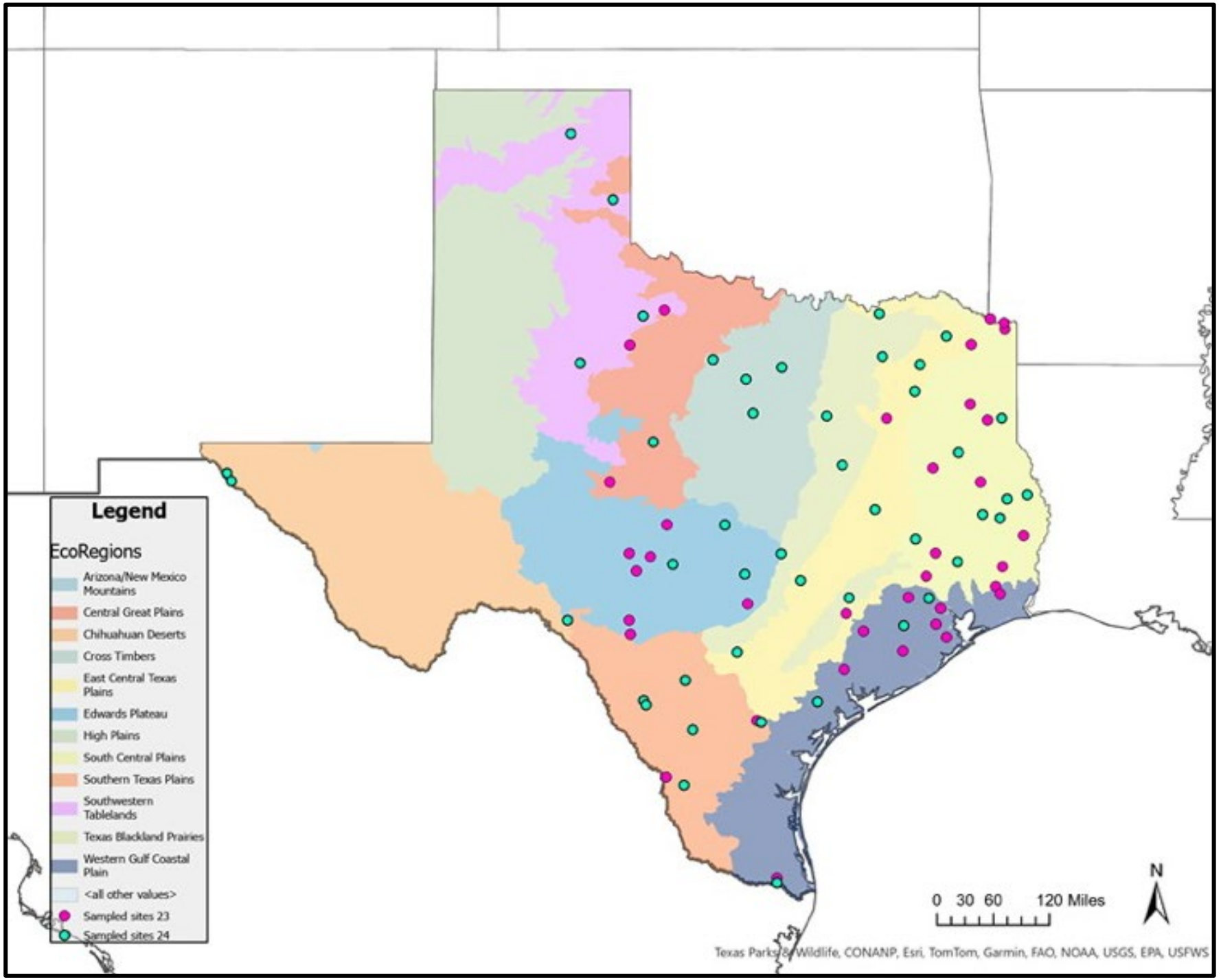
Sites

Completed:

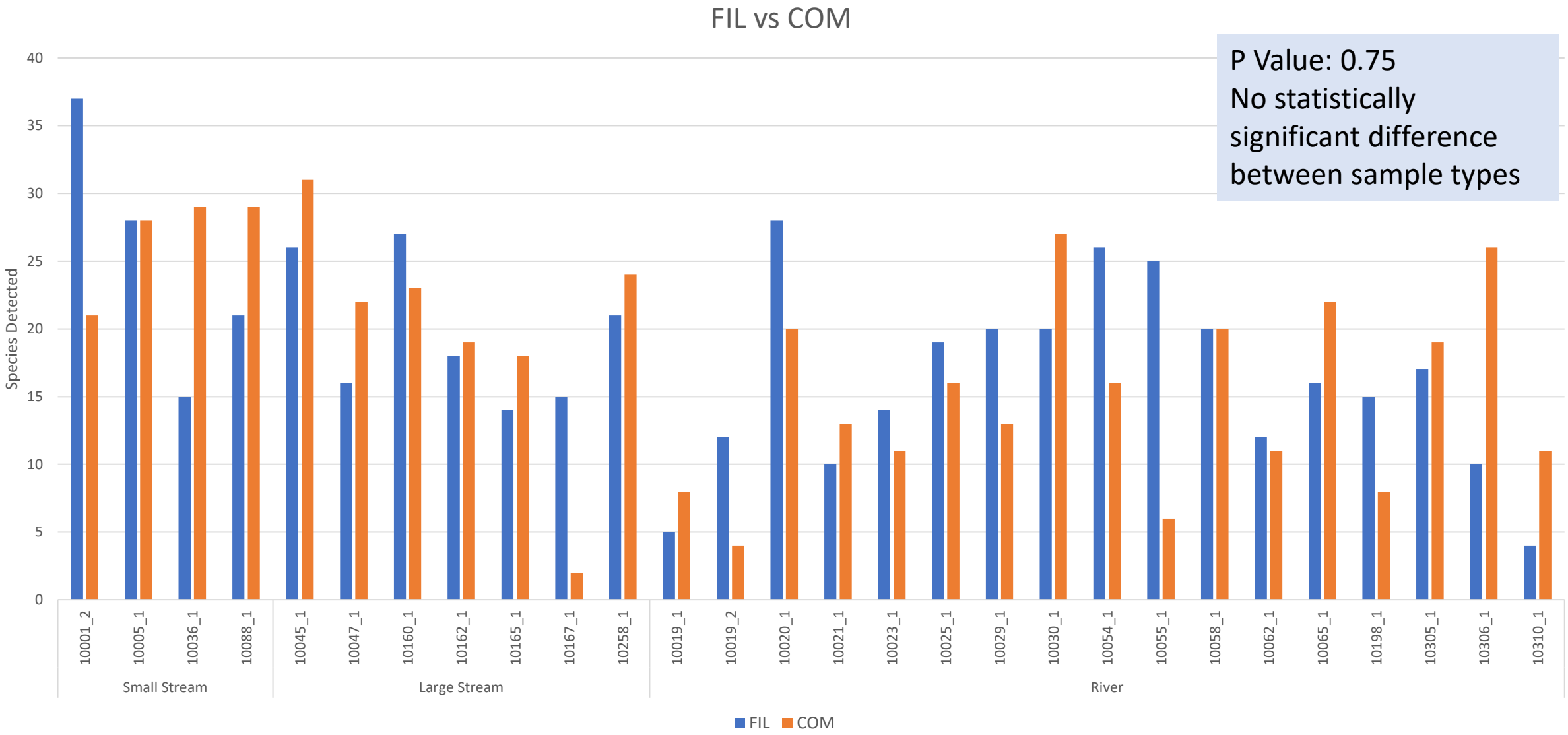
85 sampling events at 81 sites

Lab work done for:

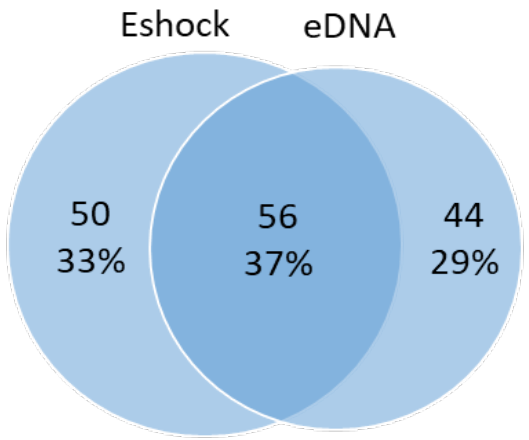
- 38 sampling events at 36 sites
- 13 of 76 samples did not yield results
- 3 sites failed to produce any results



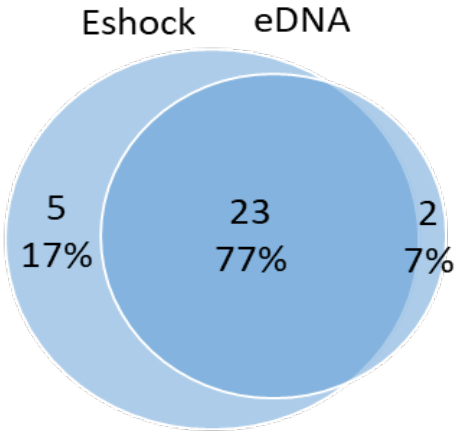
Preliminary Results – FIL and COM samples



Species



Families



Outcomes:

2023:

Electrofishing:

- 106 species, 28 families
- 13,037 individuals

eDNA:

- 100 Species in 25 families
- Paired data for 28 sites (FIL, COM, Eshock)

*94 species in 7 Families detected with only one or the other

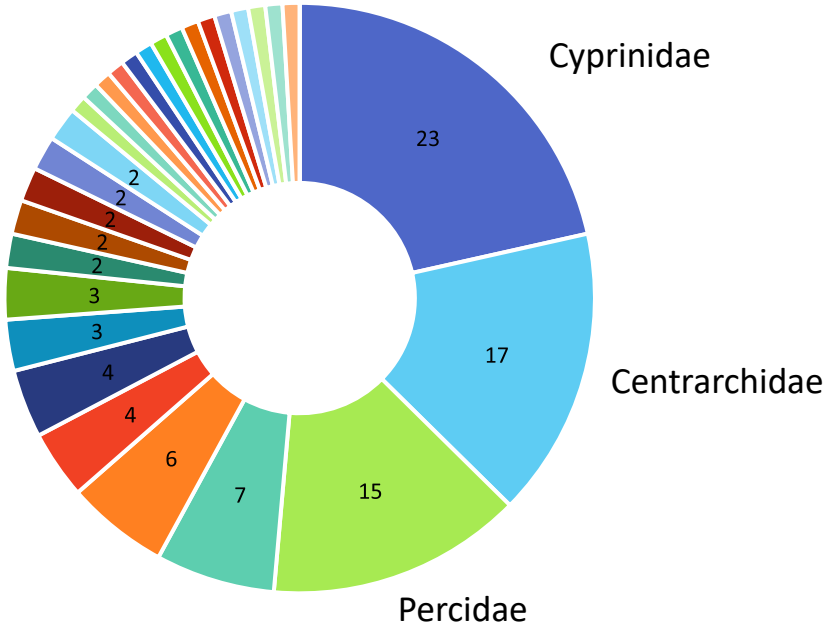
2024:

Electrofishing:

- 73 species
- 9,536 individuals

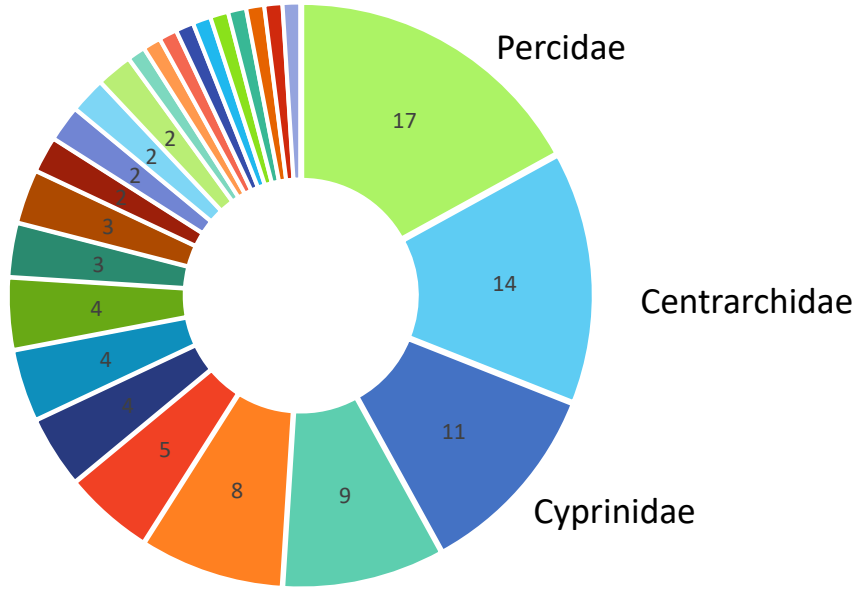
Preliminary Results – Family composition

Family composition of eShock



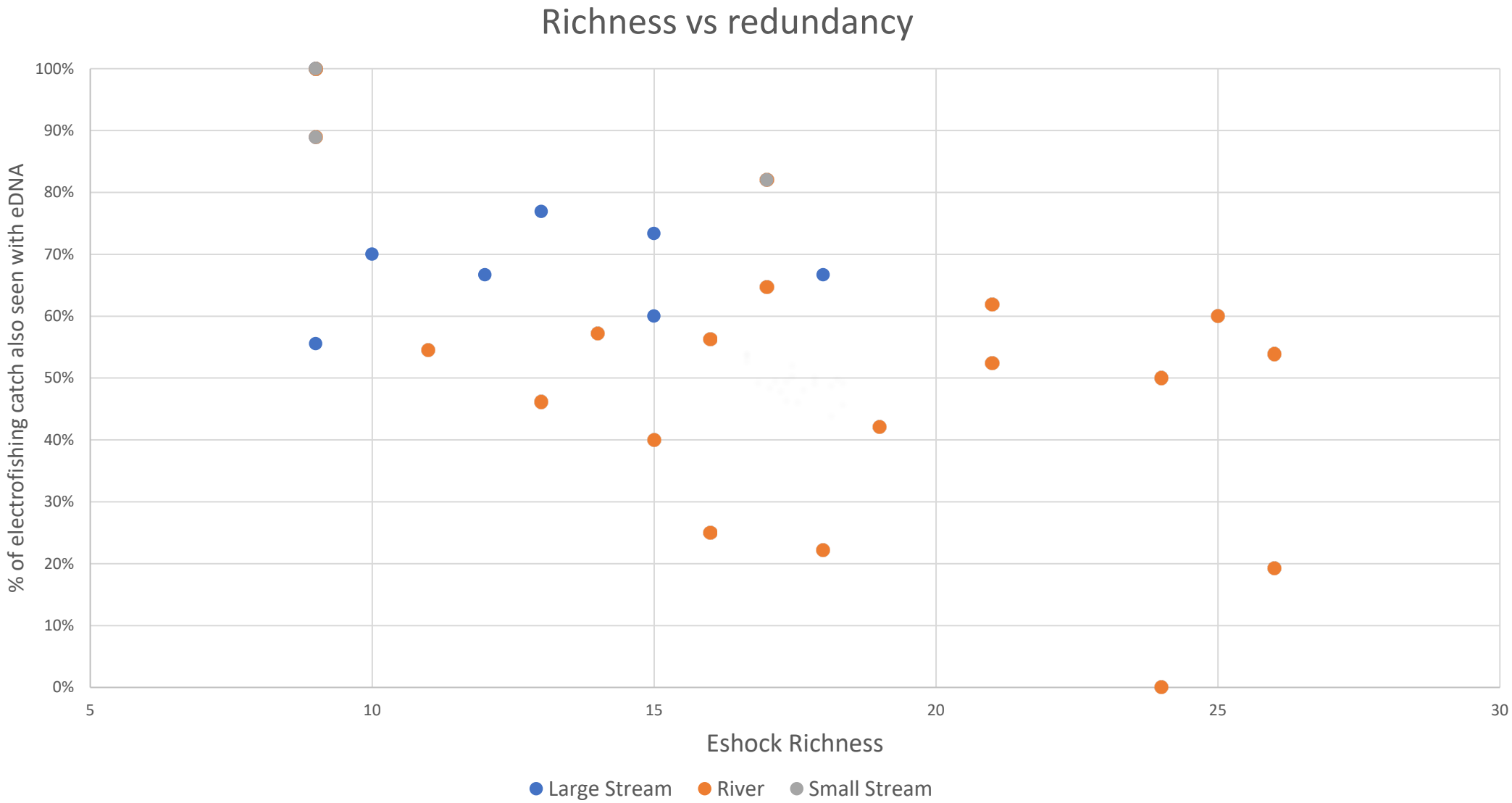
Cyprinidae, Centrarchidae, Percidae, Catostomidae, Ictaluridae, Fundulidae, Poeciliidae, Lepisosteidae, Leuciscidae, Atherinopsidae, Cichlidae, Cyprinodontidae, Dorosomatidae, Loricariidae, Achiridae, Acipenseridae, Alosidae, Amiidae, Aphredoderidae, Characidae, Elassomatidae, Engraulidae, Esocidae, Gobiidae, Moronidae, Mugilidae, Petromyzontidae, Sciaenidae

