University of Antwerp
Evolutionary Ecology Group

Adaptive radiation of sailfin silversides – Malili lakes

Genomics workshop UNHAS 2024

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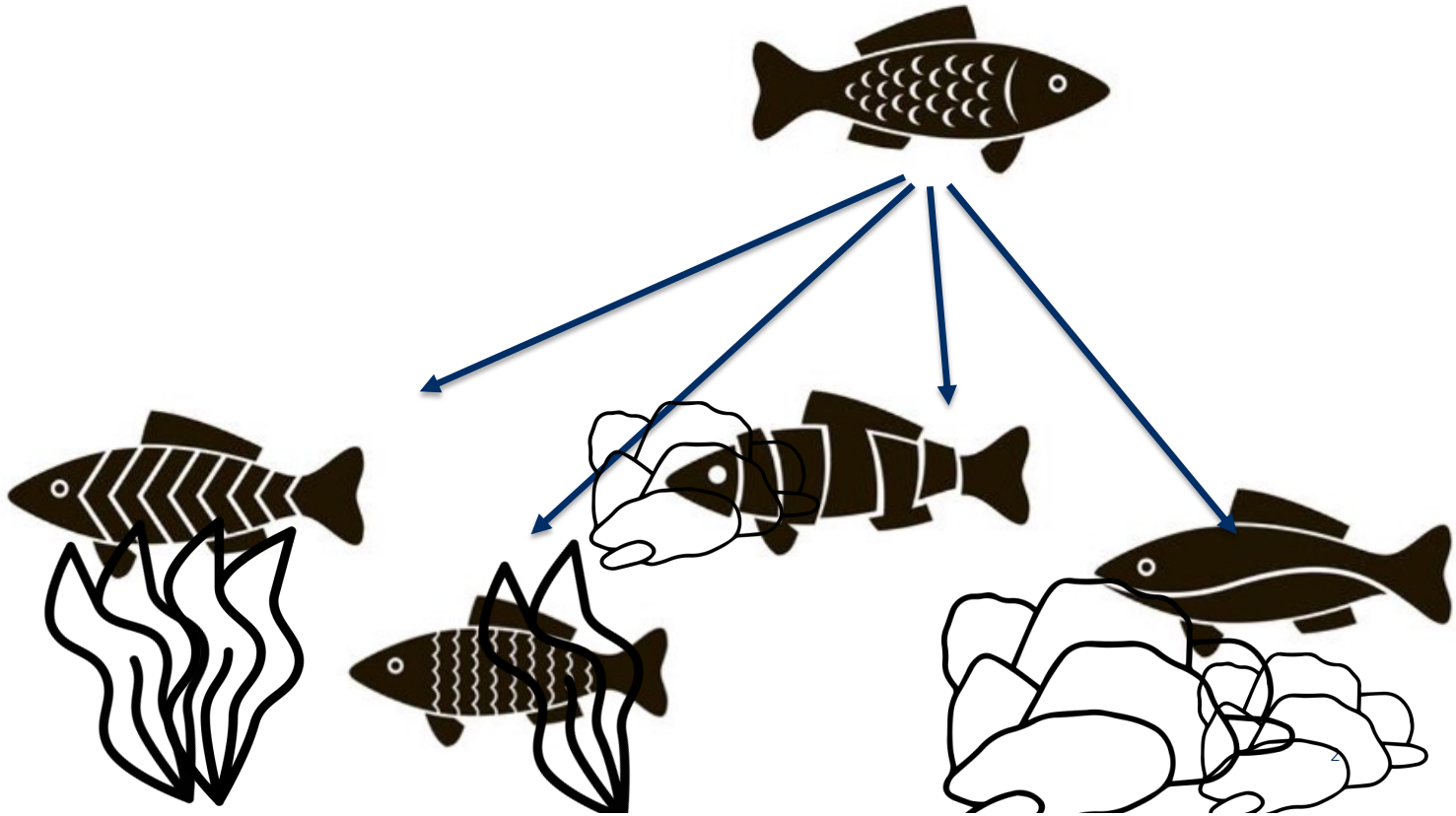
SHARING MINDS, CHANGING LIVES

Adaptive radiation

The **rapid diversification** of an ancestral species into **multiple closely related species** as a consequence of **adaptation** to different ecological niches

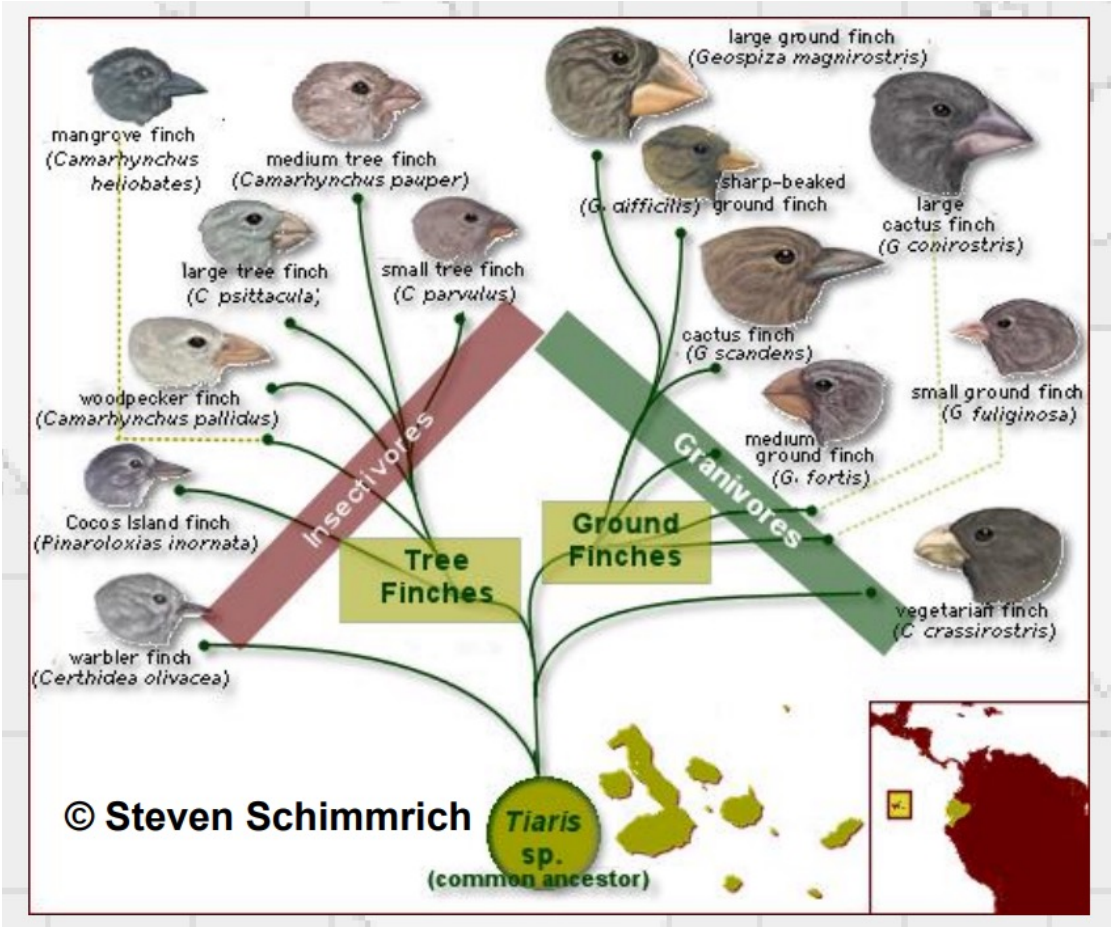


Adaptive radiation

Unique, distinct phenotypes specialised for specific ecological niches

Much of the biodiversity on Earth was produced by rapid speciation events such as adaptive radiations

Strong examples of natural selection, good systems for studying mechanisms of evolution



Research questions

What process is needed for adaptive radiations?

