Introgressive Hybridization with an Invasive Species Imperils the Savannah River Endemic Bartram's Redeye Bass

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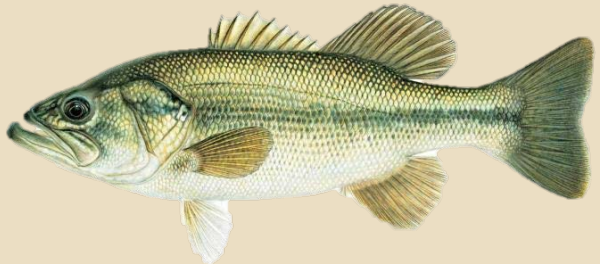
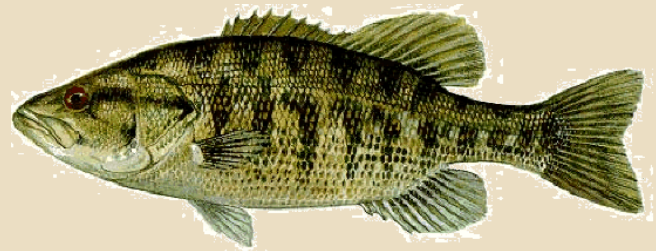
How many black bass species are there?



Largemouth Bass
Micropterus salmoides

Bartram's Bass
Micropterus sp. cf. cataractae

Florida Bass
Micropterus floridanus



Suwanee Bass
Micropterus notius

Guadalupe Bass
Micropterus treculi

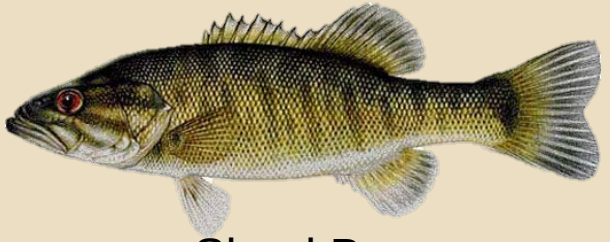
Spotted Bass
Micropterus punctulatus

Redeye Bass
Micropterus coosae

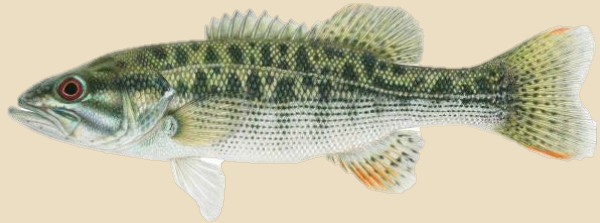
Chattahoochee Bass
Micropterus chattahoochae

