# FINAL REPORT

**South Carolina State Wildlife Grant SC-T-F14AF01233**

South Carolina Department of Natural Resources

October 1, 2014 – September 30, 2020

Project Title: SC Small River Conservation Planning

Objectives:

In South Carolina, high quality aquatic habitats support a rich fauna. The rivers and streams of the southeastern United States have the highest known diversity of mussels, snails and crayfishes in the world. In addition, freshwater fish species richness is the highest of any temperate region and the herpetofauna is globally significant. South Carolina's State Wildlife Action Plan (SWAP) contains descriptions of over 125 species of fish, herps, mussels, crayfish and snails that are directly dependent on freshwater habitats for most or all of their life-stages, accounting for approximately 40% of the state's total number of species of conservation concern (excluding marine species) (SCDNR 2015).

This study fits into a grand vision of aquatic resource conservation and management in South Carolina that focuses on landscapes and their drainage basins. Water, running off the land and coursing through streams and rivers, integrates landscapes due to the linear, connected nature of drainage networks. Simply put, tiny headwater streams join to form larger and larger channels to form the major rivers. Downstream habitats, including the reservoirs, estuaries, and coastal systems of the state, are directly influenced by upstream conditions in drainage networks. Our SWAP describes the environmental changes taking place across South Carolina's freshwater landscape that negatively affect native fauna, generally involving siltation, altered hydrology, contaminants, and other forms of habitat degradation. A landscape approach allows us to proactively address cumulative impacts to ecological integrity, integrated across taxa and geography. We can address the needs of all Priority species that depend on aquatic systems by building a true mountain-to-the-sea, headwater-to-estuary framework for addressing freshwater conservation.

The first step in building this conservation framework has been largely completed. Through a previous State Wildlife Grant, small wadeable streams were assessed during the South Carolina Stream Assessment (SCSA). Data were entered into the StreamWeb database and information served in a web-accessible Stream Conservation Planning Tool. One result apparent from those data is the increase in species richness with stream size, up to the upper size limit in the sample design (Figure 1). This result indicates that roughly one species can be expected to be added with every 10 $km^2$ increase in stream drainage area. It also suggests that a major repository of fish diversity in the state resides in larger streams and small rivers.

Small rivers are spatially and temporally important as transitional habitats between streams and the large rivers, supporting a broad diversity of aquatic taxa both permanently and seasonally. Over 3,100 km of small rivers flow through South Carolina's four major river basins. Observations from the SCSA indicate small rivers are expected to harbor a high number of Priority freshwater fishes as defined in the SWAP. Both species richness and density of Priority freshwater fishes increased with watershed area (i.e. stream size) in the SCSA, potentially extrapolating higher richness and density for small rivers (>150 km²; Figure 2). Furthermore, small rivers likely represent principal habitats for many under-studied aquatic taxa for which data gaps exist. The physical challenges of sampling small rivers have resulted in a general lack of standardized sampling devoted to these habitats in South Carolina; thus, there is a need for statewide data on species distribution and abundance from which to assess status and conservation need among species and assemblages.

The Small River Assessment is intended to extend and further the objectives of the South Carolina Stream Assessment, which was limited to wadeable streams under 150 km² in drainage area, in order to include the greater spatial extent of small rivers in the state (indicated in Figure 1), defined as draining basins between 150 and 2,000 $km^2$. The specific objectives of the project are to:

1. Design a sampling program to that will define the physical, chemical, and biological conditions in small rivers across South Carolina; and
2. Implement a standardized data collection protocol at randomly-selected sites.

With these data we will then be in a position to follow the steps of the SCSA, developing models that 1) rank influences on physical, chemical, and biological conditions, 2) identify stressor-response relationships, 3) predict and map population status from sample data, and 4) incorporate the modeled relationships into our decision support tool to allow definition of current and predicted future biological conditions in South Carolina's small rivers, including alternative scenario testing.

<u>Accomplishments</u>:

## Methods

*Sampling Design and Site Selection*

A database listing the spatial coordinates and area drained for all 100 m-long segments of every stream and river in South Carolina, compiled for the SCSA, was used to create a list frame of potential sites from which to select for the Small River Assessment. Small rivers were defined as those draining watersheds from 150 km² (the upper watershed limit of streams included in the SCSA) to 2,000 km² in area. The total linear extent of small rivers in South Carolina falling within this watershed area range was 3,168 km, representing 31,680 possible points (100-m segments) for site selection (Figure 3). Sites were stratified by major river drainage and ecoregion (=ecobasin) and by size (=drainage area). Ecoregions followed Griffith et al. (2002), using level-III ecoregions with one modification: Due to the small area of the Blue Ridge, it was merged with the Piedmont to form the “Uplands” in order to avoid issues related to small sample size in the Blue Ridge. The target statewide total was 100 sites, and the number of sites apportioned to each stratum was proportional to ecobasin area and drainage area, with three size categories defined: Class 4 = 150 to 500 $km^2$, Class 5 = 500 to 1000 $km^2$, and Class 6 = 1000 to 2000 $km^2$ (Table 1). In some ecobasins, site availability was constrained by small ecobasin size and/or drainage configurations coupled with other site selection criteria, resulting in lower sample sizes for certain river size classes.