- **Ecological opportunity**
  - Access to new niches

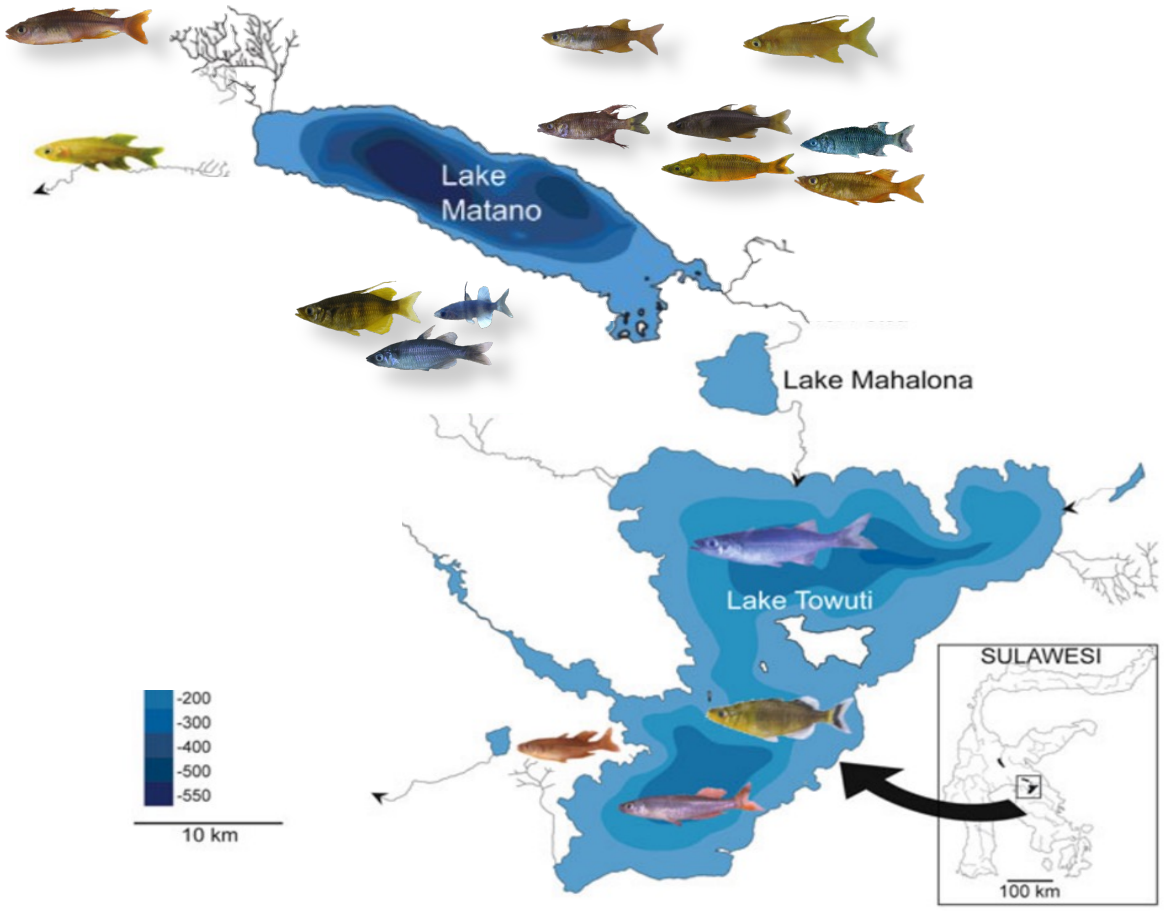
- **Adaptations of the body**
  - Determined by the genome (DNA)

➔ **What in the DNA that makes the adaptive radiation possible?**
➔ **What is the role of past and ongoing gene flow in this process?**
➔ **What happens in the genome during the adaptive radiation process**

Sailfin silversides

Sailfin silversides adaptive radiation

- **Malili lakes system Sulawesi**
- **Multiple adaptive radiations**
  - Snails
  - Shrimp
  - Fish
- **Sailfin silverside fishes (genus *Telmatherina*)**
  - ~20 (morpho)species in different ecological niches