Alabama Bass
Micropterus henshallii

Smallmouth Bass
Micropterus dolomieu

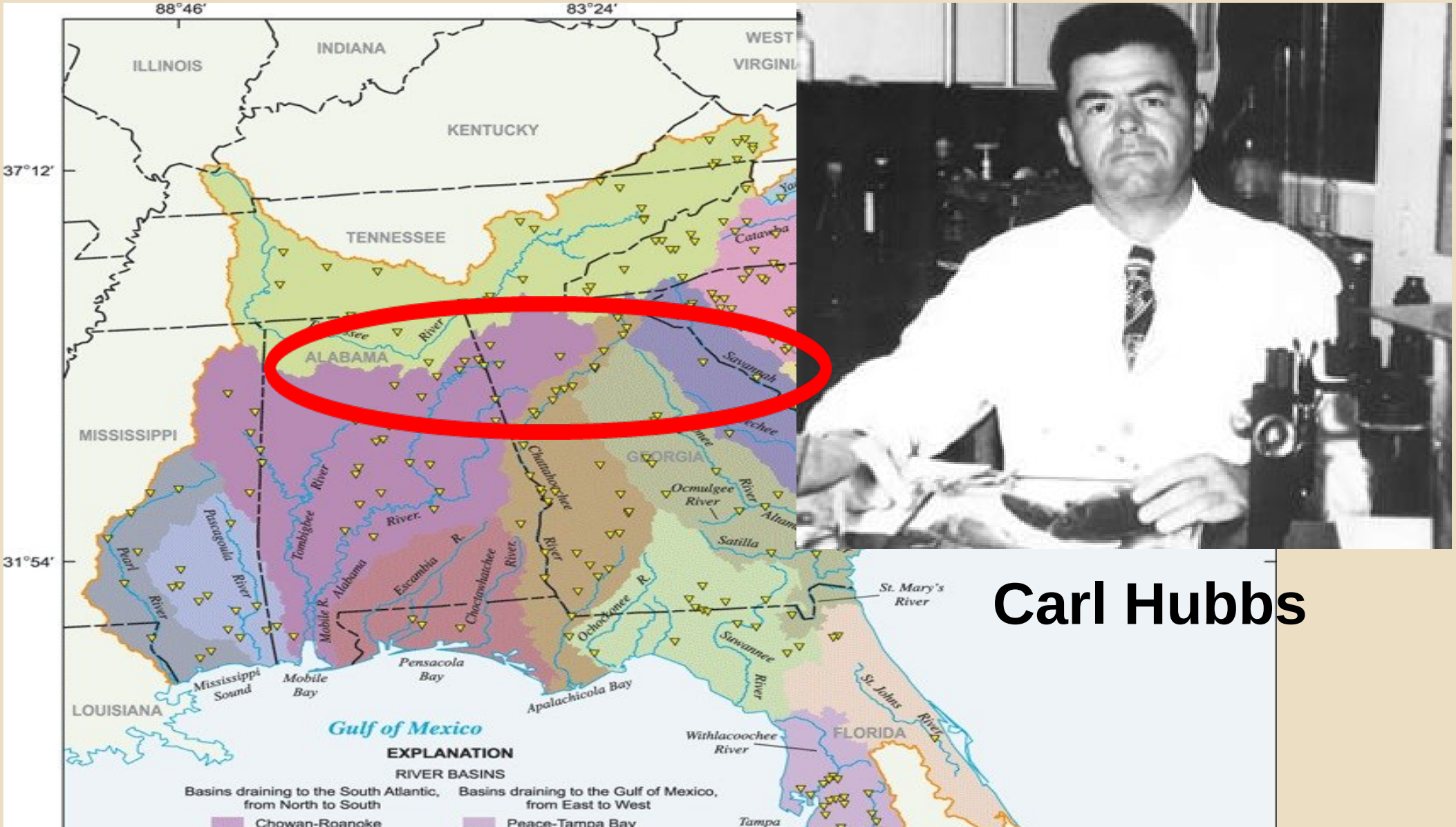


Shoal Bass
Micropterus cataractae



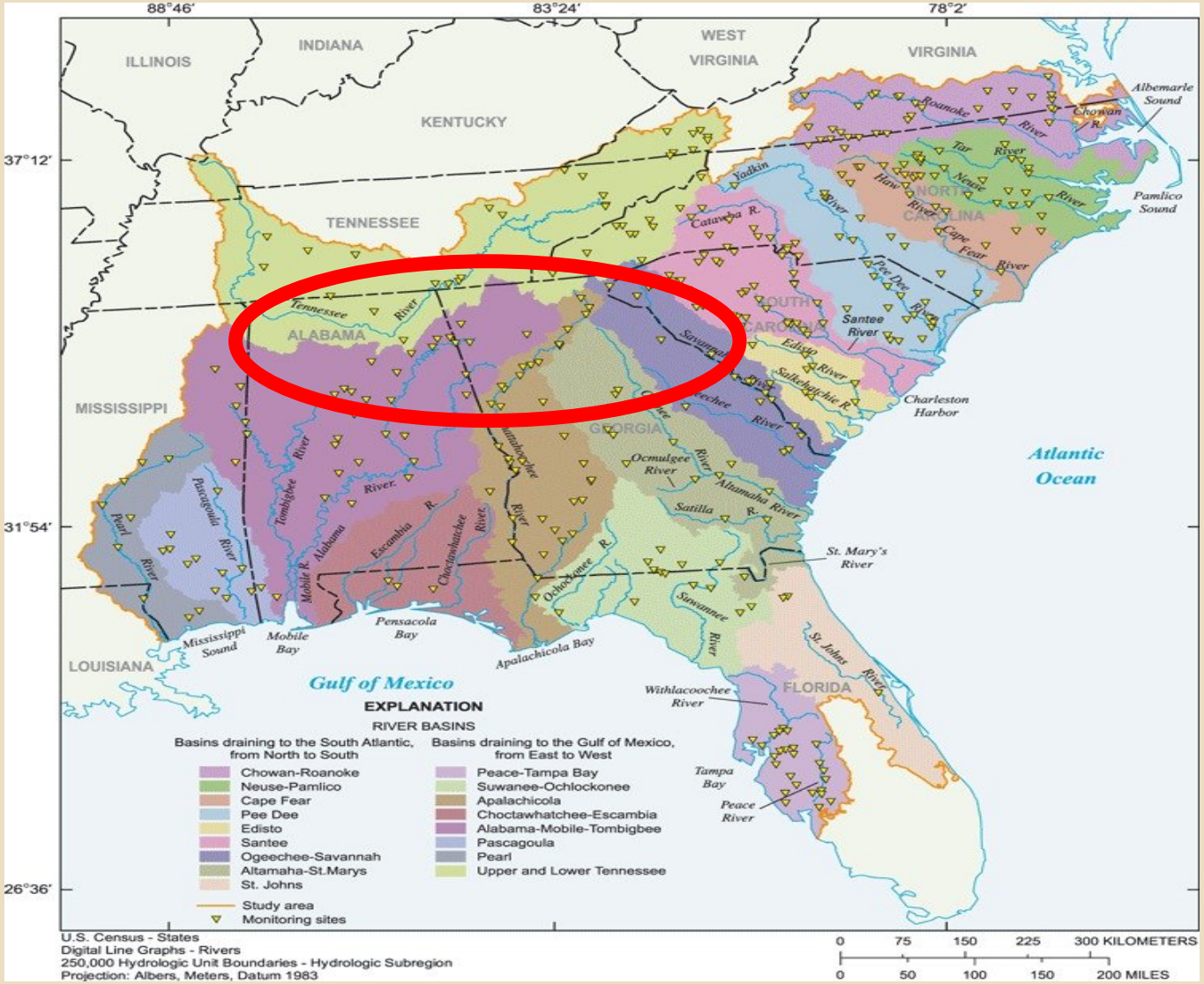
Altamaha Bass
Micropterus sp. cf. coosae

Bartram's Bass: a history



Carl Hubbs

Bartram's Bass: a history



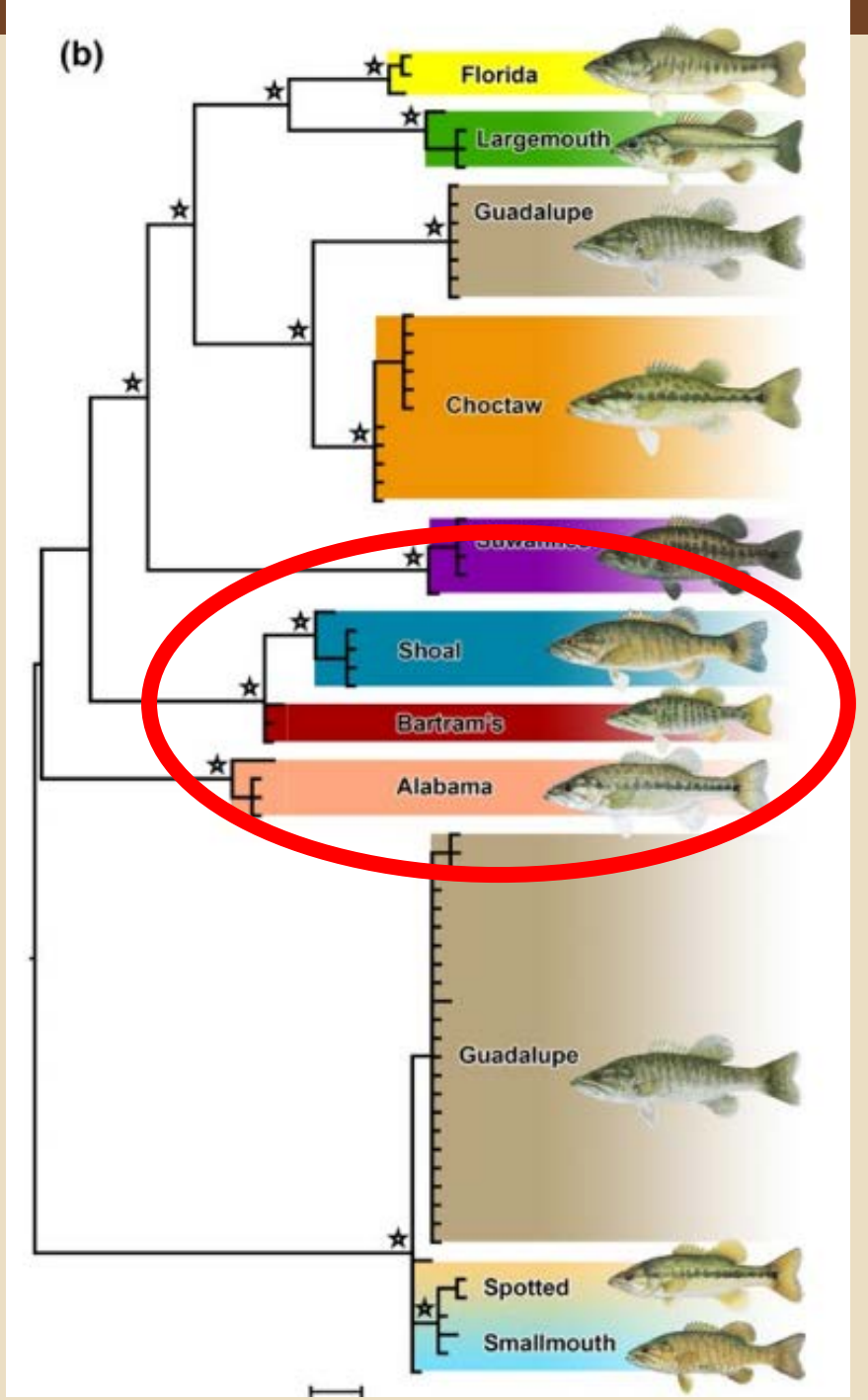
1940:
All 'upland' species are Redeye Bass