In order to achieve random site selection, the list of all potential sites for each ecobasin was randomized, establishing a rank order for selection. Sites were then plotted according to the rank order and examined in a two-phase suitability evaluation process: Sites were first evaluated using computer mapping software and satellite imagery, then visited in the field to check suitability and access. Sites were excluded from the study for the following reasons:

1. Not representative of natural river conditions for a given ecobasin (e.g. located on an impoundment or within an impounded / unnaturally wide or deep section);
2. Subject to frequent human-controlled variation in flow (e.g. daily flow fluctuations);
3. Not accessible for necessary sampling method (e.g. too deep for wading and not accessible for boat electrofishing); and/or
4. Access denied by property owner.

Furthermore, to maintain sufficient independence of sample sites, a threshold of 50% watershed area overlap was implemented, such that one site could not share more than 50% of the watershed (by area) of another site. The final 100 sample sites are shown in Figure 4 and listed in detail in Appendix A.

*Fish Sampling*

Fish sampling was conducted during base flow conditions from spring through fall of 2016-2020. A site was defined as a reach of river 1 km in length, which was sufficient to exhibit at least one full sequence of expected habitat types for a given ecoregion (e.g. runs, pools, and riffles/shoals). Within each site, multiple spatial sampling units (replicates) were selected within each habitat type to apportion sampling effort among the primary habitats influencing fish species composition in order to collectively represent the fish assemblage structure of the site. Habitat heterogeneity varied naturally among ecoregions, and the number and distribution of spatial replicates was allocated in proportion to the observed coverage of habitat types and corresponding sampling methods (Table 2). In some sites exhibiting a wide range of habitat types, multiple sampling methods were employed to effectively sample all habitats and target all species.

Backpack electrofishing was the primary sampling method in shallow (wadeable), homogenous habitats including runs and shallow pools. In each 50-m segment (replicate), a team of 4-8 persons using 2-3 backpack electrofishing units (depending on habitat complexity) began at the downstream end of each segment and proceeded electrofishing in an upstream (longitudinal) direction along the bank or in the middle of the channel. Segments were distributed throughout each site in alternating fashion along both banks and the middle portions of the channel in order to provide coverage of all habitats. In moderately deep, wadeable habitats, electrofishing was conducted in 50-m segments using a barge-mounted electrofishing unit in the same manner as described for backpack electrofishing. For non-wadeable rivers, boat electrofishing was performed in 50-m segments following the same spatial distribution of segments as described for backpack electrofishing. In large, complex shoal habitats, electrofishing was conducted in smaller spatial units while employing a seine to effectively capture fishes in faster and more turbulent flows. A seine was set at the downstream end of each unit, and a single electrofisher began 5 m upstream of the seine and sampled in a downstream direction toward the seine.

*Habitat Characterization*

Physical habitat was measured at each fish sampling spatial replicate to characterize the habitat conditions at the scale of replicates as well as the site (aggregate). For each 50-m fish sampling segment in wadeable habitats in which backpack or barge electrofishing was conducted, five habitat measurements were taken along the segment, moving from downstream to upstream. At each measurement point, the following habitat features were measured:

1. Depth (m);
2. Mean current velocity (m/sec), measured at 6/10ths depth from water surface;
3. Primary inorganic particle size diameter (mm), measured along the intermediate axis of the particle; and
4. Secondary/organic substrate type (if present within 2 m of measurement point). Organic substrate types included large woody debris (LWD), fine woody debris (FWD), coarse particulate organic matter (CPOM), fine particulate organic matter (CPOM), and aquatic vegetation (AV).

For electrofishing with seine sets in shoal/riffle habitats, one habitat measurement was taken per electrofishing/seine set, in the central location of the sampled area. In non-wadeable habitats sampled using boat electrofishing, two measurements were taken from the electrofishing boat or a canoe—at the downstream and upstream ends of the segment. Depth and current velocity were measured using a Marsh-McBirney Flo-Mate 2000 with top-set wading rod (Marsh-McBirney, Inc., Frederick, MD, USA). Wetted width of each site was measured using a laser rangefinder at the downstream end of each replicate (for 50-m segments) or every 25 m in shoal/riffle areas being sampled with a seine. Water quality was measured at each site prior to fish sampling using a YSI 556 multimeter for water temperature (C), conductivity (µS/cm), salinity (ppt), and dissolved oxygen (DO) (mg/L), and a YSI pH10 meter for pH (Yellow Springs Instruments, Inc., Yellow Springs, OH, USA). Turbidity (NTU) was measured using the HF Scientific MicroTPW meter (HF Scientific, Inc., Fort Myers, FL, USA).

*Empirical Relationships between Fish and Environmental Factors*

We used linear models to examine responses of select fish assemblage metrics to several environmental variables expected to influence biota in rivers and streams. We performed the analyses separately for sites above the Fall Line (upland) and sites below (coastal plain) using single covariate generalized linear regression models to predict three fish metrics: native species richness, SWAP-listed Priority species richness, and SWAP Priority species relative abundance. Eight covariates were considered in our analysis and included: dissolved oxygen (mg/L), temperature (°C), velocity (m/s), turbidity (NTU), watershed area (km$^2$), and elevation (m), along with two watershed land cover measures: percent urban cover and percent forest cover, as provided in the 2016 National Land Cover Database (Dewitz 2019). The urban cover covariate was created by combining the percent high, medium, and low intensity urban land use within the watershed drainage to each sample site, whereas the forest cover covariate was created by combining the percent deciduous, conifer, mixed forest, and woody wetland cover in each watershed. Models were compared using Akaike's Information Criterion adjusted for small sample size (AICc; Burnham & Anderson 2002), and models were considered competing if they carried greater than 10% of the total model weight. We then constructed multi-covariate models with the competing covariates for each of these three fish metrics. Variance inflation factors (vif) were calculated to determine whether multicollinearity was present (with a cutoff of 3) in the multi-covariate models (Zuur et al. 2010).