Family composition of eDNA



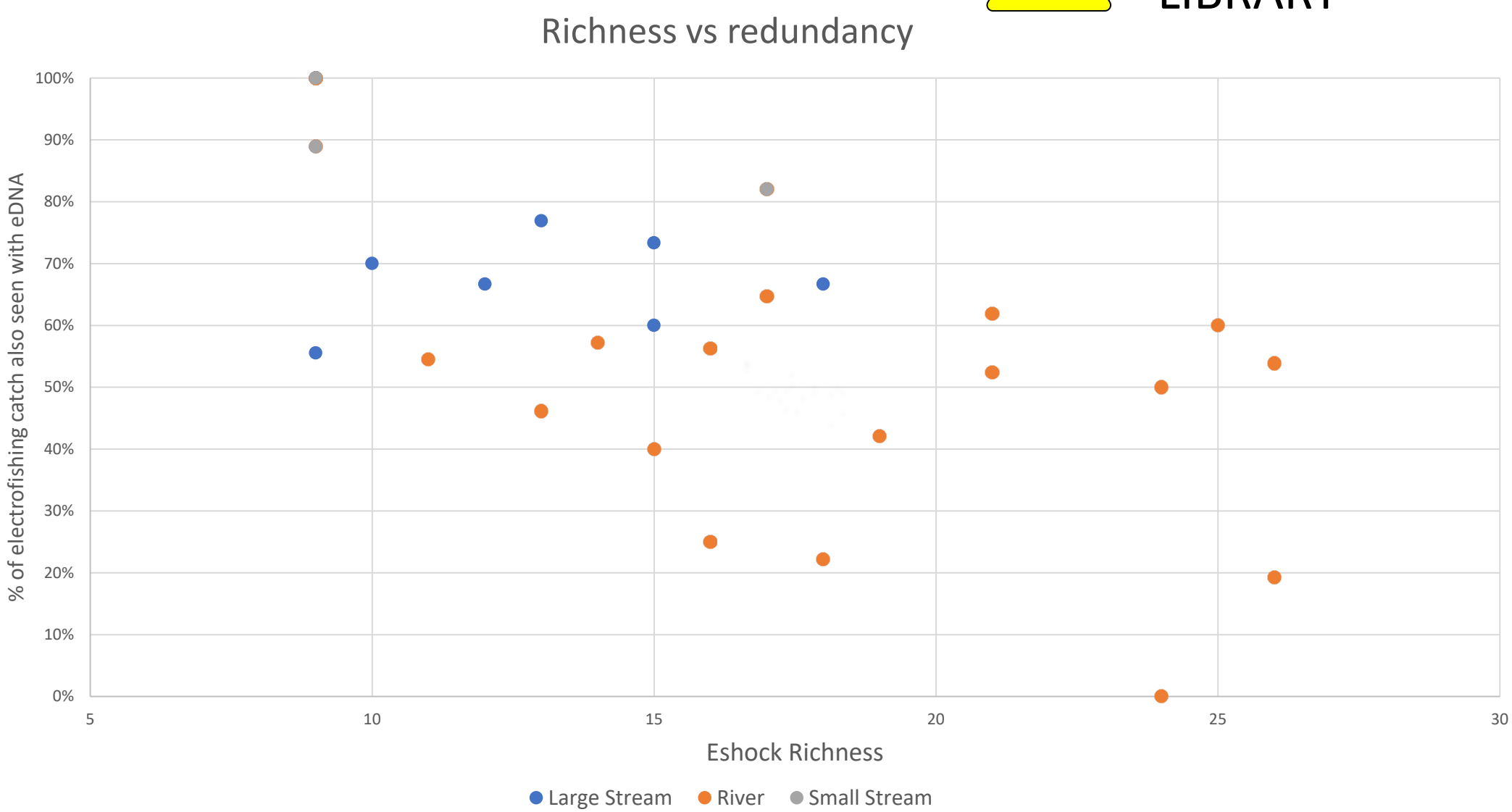
Percidae, Centrarchidae, Cyprinidae, Catostomidae, Ictaluridae, Lepisosteidae, Cichlidae, Fundulidae, Poeciliidae, Gobiidae, Mugilidae, Atherinopsidae, Dorosomatidae, Esocidae, Loricariidae, Amiidae, Aphredoderidae, Characidae, Cyprinodontidae, Elassomatidae, Leuciscidae, Moronidae, Pimelodidae, Sciaenidae, Xenocyprididae