Redeye Bass
Micropterus coosae

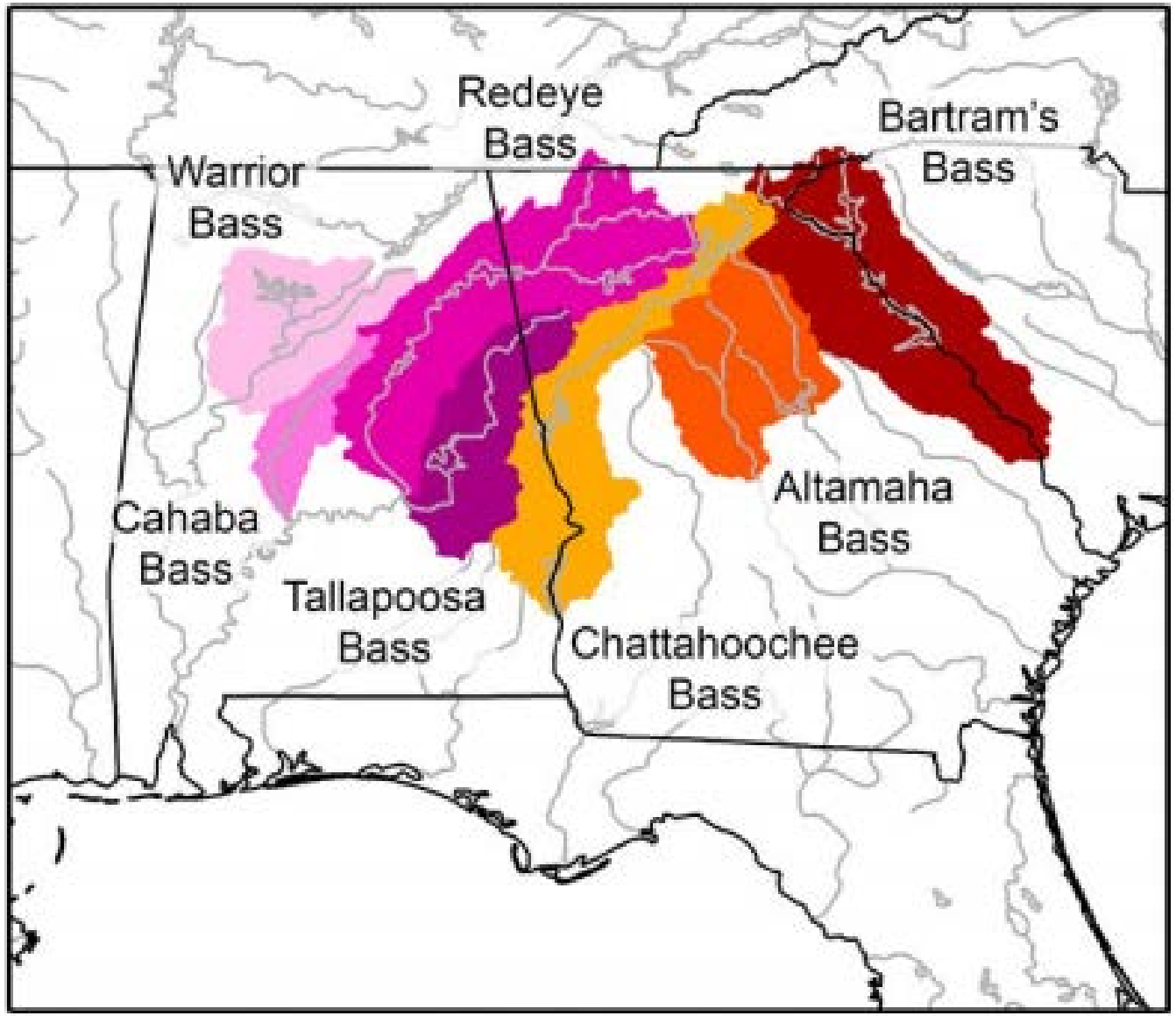
Bartram’s Bass: a history

Tringali et al. 2015: Bartram’s Bass closely related to Shoal Bass

Freeman et al. 2015: Bartram’s Bass recognized as a ‘provisional species’



Bartram's Bass: a history



Original "Redeye bass" represents 3 to 8 separate bass species

True "Redeye bass" inhabits upper Mobile Basin

Separate species:

- **Chattahoochee Bass**
- **Altamaha Bass**
- **Bartram's Bass (Savannah)**

Credit: Katie Burelle
nas.er.usgs.gov

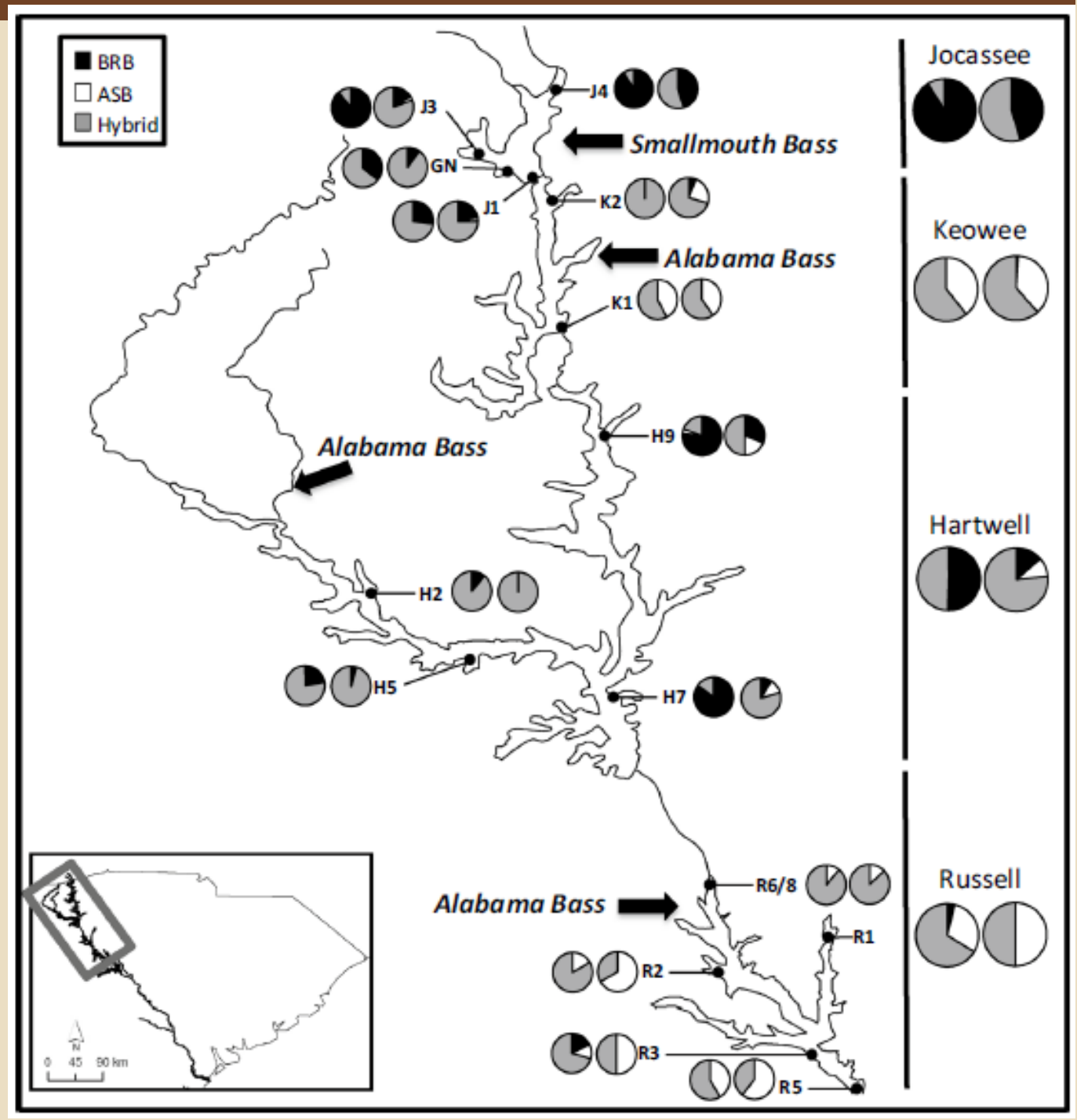
- Mid 1980s: Alabama Bass *M. henshalli* illegally introduced by anglers into Savannah River reservoirs
- By end of 1990s, biologists were arguing over bass IDs due to hybridization and mixed phenotypes

By 2004 (pie chart on left) when fish samples were genotyped, hybrids already made up significant portion of most reservoirs.

By 2010 (pie chart on right), few pure Bartram's Bass remained.

Bartram's alleles being purged from system via introgression

Endemic fish facing potential for extinction before being formally described



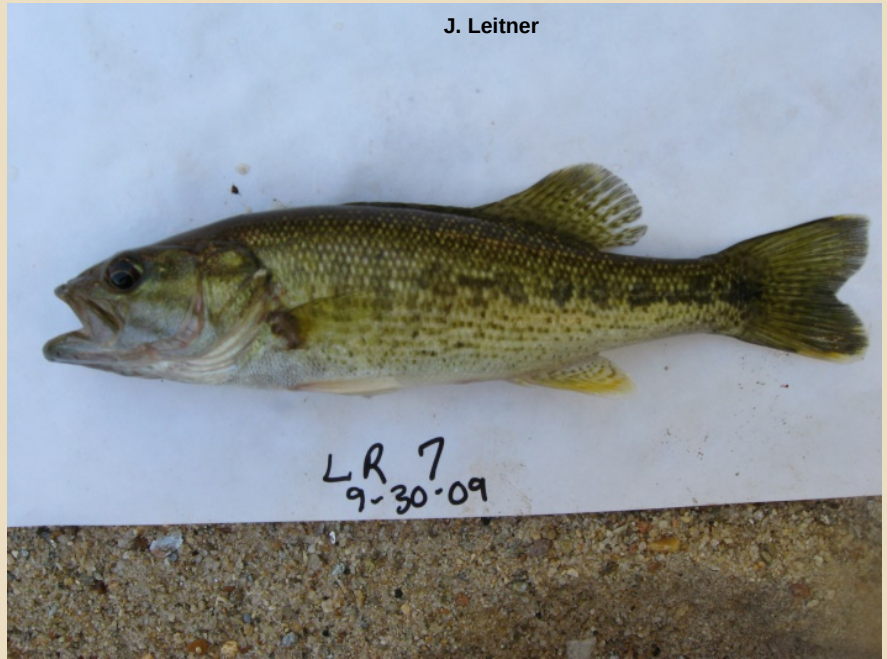
Bangs et al. 2018

Prior findings

- Steadily introgression since with Bartrams Bass = genetic swamping; Alabama Bass *M. henshalli* now appear to be dominating lakes
- Work in tributaries showed scattered presence of ALB and hybrids