**Results & Discussion**

Altogether, 108 fish species were observed in the study, including 98 native species or 85% of South Carolina's native freshwater fish fauna (Appendix B). Mean observed species richness among sites was 20.7 (mean native richness 19.3) and ranged from 9 to 31 (native richness 8 to 29; Fig. 5). In the continuum of South Carolina's streams to rivers for which recent standardized studies have been conducted, observed species richness showed a net increase with watershed area, reaching a general maximum in the transition range from large streams into small rivers and remaining high through the extent of small rivers (Fig. 6). These results reflect the importance of small rivers as a consistent stronghold of aquatic biodiversity in the state, although the positive relationship of richness with area appeared to be asymptotic in the vicinity of 200 $km^2$.

Small rivers were particularly important in supporting State Wildlife Action Plan (SWAP) Priority freshwater fish species in South Carolina. Altogether, 44 Priority freshwater and diadromous fish species were observed in small rivers, representing 74% of the Priority freshwater fish species identified in the SWAP. At least one Priority freshwater fish species was observed at 92% of the randomly selected small river sites, and 84% of sites yielded multiple Priority species (Figures 7-8; Table 3). On average, more than four Priority freshwater fish species were observed at each river site, with as many as 11 Priority species observed in a single river site. The occurrence of Priority species was about twice as high in small rivers than wadeable streams, with Priority species representing approximately one in every five species observed in small rivers compared with about one of every ten species in wadeable streams. Priority species occurred in all ecobasins of the state; species occurrence and relative abundance by ecobasin are shown in Tables 4 and 5. Priority fish species richness was generally higher in the uplands (Piedmont and Blue Ridge) than the coastal plain (Southeastern Plains and Middle Atlantic Coastal Plain), largely due to a greater diversity of range-restricted and endemic species in the uplands, many of which are Priority species. Individual Priority species maps are presented in Appendix C.

Results of linear modeling suggested both natural and anthropogenic land cover gradients across South Carolina likely influence fish assemblages, including SWAP Priority fish species. However, landuse/cover appeared to be more important in the uplands. Richness of all native fish species primarily corresponded to elevation and urban land use gradients in the upland sites (Table 6; Figure 9), whereas in the coastal plain, native richness was related to gradients in dissolved oxygen and elevation (Table 7; Figure 10). Conservation Priority species richness in the uplands was also positively related to dissolved oxygen as well as mean flow velocity (Table 8; Figure 11), whereas in the coastal plain, Priority species richness was positively related to elevation and dissolved oxygen (Table 9; Figure 12). In terms of conservation Priority species relative abundance, several predictors ranked high as predictors in the uplands, including water temperature, elevation, turbidity, forest cover, and DO (Table 10; Figure 13). For the coastal plain, site characteristics such as DO, water temperature, and elevation again were more predictive of Priority species relative abundance than watershed variables (Table 11; Figure 14).

This study represents the first standardized, statewide assessment of small rivers in South Carolina. The results showed that small rivers harbor a high proportion of the state's aquatic biodiversity and, in particular, support a substantial number of the Priority species as identified in the State Wildlife Action Plan, which are in greatest need of conservation attention. Furthermore, the broad dataset amassed in this study—including biological, physical, chemical and watershed/landscape attributes—represents a foundation upon which additional analyses and modeling efforts will be built. This statewide Small Rivers effort furthers the aquatic conservation framework established by the South Carolina Stream Assessment in providing a comprehensive decision-support basis for prioritizing conservation actions among habitats and species.

Significant deviations:
Repeated high water events due to historic storms, with long recovery times back to baseflow, were significant impacts on small rivers during the project period, which was originally set to end September 2018. This, in combination with personnel issues beyond our control, delayed the sampling schedule for the project, resulting in project extensions and additional funding requests through September 2020 to permit additional field seasons as we attempted to complete the target number of 100 sites. Finally, the unprecedented COVID-19 global pandemic was a significant barrier to field logistics, compounding the difficulties presented to staff in completing the target samples.

Acknowledgements
Numerous individuals assisted with data collection, and we thank Colby Denison, Kenson Kanczuzewski, Tom Daniel, Abbey Nichols Bellotte, Kristen Smith, Brett Kelly, Bea DiBona, and Savannah Bowen for their efforts. We thank Joe Lemeris for assembling the map figures, and Kasey Pregler and Yoichiro Kanno for field assistance and contribution to study design and statistical analysis.

Literature Cited
Burnham KP, Anderson DR. 2002. Model selection and multimodel inference: a practical information-theoretic approach. New York: Springer.
Dewitz, J. 2019. National Land Cover Database (NLCD) 2016 Products: U.S. Geological Survey data release, https://doi.org/10.5066/P96HHBIE.
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South Carolina Department of Natural Resources (SCDNR). 2015. South Carolina's State Wildlife Action Plan and Supplemental Volume. https://www.dnr.sc.gov/swap/index.html
Zuur AF, Ieno EN, Elphick CS. 2010. A protocol for data exploration to avoid common statistical problems. Methods in Ecology and Evolution. 1:3-14.