Preliminary Results – eDNA



Preliminary Results – eDNA

GENETIC LIBRARY

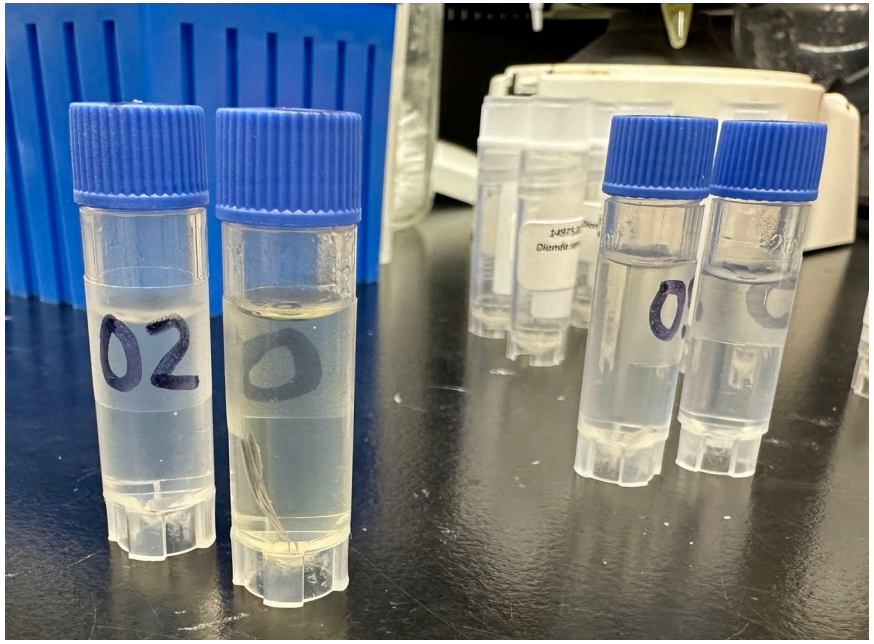


Genetic Library

2023

Texas FW Fish count: 242

Genetic data available: 152



Completed 2023-24:

Field Collected: 118 clips

Biodiversity Research and Teaching collections at Texas A&M: 199 fin clips

TPWD - Coastal Fisheries Division: numerous clips for 3 species

For a total of 62 additional species

2025

Still no data or fin clips for 34 species

Acknowledgements

- The EPA – Office of Research and Development

- UHCL – Environmental Institute of Houston field team:
  - Fish Taxonomists: Noah Daun and Noah Santee
  - Angelica Castillo, Mandi Gordon, Gabbi Hammerbach, Heather Hinchliffe, Aurora Alvarez, Kaylei Chau, Danielle DeChellis, Ashlyn Sak, Erica Underwood, Jenny Oakley, Lauren Soliz, Bailey Steward, Luke Hammock

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Species with no genetic data

- **Amistad gambusia** - *Gambusia amistadensis*
- **Big Bend gambusia** - *Gambusia gaigei*
- **Blotched gambusia** - *Gambusia senilis*
- **Bluehead shiner** - *Pteronotropis hubbsi*
- **Chestnut lamprey** - *Ichthyomyzon castaneus*
- **Clear Creek gambusia** - *Gambusia heterochir*
- **Clown goby** - *Microgobius gulosus*
- **Cypress minnow** - *Hybognathus hayi*
- **Fountain darter** - *Etheostoma fonticola*
- **Freshwater goby** - *Ctenogobius shufeldti*
- **Golden redhorse** - *Moxostoma erythrurum*
- **Leon Springs pupfish** - *Cyprinodon bovinus*
- **Lyre goby** - *Evorthodus lyricus*
- **Mexican goby** - *Ctenogobius claytonii*
- **Pecos bluntnose shiner** - *Notropis simus pecosensis*
- **Peppered chub** - *Macrhybopsis tetranema*
- **Phantom shiner** - *Notropis orca*
- **Redfin darter** - *Etheostoma whipplei*
- **Rio Grande bluntnose shiner** - *Notropis simus simus*
- **Rio Grande chub** - *Gila pandora*
- **Rio Grande silvery minnow** - *Hybognathus amarus*
- **River goby** - *Awaous tajasica*
- **San Marcos gambusia** - *Gambusia georgei*
- **Skipjack herring** - *Alosa chrysochloris*
- **Spinycheek sleeper** - *Eleotris pisonis*
- **Swamp darter** - *Etheostoma fusiforme*
- **Tex-Mex gambusia** - *Gambusia speciosa*
- **Texas silverside** - *Menidia clarkhubbsi*
- **Toothless blindcat** - *Trogloglanis pattersoni*
- **West Mexican redhorse** - *Moxostoma austrinium*
- **Western creek chubsucker** - *Erimyzon claviformis*
- **Western sand darter** - *Ammocrypta clara*
- **Western starhead topminnow** - *Fundulus blairae*
- **Widemouth blindcat** - *Satan eurystomus*