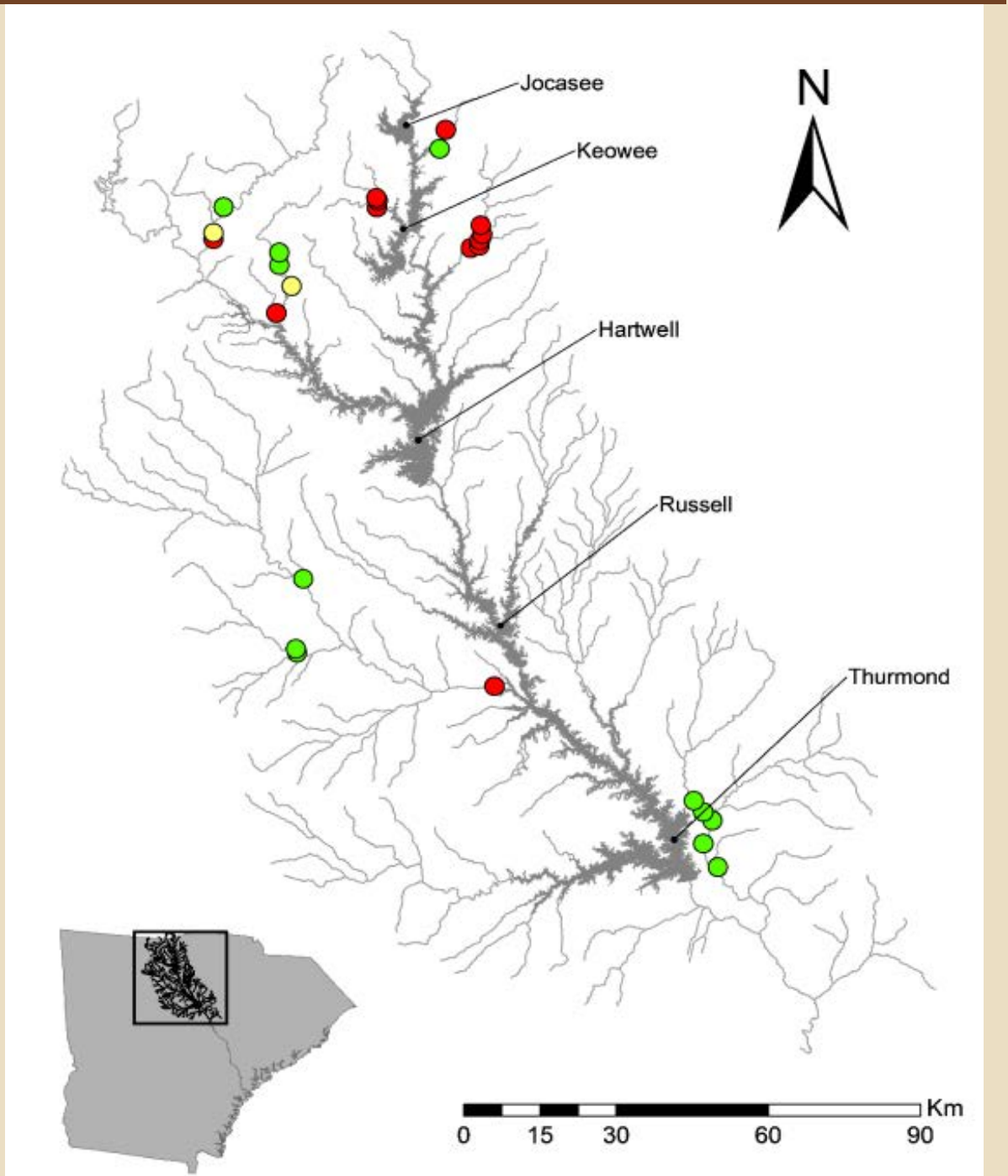
Focus on running waters

- Are ALB invading tributary rivers and streams? To what extent are ALB and hybrids distributed throughout the upper Savannah drainage? Can we identify refugia with pure BTB populations?
- Is hybridization occurring in flowing waters?
- What are the spatial and anthropogenic disturbance factors associated with pure BTB populations?



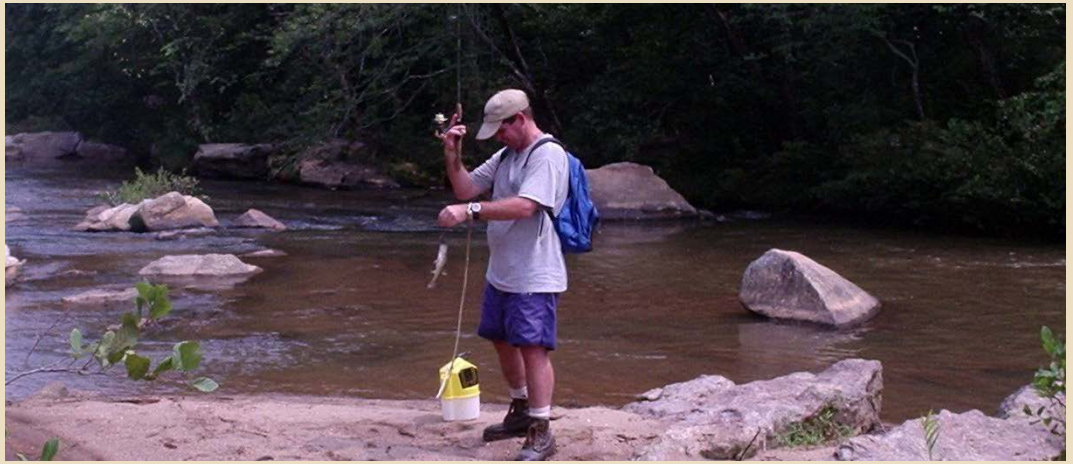
Upper Savannah River Basin

- 2013 – 2015 Longitudinal surveys in select tributaries
- Hybridization detected
- Refugia identified
- Distance from reservoir a factor