Estimated Federal Cost: $582,587 (expenditure over the project period)

Recommendations: Close the grant. On an ongoing basis, data will be integrated with the existing modeling framework developed from the SC Stream Assessment (2006-2011), allowing long-term decision support for conservation of aquatic resources in the South Carolina Department of Natural Resources and its partners.

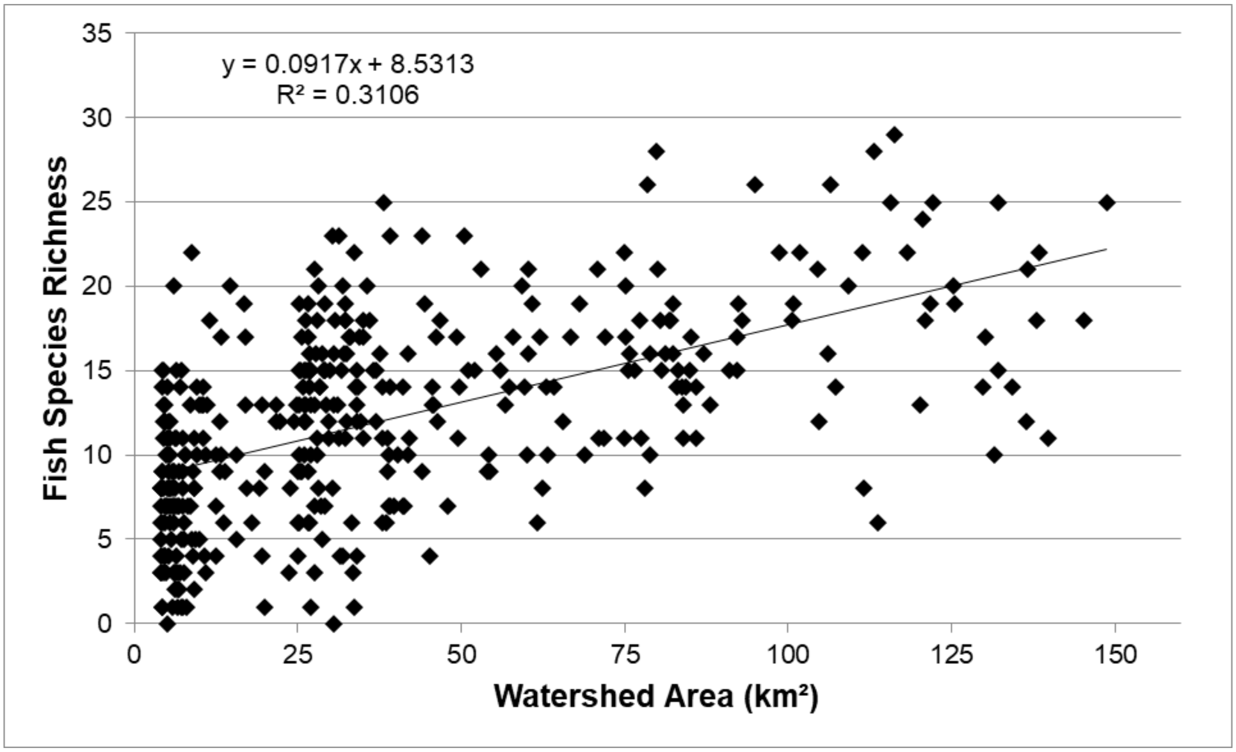



Figure 1. Observed species richness versus watershed area for wadeable streams (n=397) in the South Carolina Stream Assessment (2006-2011).