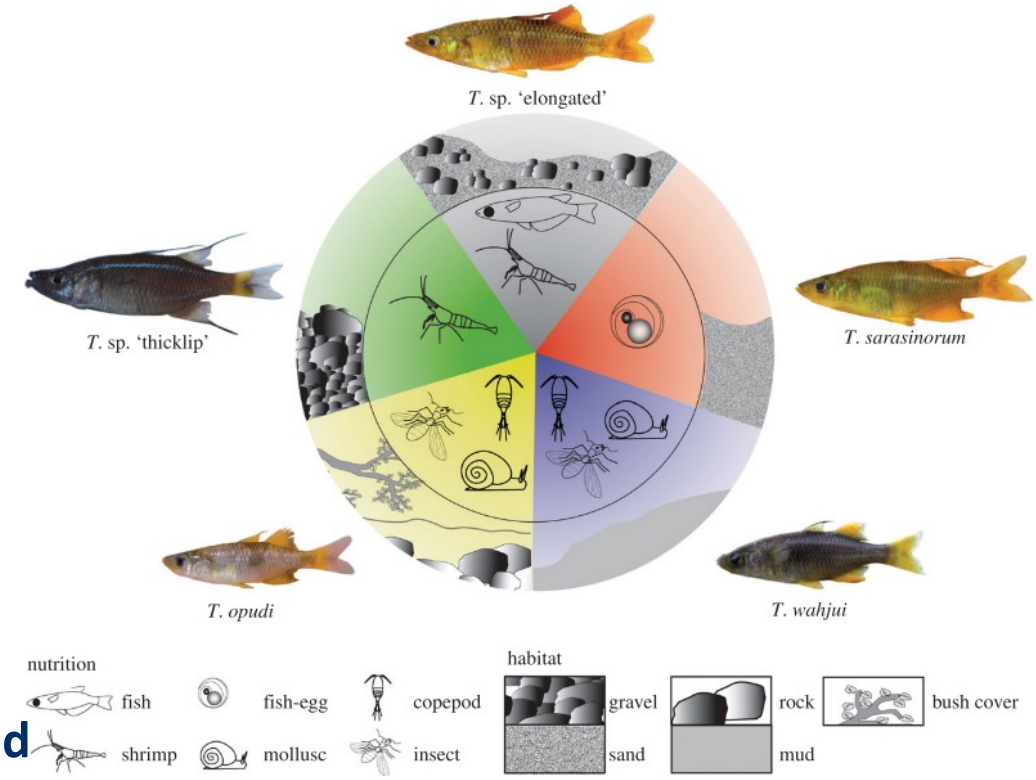


Sailfin silversides adaptive radiation

Different patterns of ecological resource use

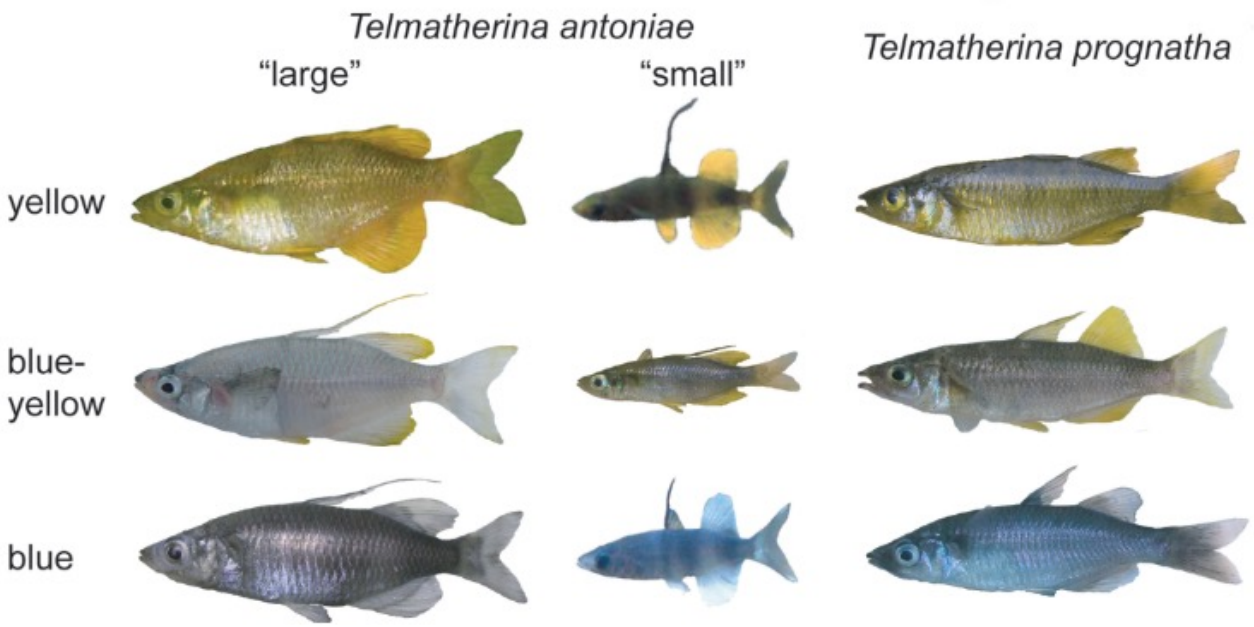
- **Habitat**
  - Substrate
  - Vegetation
- **Diet**
  - Fish eggs (*T. sarasinorum*)
  - Shrimp (*T. sp. thicklip*)
  - Molluscs
  - Insect larvae
- **Behavior**
  - Mating
  - Feeding

- **Link between diet, behavior, habitat and body shape**



Pfaender 2016 (Proc Royal SocB)

Sailfin silversides adaptive radiation



Males have variation in color

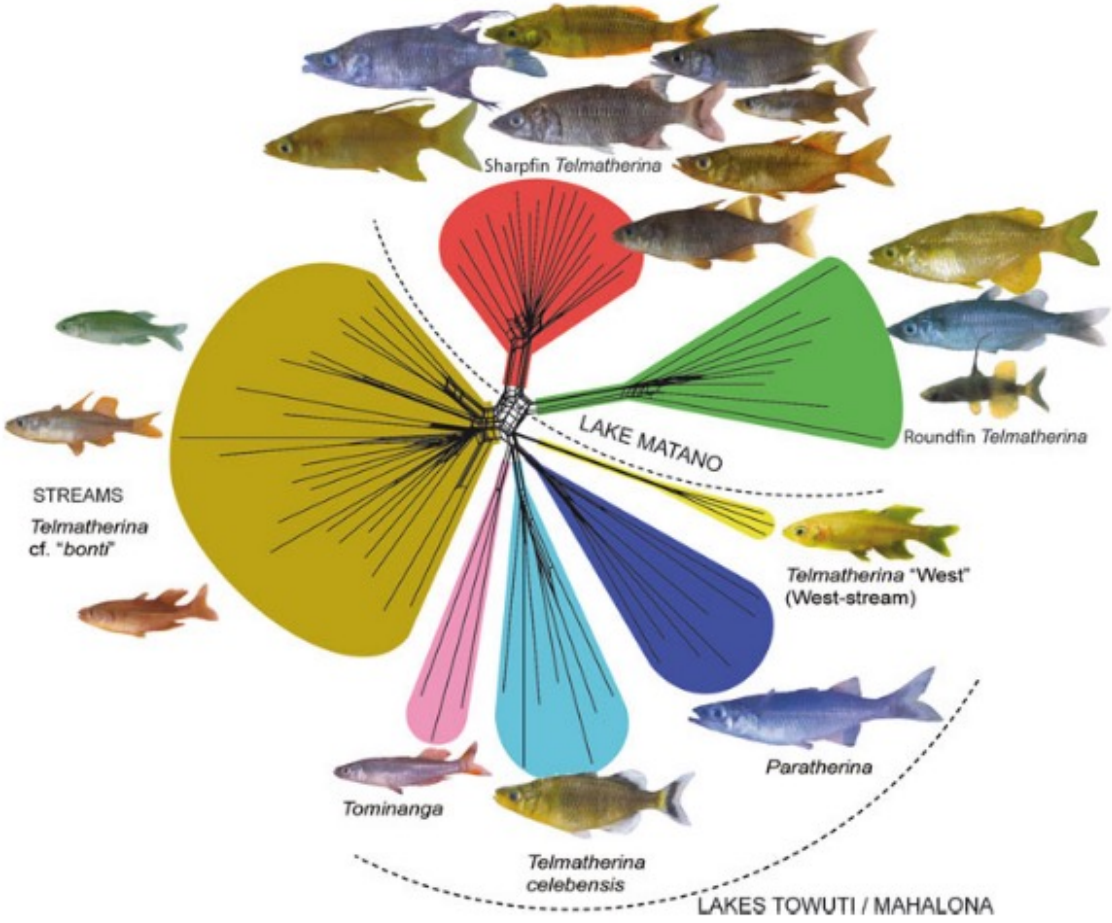
Yellow, blue and yellow-blue morphs in many of the species

Suggested to be associated with sexual selection

Herder, Pfaender & Schliewen 2007 (Evolution)