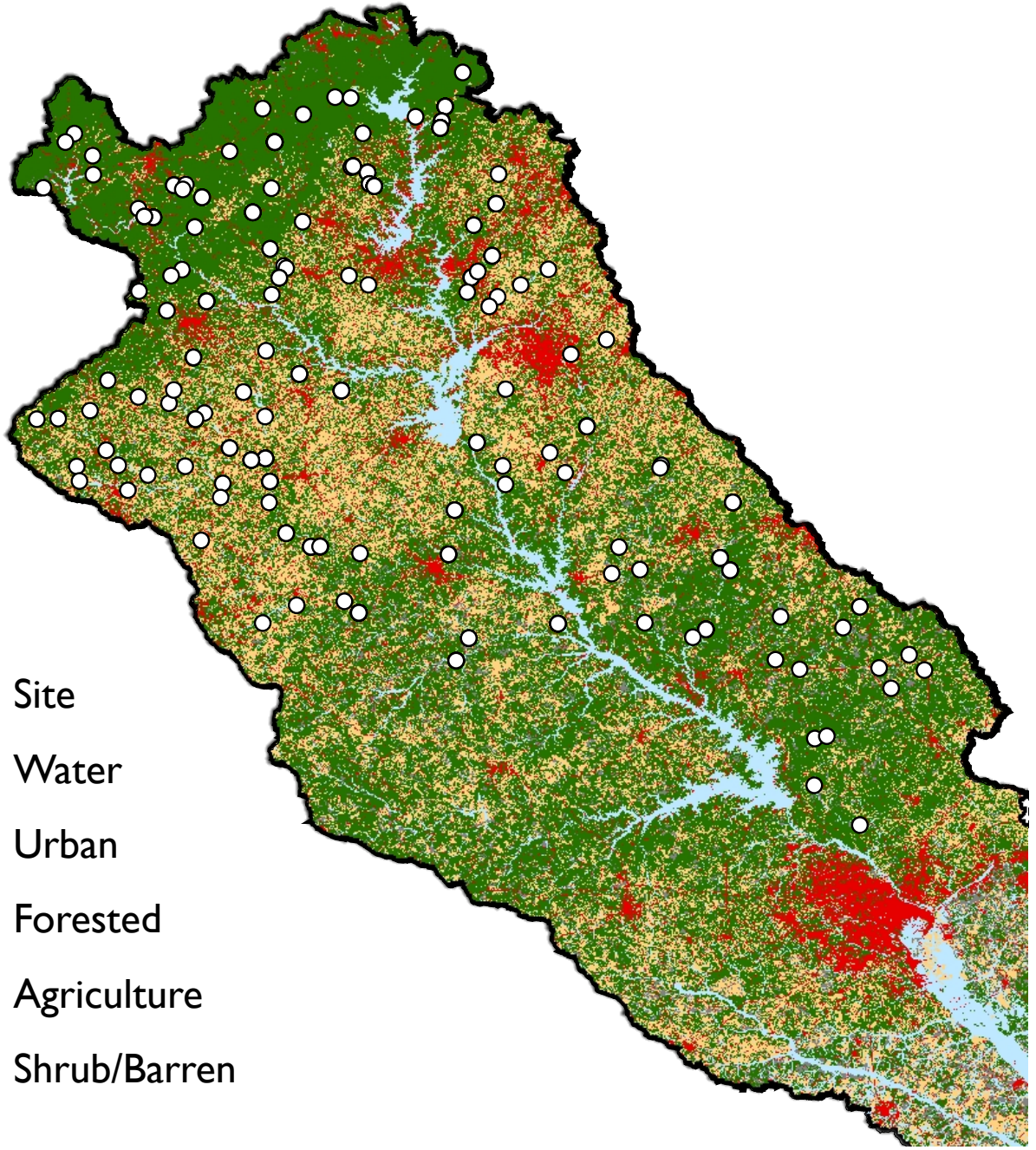


2017-2018 Methods

- 160 sites on tributaries
- Fish collected by backpack electrofishing & angling
- Photographed and fin clipped all black bass
- Nesting sites were monitored, eggs and larvae sampled for DNA
- Microsatellite DNA analysis based on previous work by Tringali et al.
- Catchment data for sites clipped from NFHA



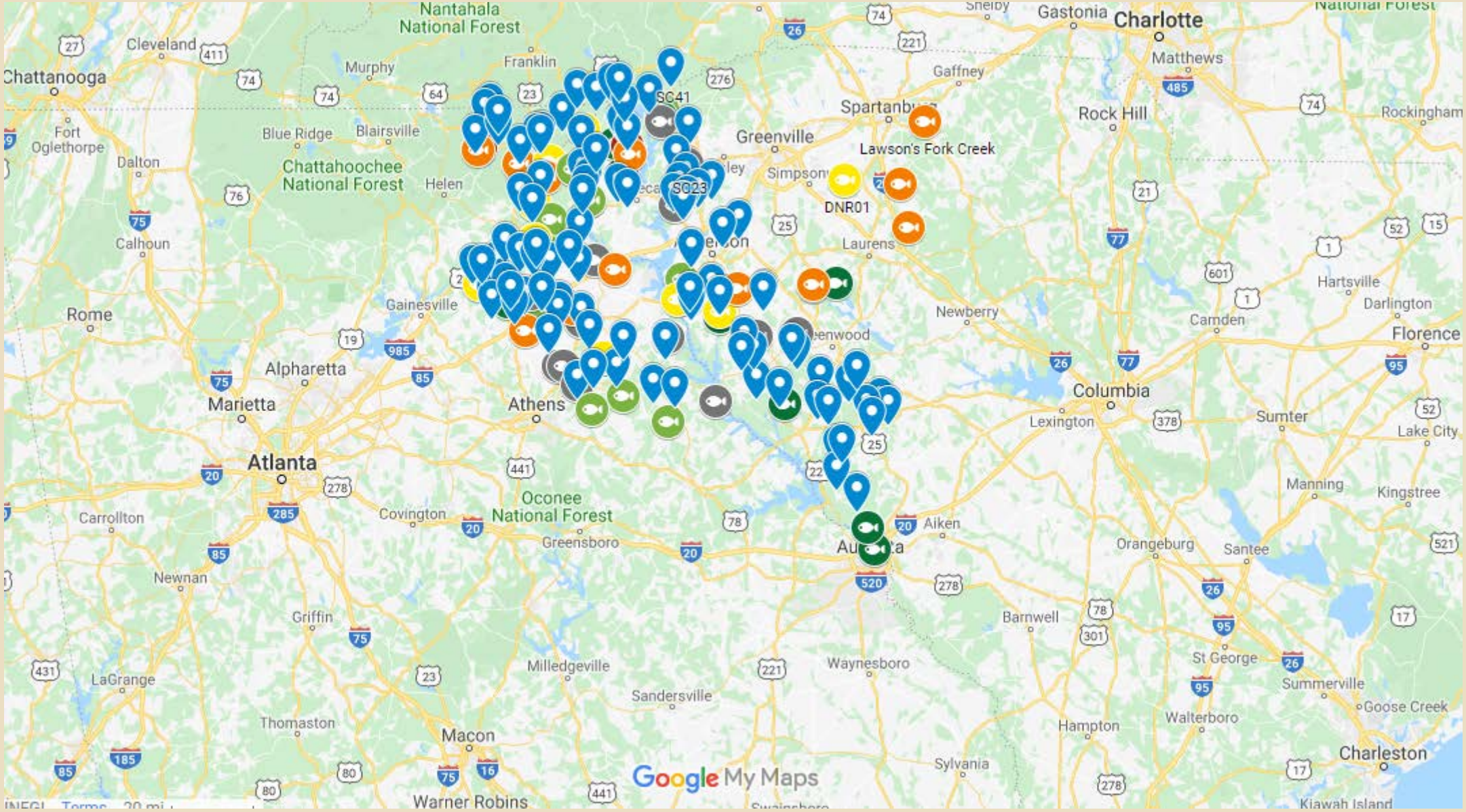
160 sites in 2017 & 2018



Emily Judson, M.S.