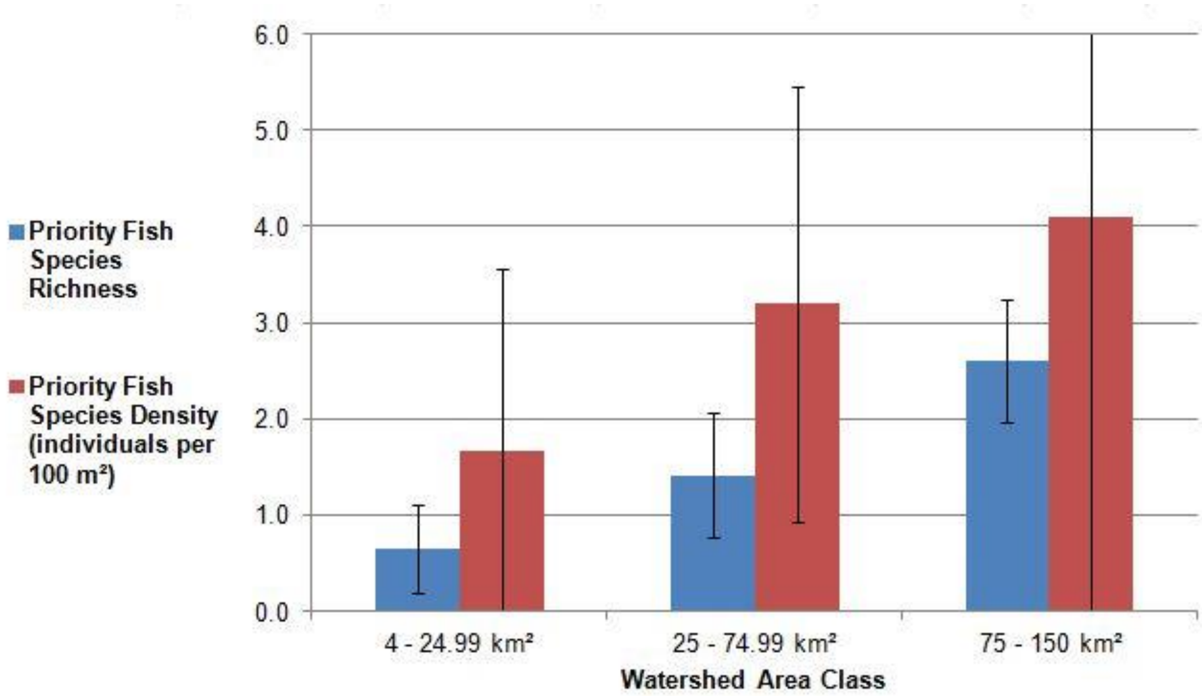



Figure 2. Standardized estimates of mean Priority fish species richness and density (number of individuals per 100 $m^2$) by watershed size class from the SCSA. Error bars represent 95% confidence intervals about the mean estimate (upper limit for 75 – 150 $km^2$ watershed class density [not shown] is 9.3). Priority species richness and density both increase with watershed area class (i.e. stream size), suggesting high levels of Priority species richness and density likely occur in small rivers (>150 $km^2$).

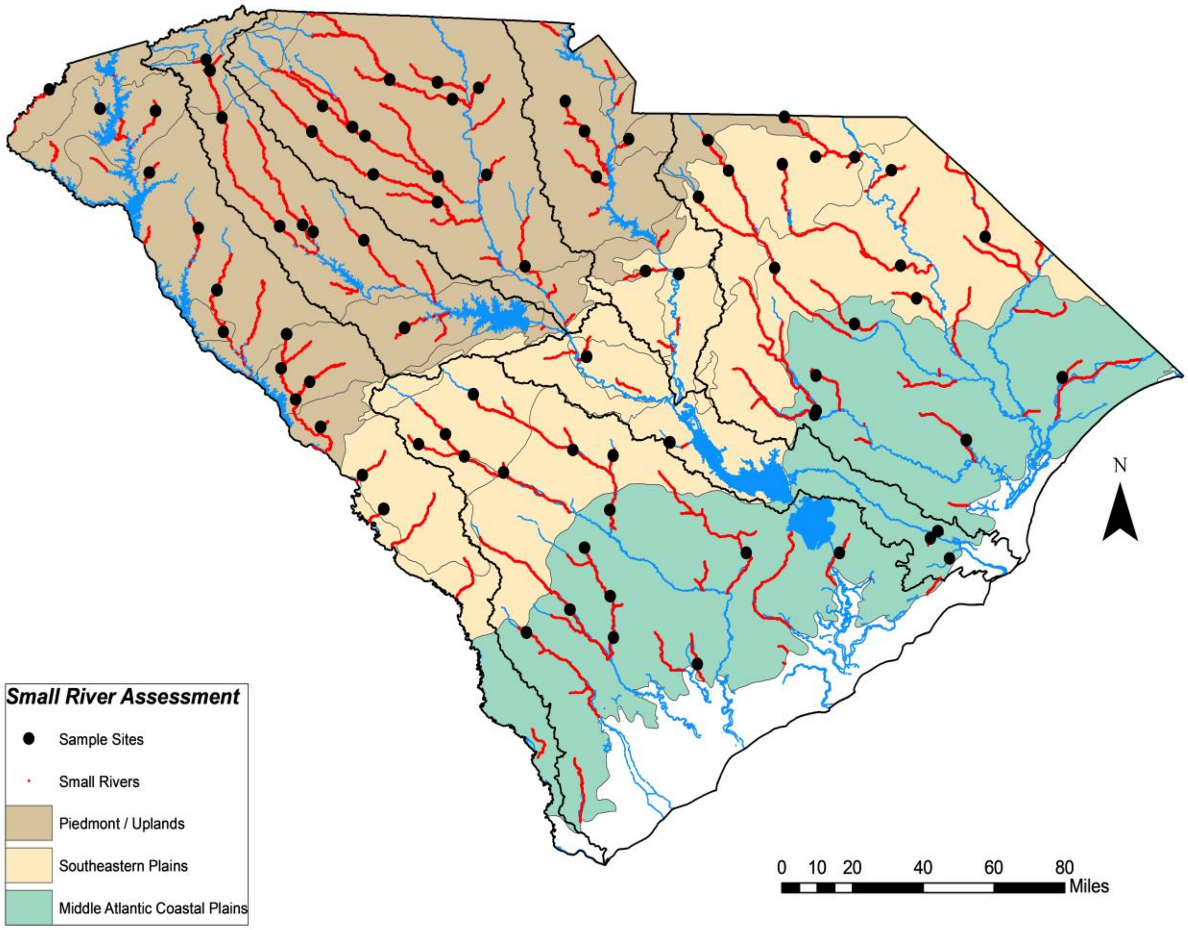



Figure 3. Occurrence of small rivers in South Carolina (red lines), showing Small River Assessment sample sites through 2019 (black points).