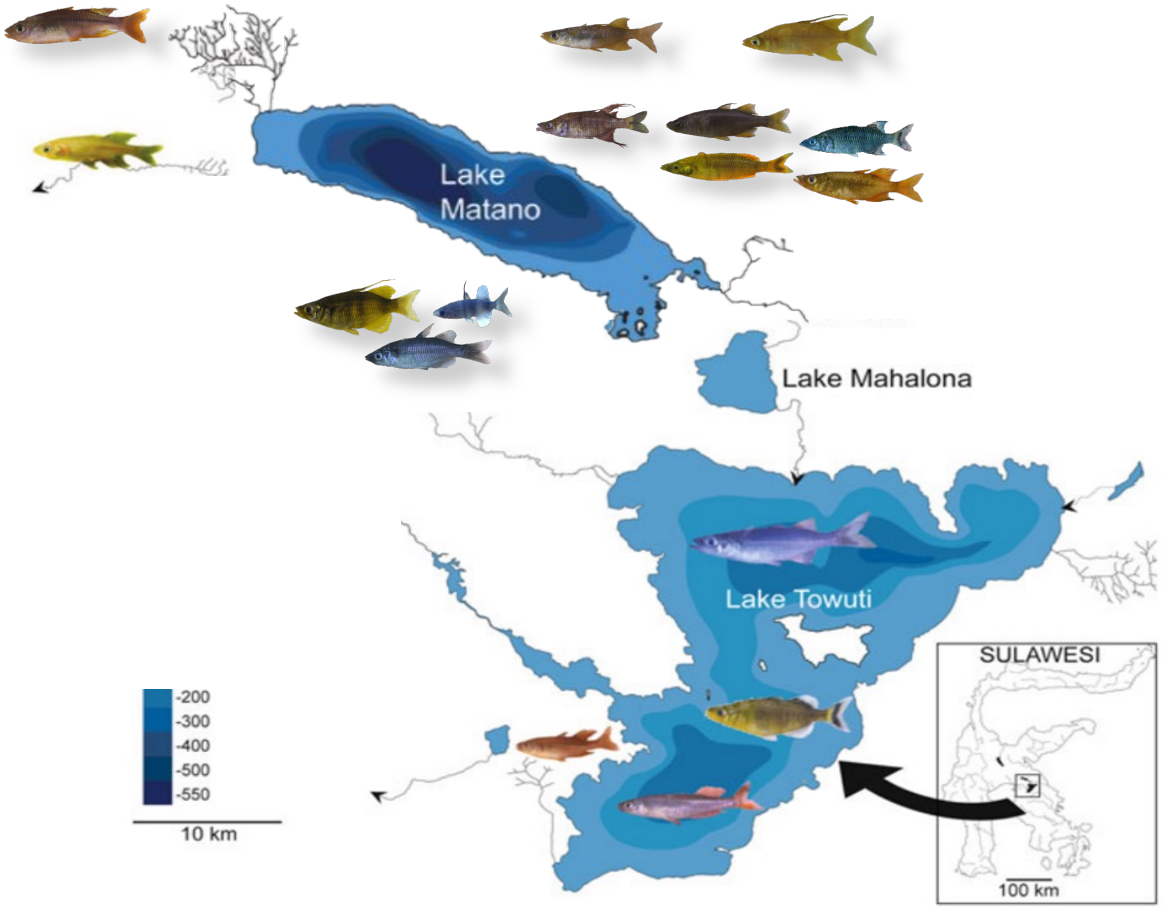
Sailfin silversides adaptive radiation

- **Diversified within the last 2 million years**
- **Lake Matano: two groups**
  - Roundfins (3 species)
  - Sharpfins (7 species)
  - Originated from a single lineage
  - Diverged ~600.000 years ago
- **One riverine group**
- **Additional groups in other lakes**
- **Relationship between fish difficult to understand**
  - closely related
  - hybridization between different species

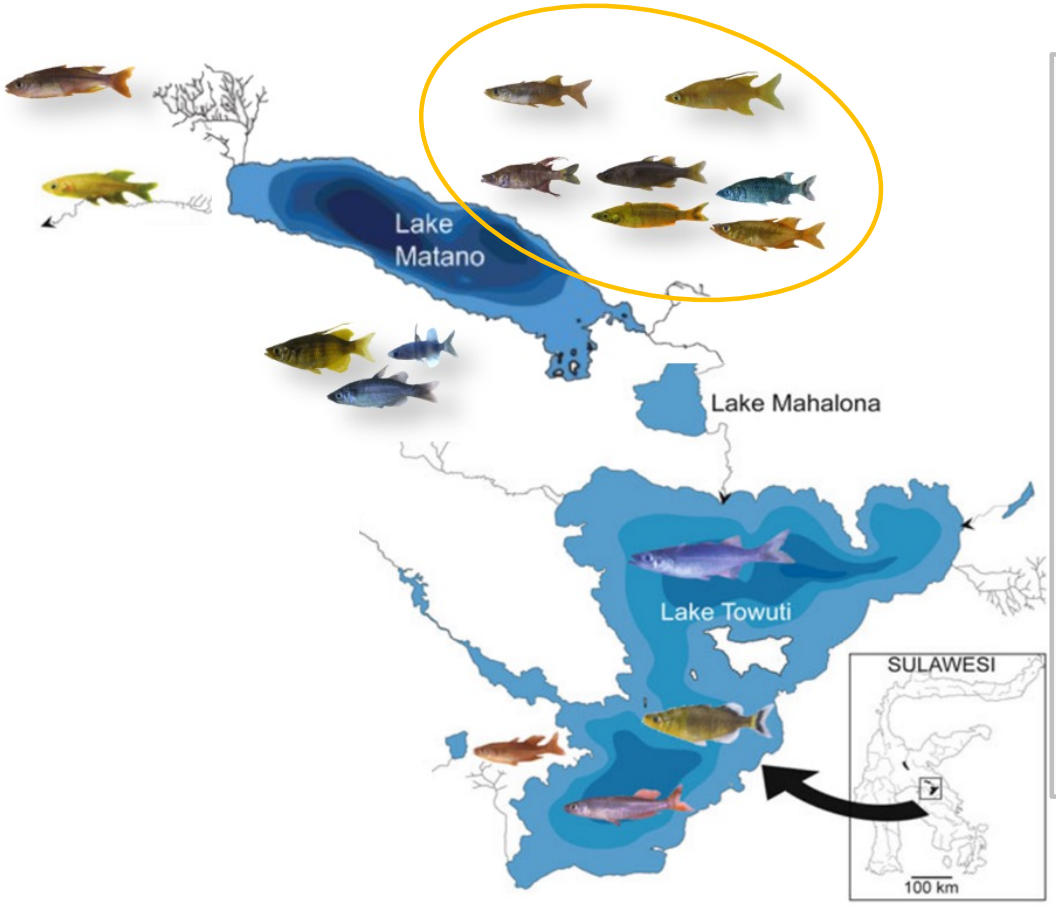


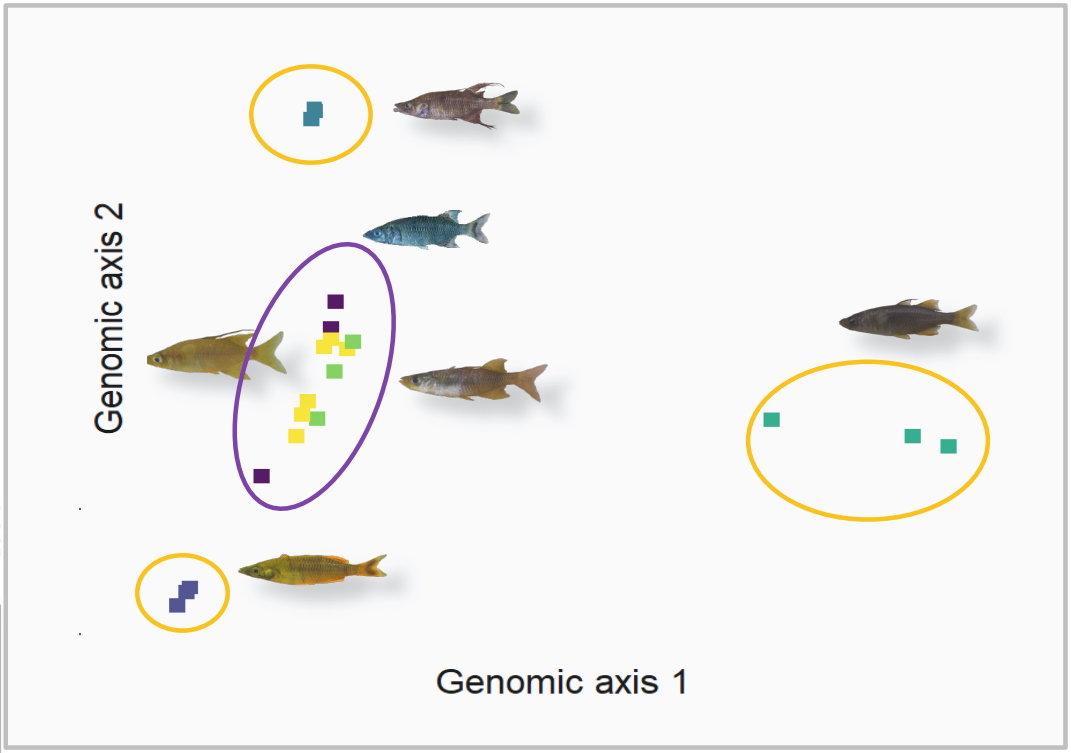
Phylogenomics of the Lake Matano silversides