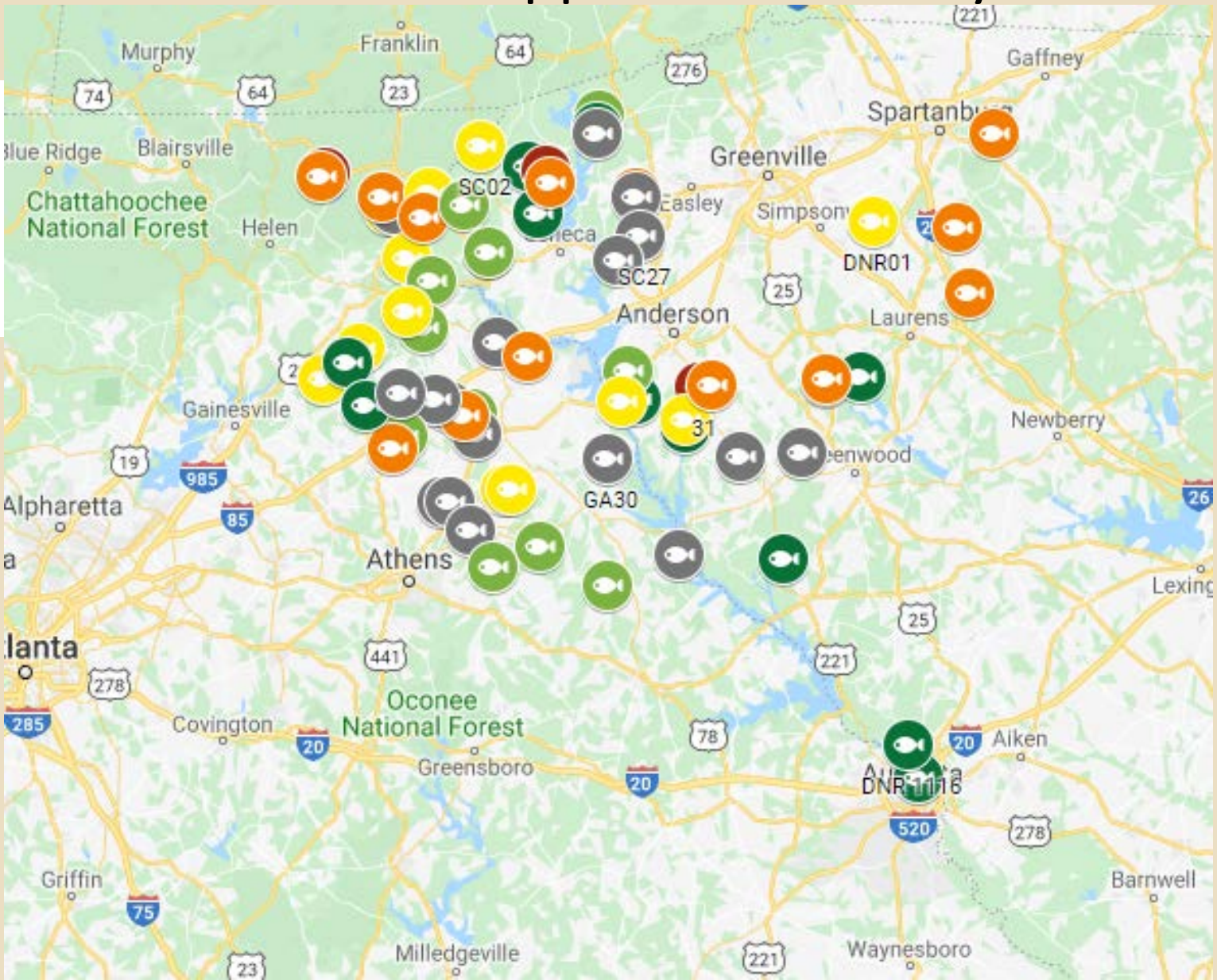

Attempted to capture fish off nest

2017-2018 Results – Fin Clipped Adults Only



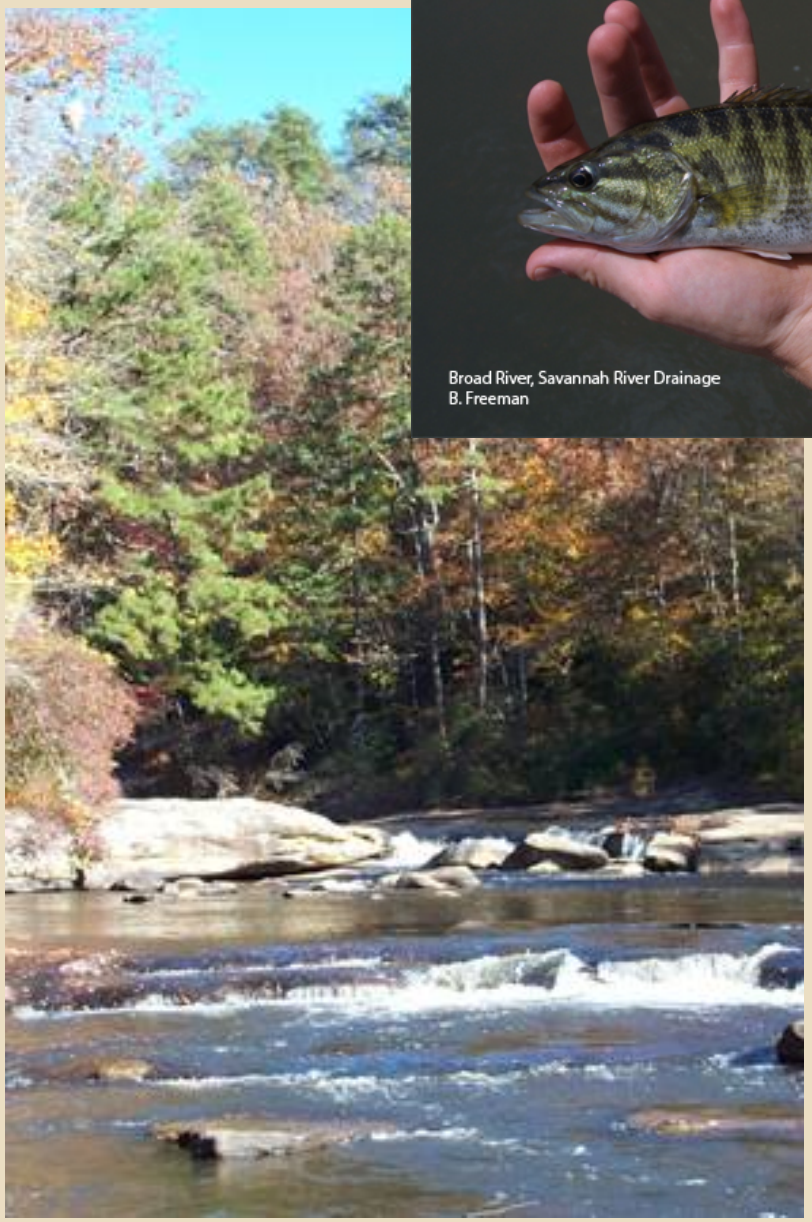
2017-2018 Results – Fin Clipped Adults Only