Table 1. Sample site allocations (*n*) are proportional according to area of ecobasin and watershed size class for the Small River Assessment. Watershed area size classes are as follows: Class 4 = 150 to 500 km$^2$; Class 5 = 500 to 1000 km$^2$; Class 6 = 1000 to 2000 km$^2$. Lack of size class representation was a result of site selection constraints as noted in Methods.

| **Ecobasin** | **Area (km$^2$)** | ***n*** | ***n* (size 4)** | ***n* (size 5)** | ***n* (size 6)** |
|---|---|---|---|---|---|
| UPLANDS | | | | | |
| Savannah Basin | 8,180 | 12 | 8 | 3 | 1 |
| Santee Basin | 20,178 | 25 | 16 | 6 | 3 |
| Pee Dee Basin | 711 | 2 | 2 | 0 | 0 |
| **Uplands Total** | **29,069** | **39** | **26** | **9** | **4** |
| SOUTHEASTERN PLAINS | | | | | |
| Savannah Basin | 2,555 | 4 | 4 | 0 | 0 |
| ACE Basin | 5,686 | 10 | 7 | 1 | 2 |
| Santee Basin | 5,149 | 4 | 4 | 0 | 0 |
| Pee Dee Basin | 10,210 | 14 | 9 | 2 | 3 |
| **Southeastern Plains Total** | **23,600** | **32** | **24** | **3** | **5** |
| MIDDLE ATLANTIC COASTAL PLAIN | | | | | |
| Savannah Basin | 849 | 3 | 3 | 0 | 0 |
| ACE Basin | 10,637 | 14 | 8 | 3 | 3 |
| Santee Basin | 1,589 | 3 | 3 | 0 | 0 |
| Pee Dee Basin | 8,805 | 9 | 6 | 2 | 1 |
| **Middle Atlantic Coastal Plain Total** | **21,880** | **29** | **20** | **5** | **4** |
| **GRAND TOTAL** | **74,549** | **100** | **70** | **17** | **13** |

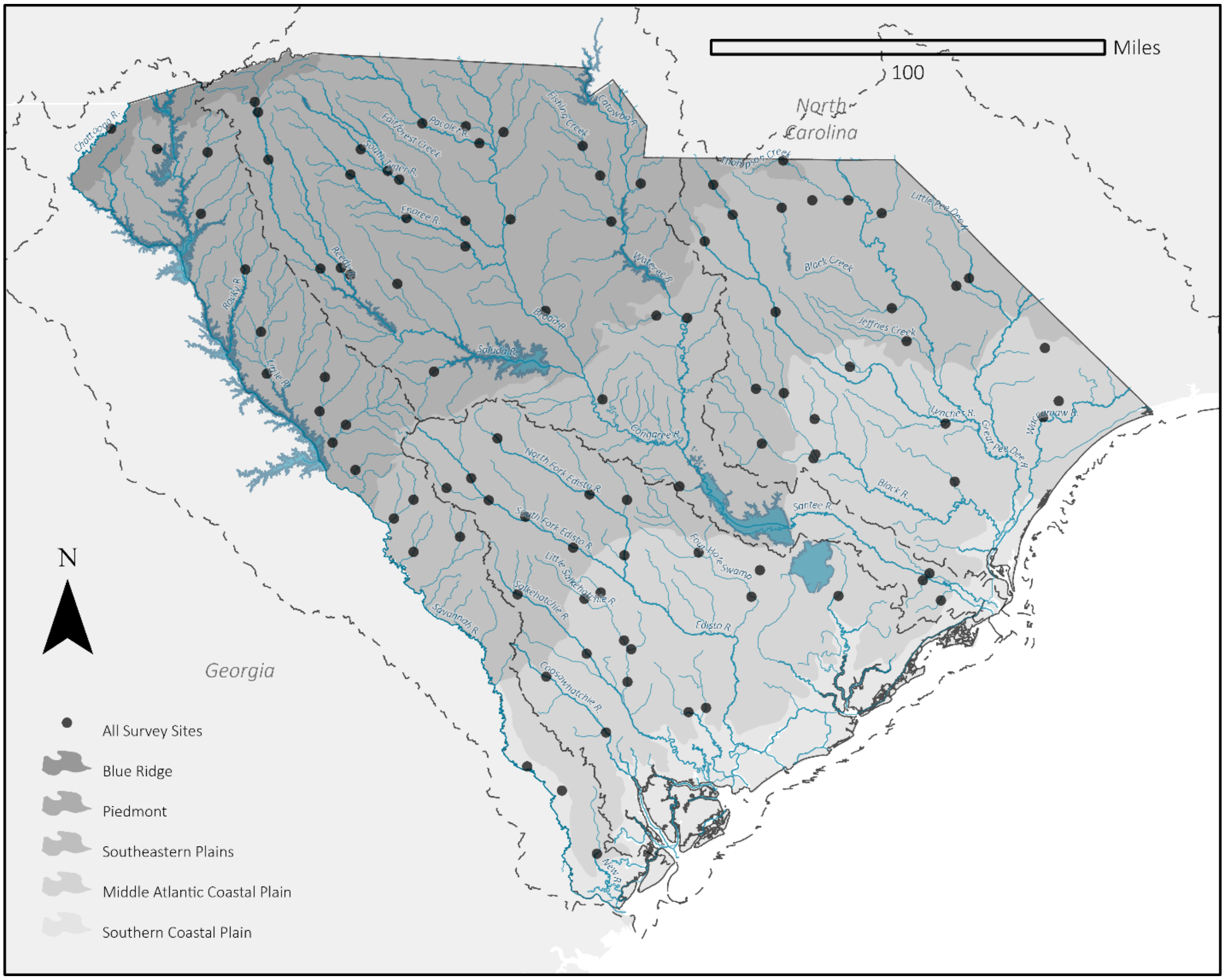


Figure 4. Small River Assessment sample sites.