- Whole genome sequencing
  - 33 Telmatherina from Lake Matano
  - 3 riverine Telmatherina (*T. bonti*)
  - 2 Marosatherina ladigesi (as outgroup)
- Museum collections ZFMK Bonn (Germany)
- 17.000.000 SNPs



Matano sharpfin sailfin silversides





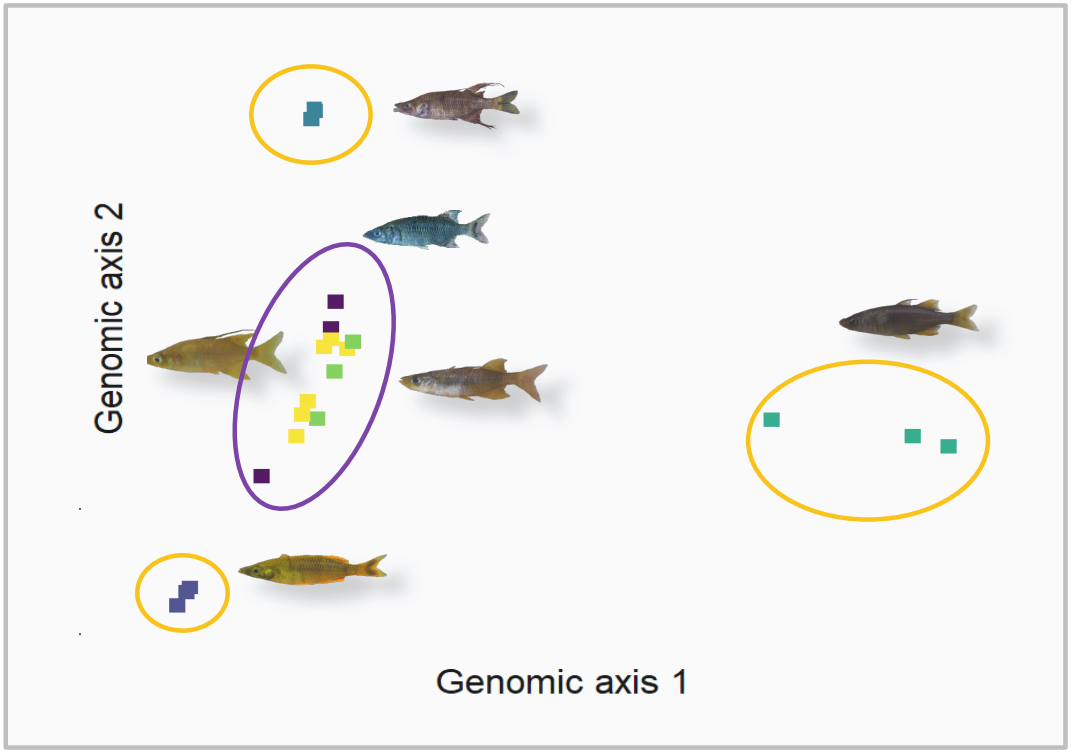
Three genetically distinct groups
One hybrid swarm of three species

Effect of ongoing hybridisation on differentiation

Hybrid swarm within sharpfins – early speciation?