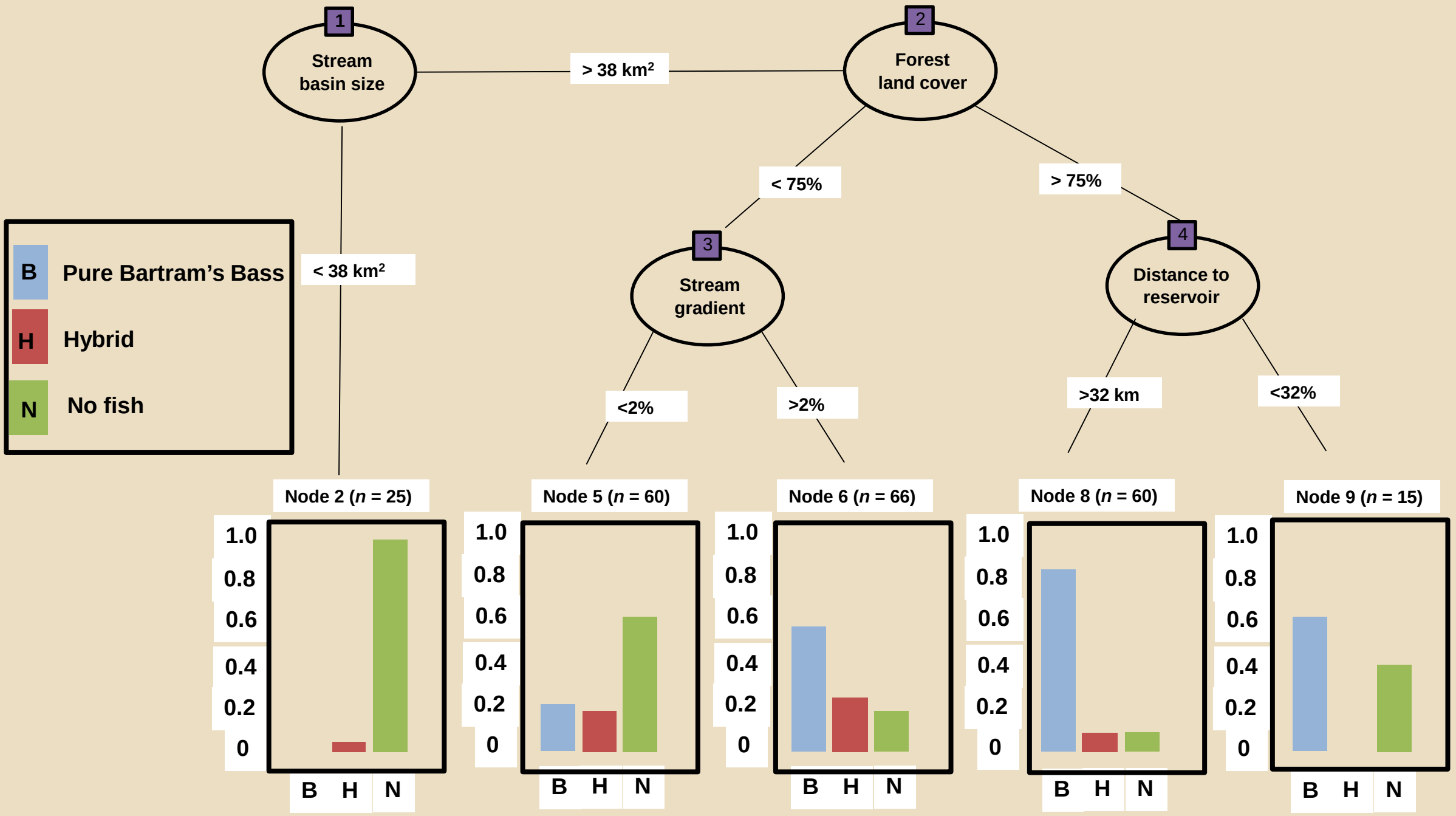
- Pure BTB
- Near-pure BTB
- Hybrids
- Hybrids / ALB
- Near-pure ALB
- No bass of interest



Habitat Alteration as Facilitator of Hybridization

- “Hybridization of the Habitat” Anderson (1948)
- May enhance fitness of hybrids relative to native genotype
- Can generate new niches favorable to hybrids
- Hybrids more prevalent in disturbed habitats
  - Plants (Guo 2014), Insects (Brust 2009), Amphibians (Vogel & Johnson 2007), Birds (Maciorowski et al. 2015), Fish (Hasselman et al. 2014)
- Todesco et al. (2016) found in their lit survey of extinction through hybridization that the association with human activities was among strongest




1
Stream basin size
> 38 km²
2
Forest land cover
< 38 km²
< 75%
> 75%
3
Stream gradient
4
Distance to reservoir
<2%
>2%
>32 km
<32%
B
Pure Bartram's Bass
H
Hybrid
N
No fish
Node 2 (n = 25)
Node 5 (n = 60)
Node 6 (n = 66)
Node 8 (n = 60)
Node 9 (n = 15)
1.0
0.8
0.6
0.4
0.2
0
B H N

Conclusions

- ALB or hybrids are present in significant number of tributary sites
- Documented tributary sub-basins and zones of pure BTB populations
- Established baselines of the extent of ALB invasion for trend monitoring
- Young hybrids collected at some upstream sites; likely that hybridization is occurring in flowing systems rather than migration up from impoundments
- Proportion of ALB at a site related to spatial and anthropogenic factors; hypotheses include: disturbed habitats may stress fish -> affect spawning cues, or may simply be more suitable for ALB.

Implications for Conservation of Bartrams Bass

- If catchment disturbance relationships are confirmed, need to establish target levels necessary to sustain BTB populations
- Preliminary targets:
  - Catchment riparian forest > 75%
  - Agricultural land use < 20%
  - Impervious surface < 1%
- Re-evaluate with additional data

Next steps:

- Describe the species!
- Occupancy modeling for BTB in upper Savannah basin based on spatial and geographic predictors and instream habitat suitability
- Mapping:
  - Areas of potential BTB refugia that meet target disturbance levels
  - Track extent of ALB longitudinal invasion up tributaries as baseline information to compare future spatial distribution
- Investigate potential for BTB culture and conservation stocking at suitable locations

Acknowledgements

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