Table 2. Small river habitat types, corresponding sampling methods and spatial replicate definitions. Note that multiple sampling methods were used in some sites.

| **Habitat type** | **Habitat description** | **Sampling method** | **Spatial replicate unit/size** | **Number of sites by method** | **Number of replicates per site** |
|---|---|---|---|---|---|
| Wadeable/shallow | Shallow runs; narrow riffles; shallow pools; shallow swamp | Backpack electrofishing (2-3 backpack units) | 50 m long x 5 m wide | 66 | 3-12 |
| Wadeable/shallow | Large shoal complexes; wide riffles | Backpack electrofishing into 10-foot seine (1 backpack unit) | 5 m long x 3 m wide | 10 | 15-60 |
| Wadeable/moderate | Moderately deep runs and pools | Barge electrofishing | 50 m long x 5 m wide | 5 | 9-12 |
| Non-wadeable/deep | Deep runs and pools; deep swamps | Boat electrofishing | 50 m long x 5 m wide | 24 | 6-9 |

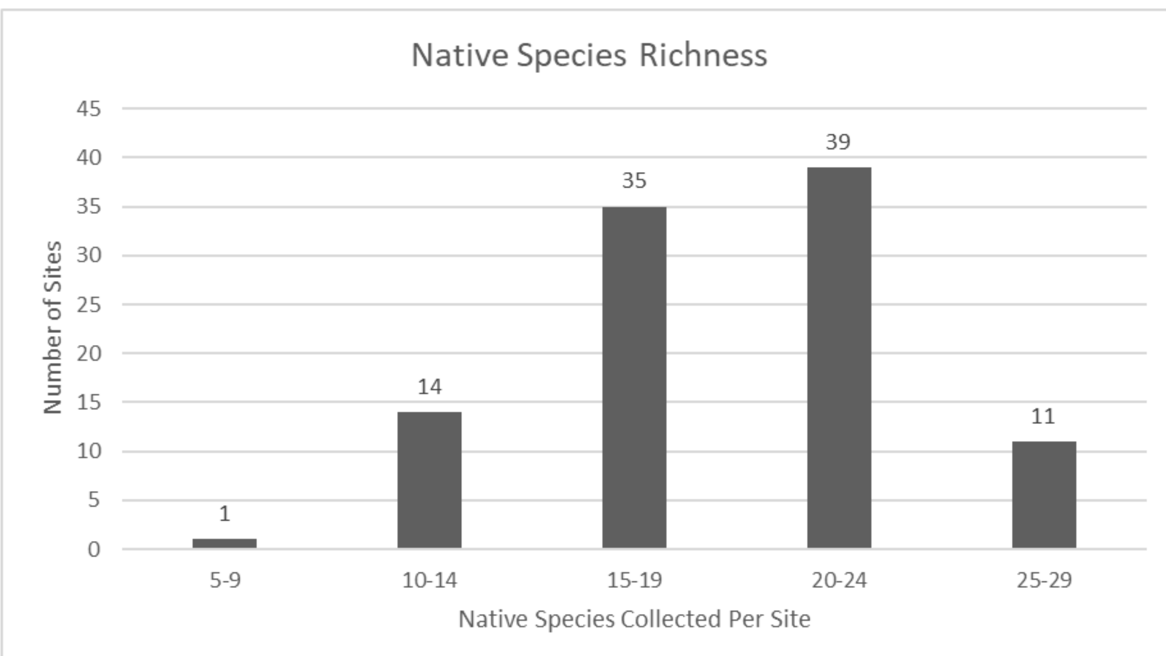



Figure 5: Frequency (number of sites) of native species richness categories in the Small River Assessment.