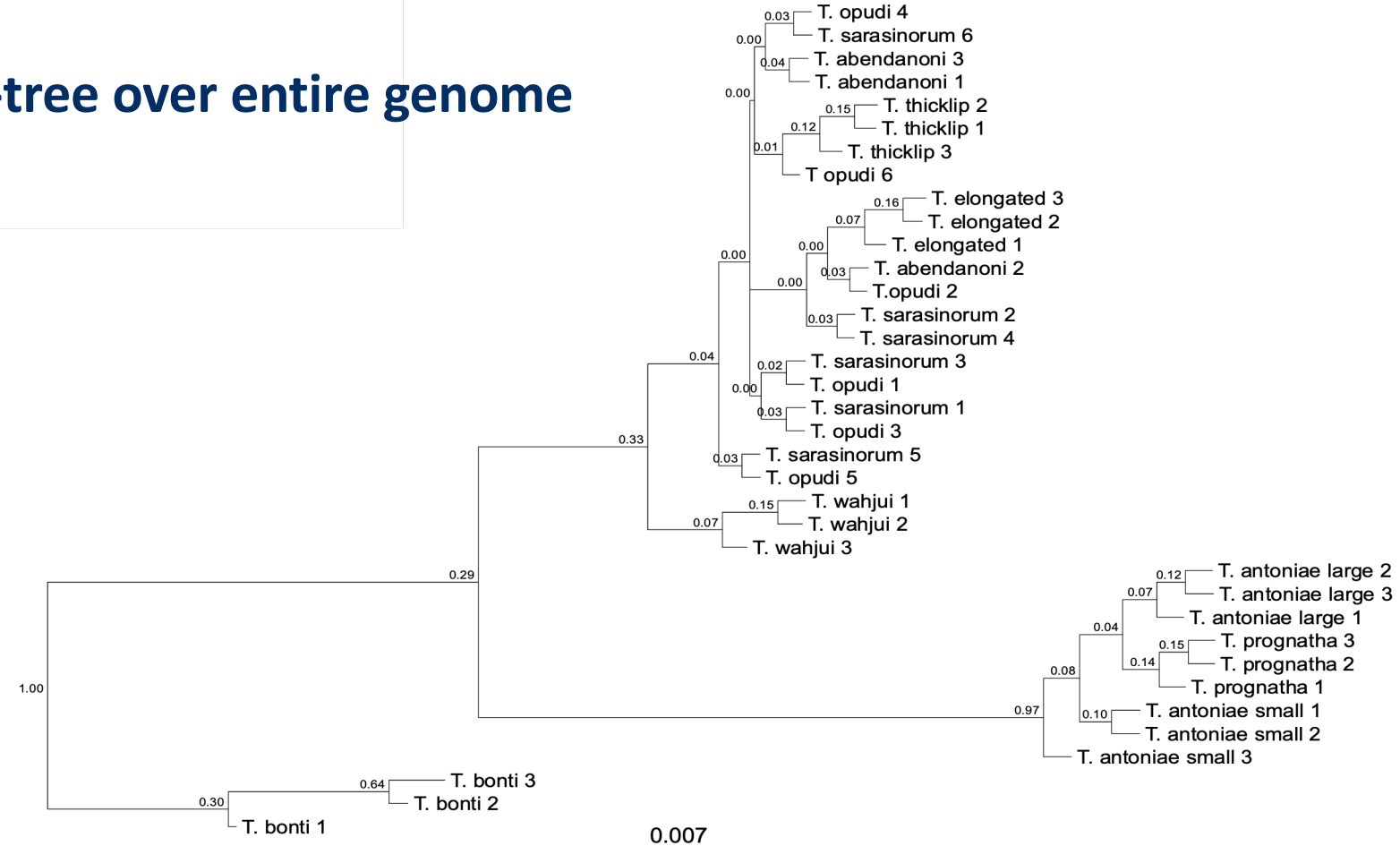
incomplete reproductive isolation

Test hypotheses of the mechanisms promoting early stages of speciation

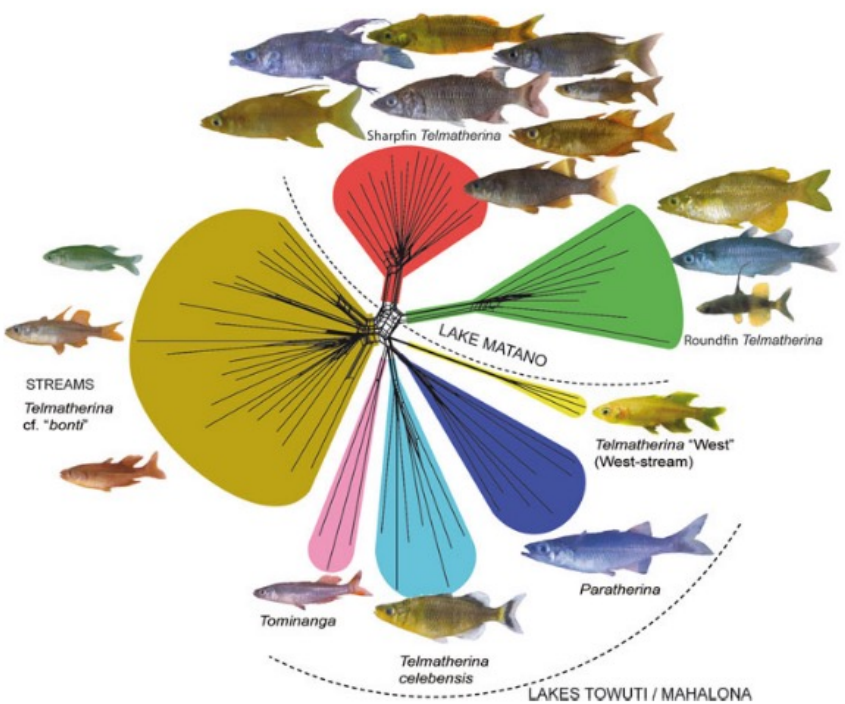


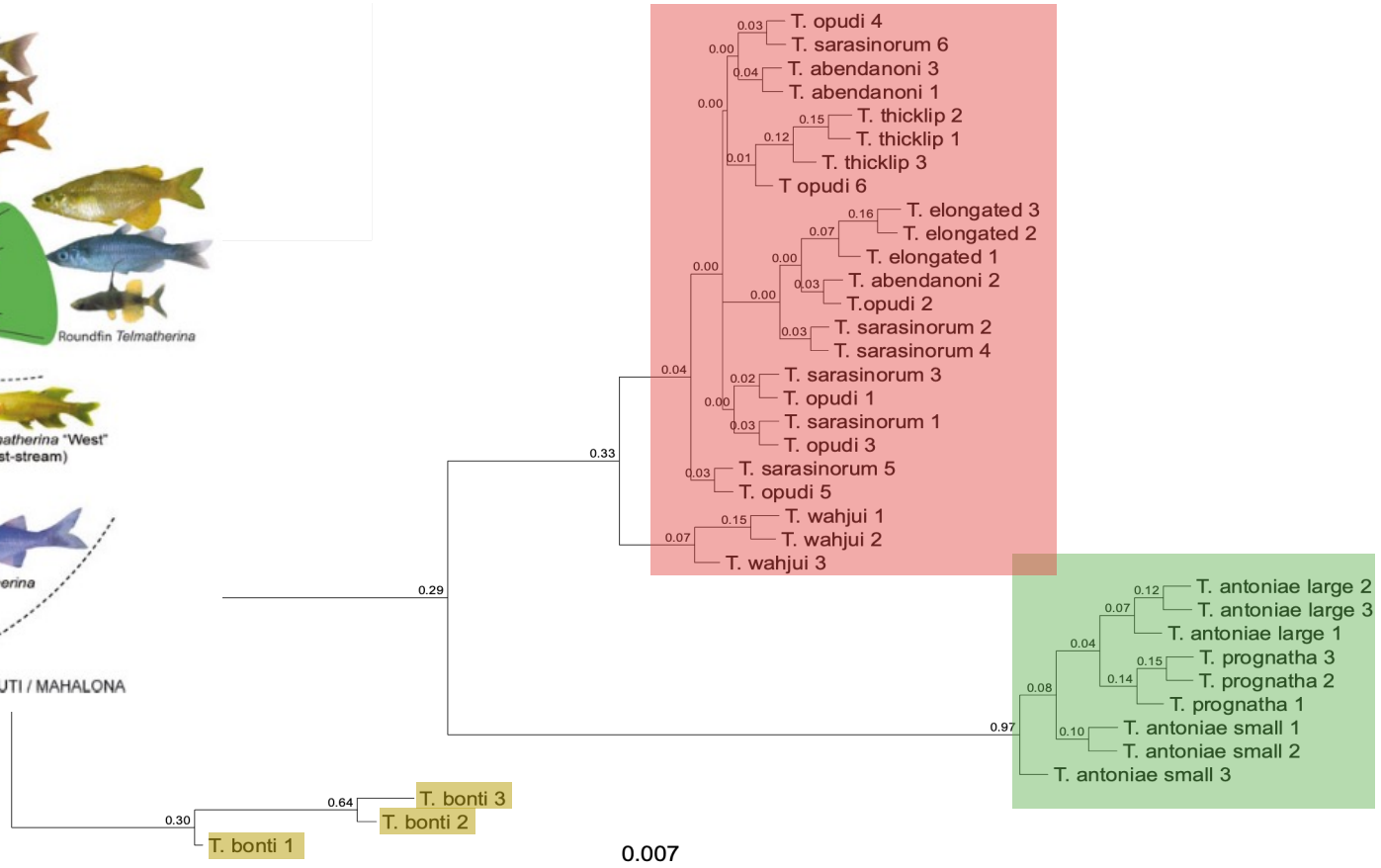
Phylogenomics of the Lake Matano silversides

- **NJ-tree over entire genome**



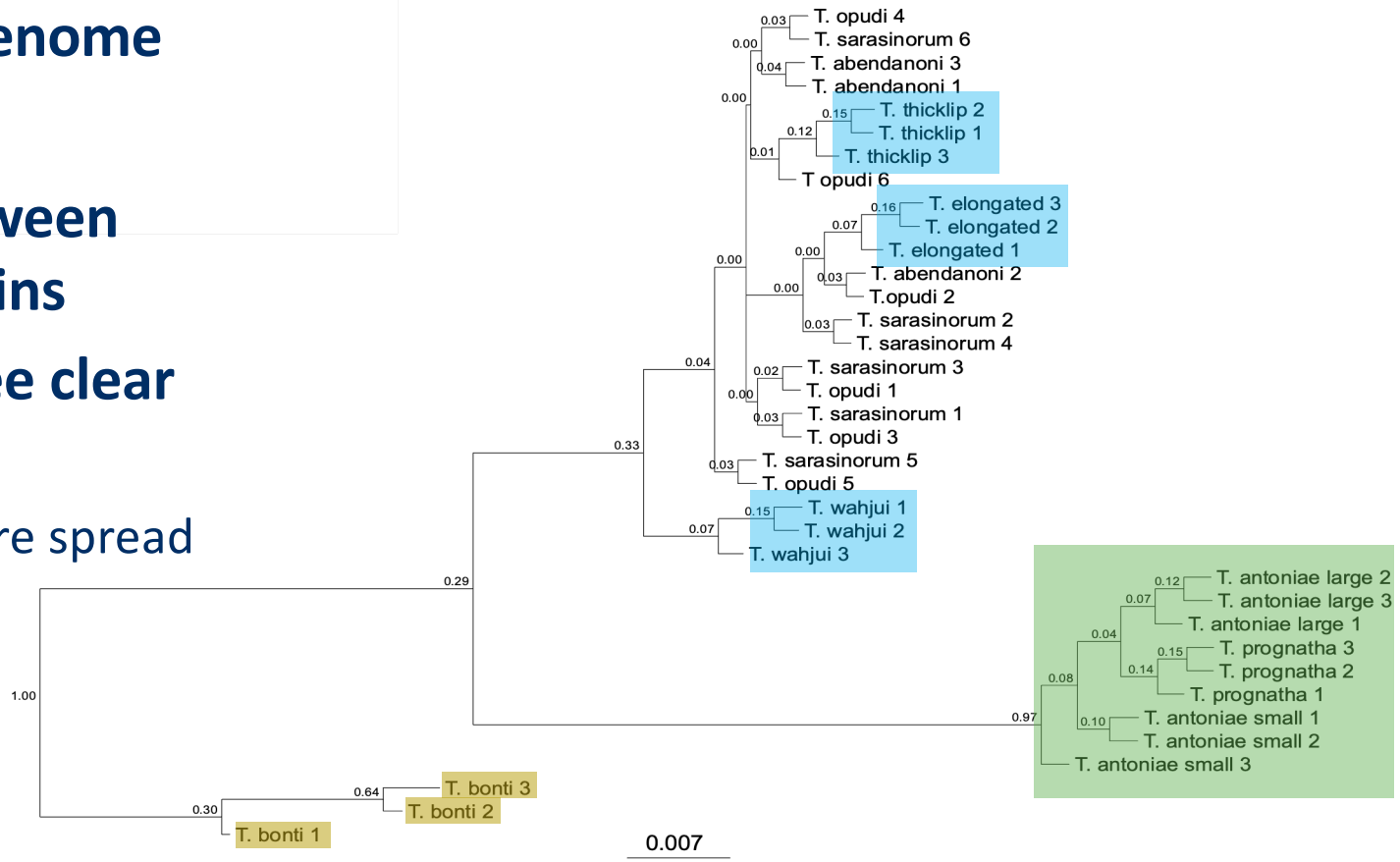
Phylogenomics of the Lake Matano silversides





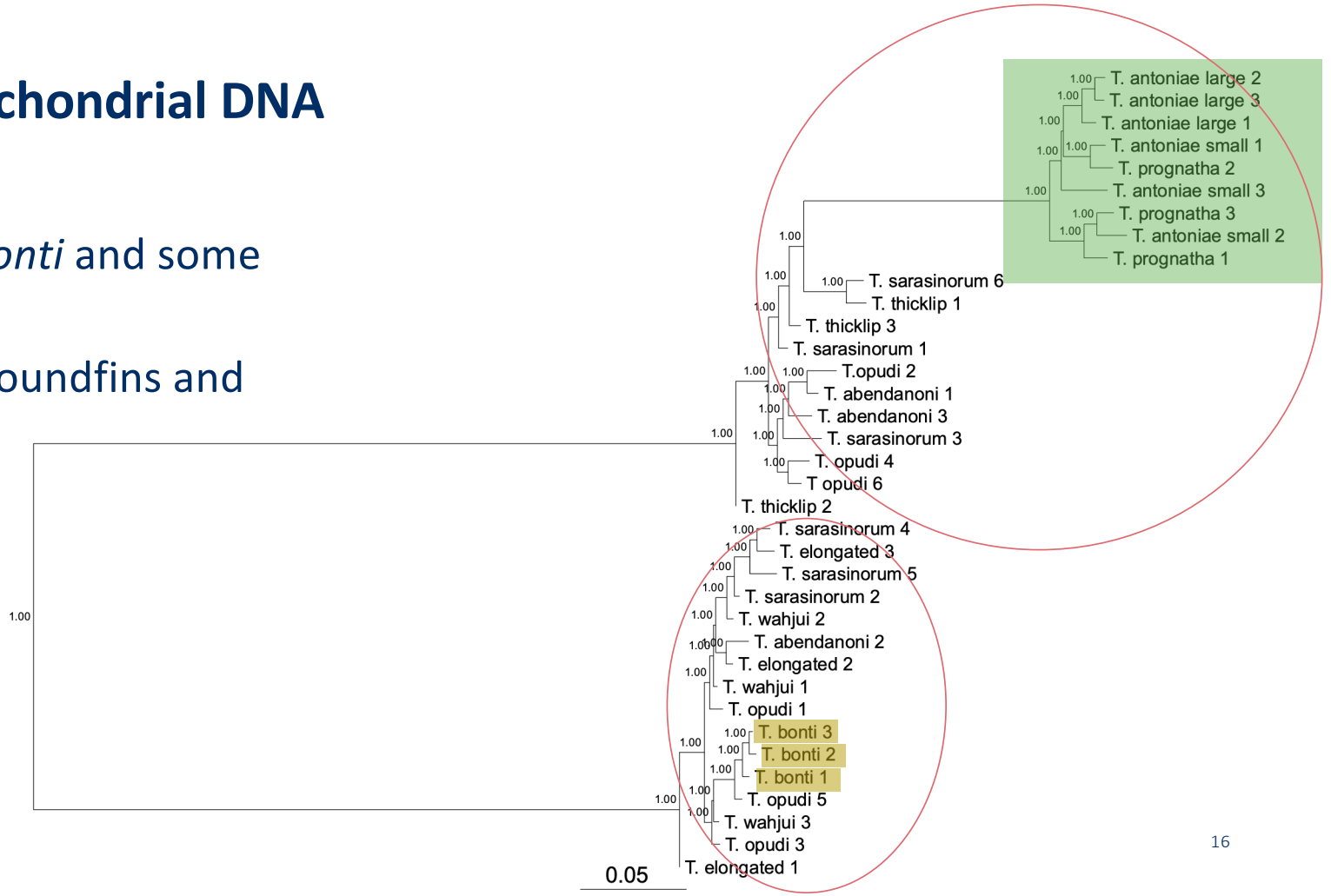
Phylogenomics of the Lake Matano silversides

- **NJ-tree over entire genome**
- ***T. bonti* as outgroup**
- **Clear separation between sharpfins and roundfins**
- **Within sharpfins three clear groups**
  - Three species which are spread along the tree



Phylogenomics of the Lake Matano silversides

- **NJ-tree over mitochondrial DNA**
- **Two groups**
  - One including *T. bonti* and some sharpfins
  - One including all roundfins and some sharpfins

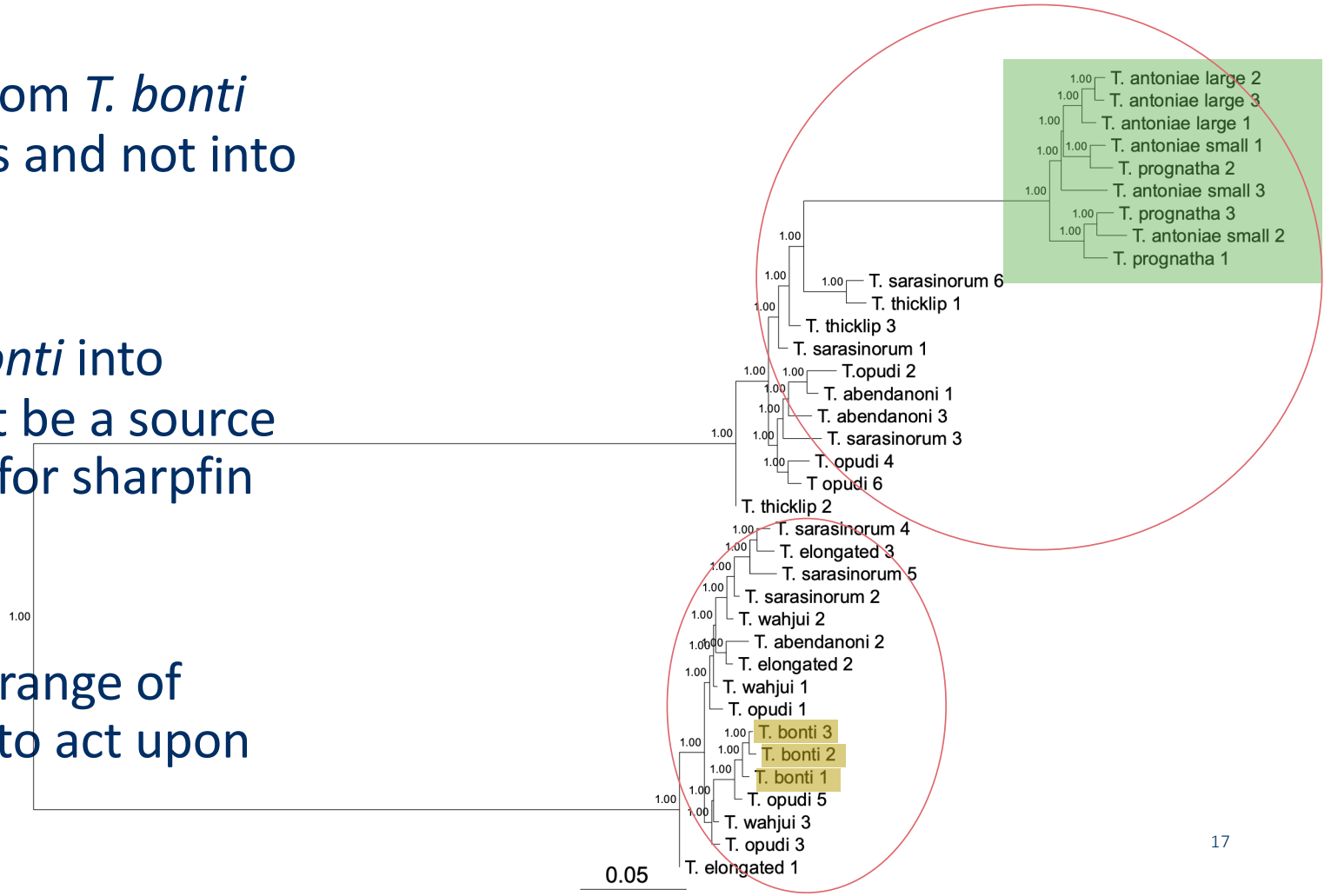


Phylogenomics of the Lake Matano silversides

Past introgression from *T. bonti* into sharpfin species and not into roundfins

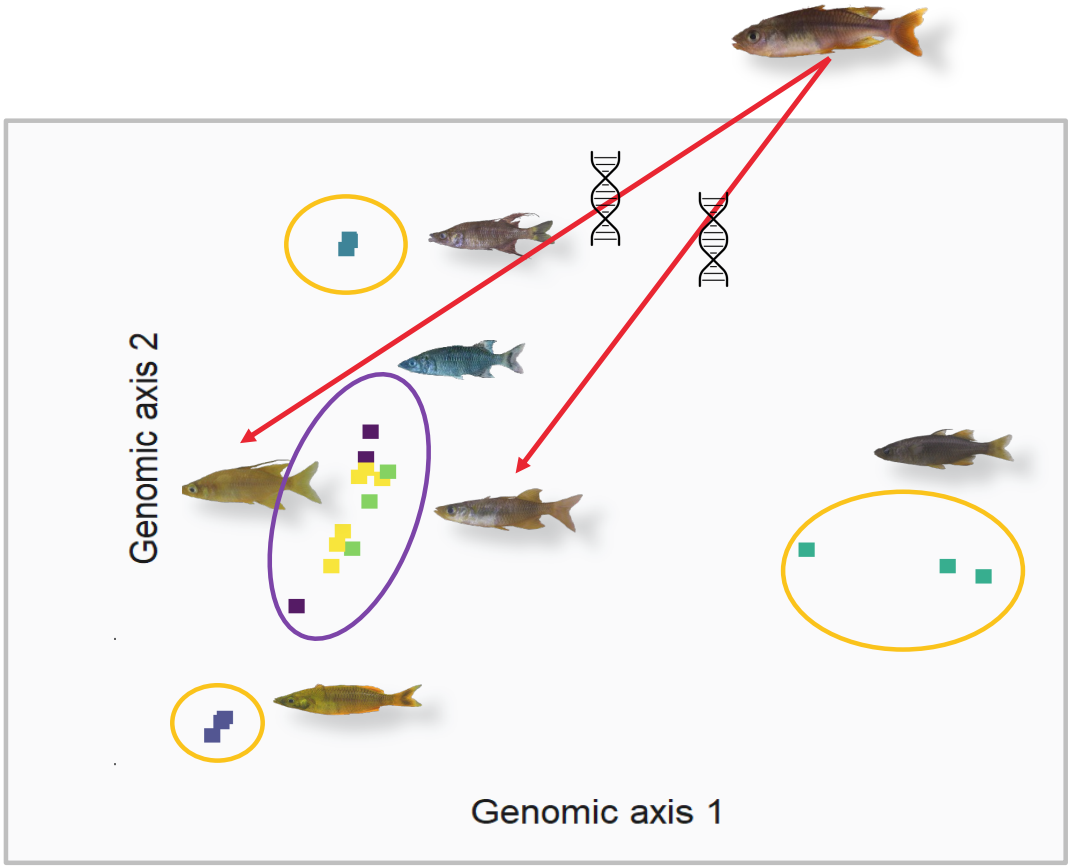
Geneflow from *T. bonti* into sharpfin clade might be a source of genetic variation for sharpfin clade

access to a broader range of alleles for selection to act upon



Some things to look into

- How do the interbreeding species remain distinct?
- What is the role of the ongoing gene flow of the riverine species?
- Which parts of the genomes are introgressed
- How does this relate to phenotypical differences



Thank you for your attention

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