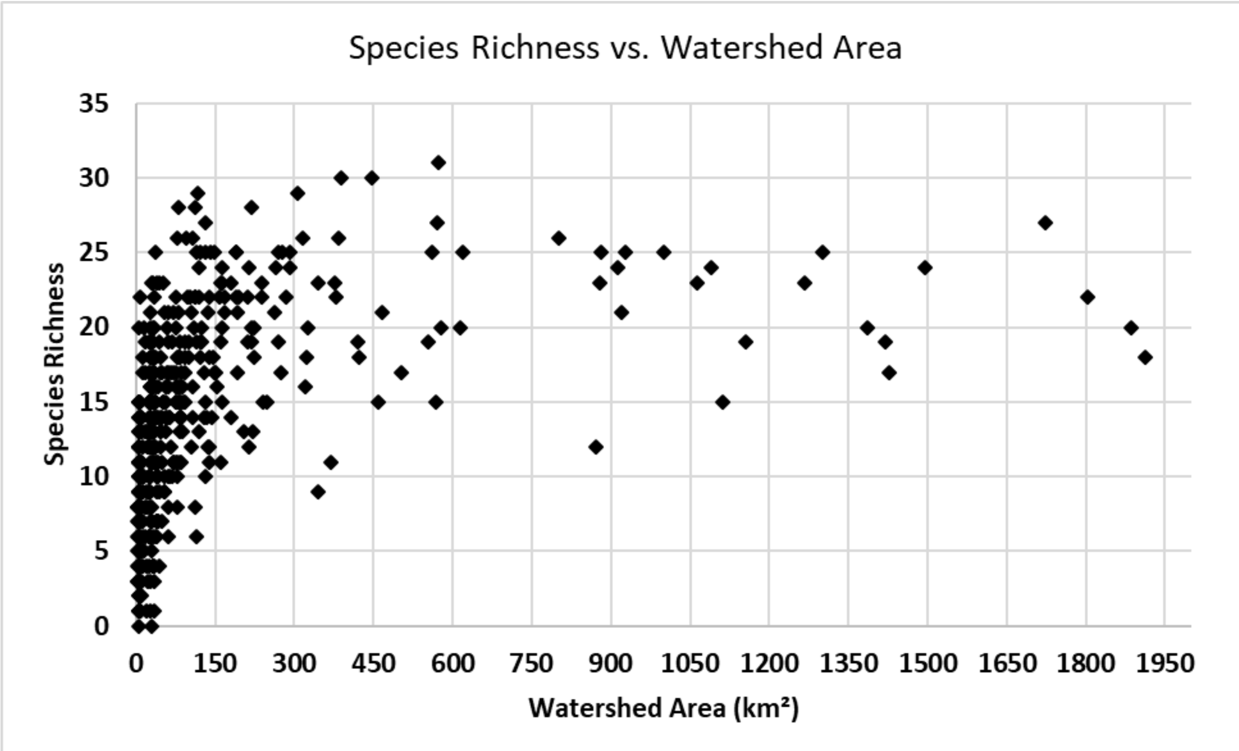



Figure 6. Species richness versus watershed area for randomly selected wadeable streams (watershed area 4-150 km²; n=397) sampled previously for the South Carolina Stream Assessment and randomly selected small rivers (>150 km²; n=100) sampled for the current Small River Assessment.

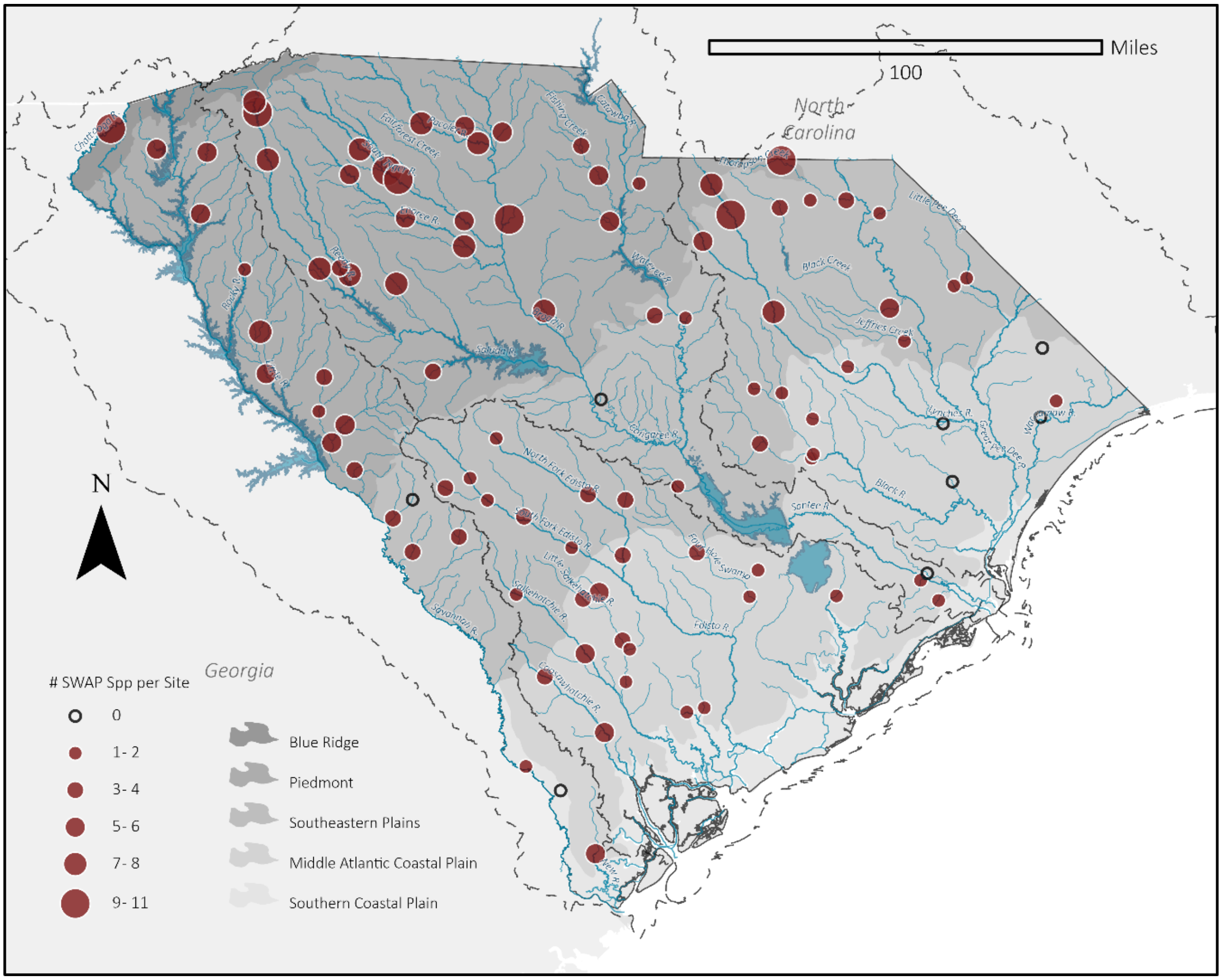



Figure 7. Richness of observed SWAP Priority fish species by site in the Small River Assessment.

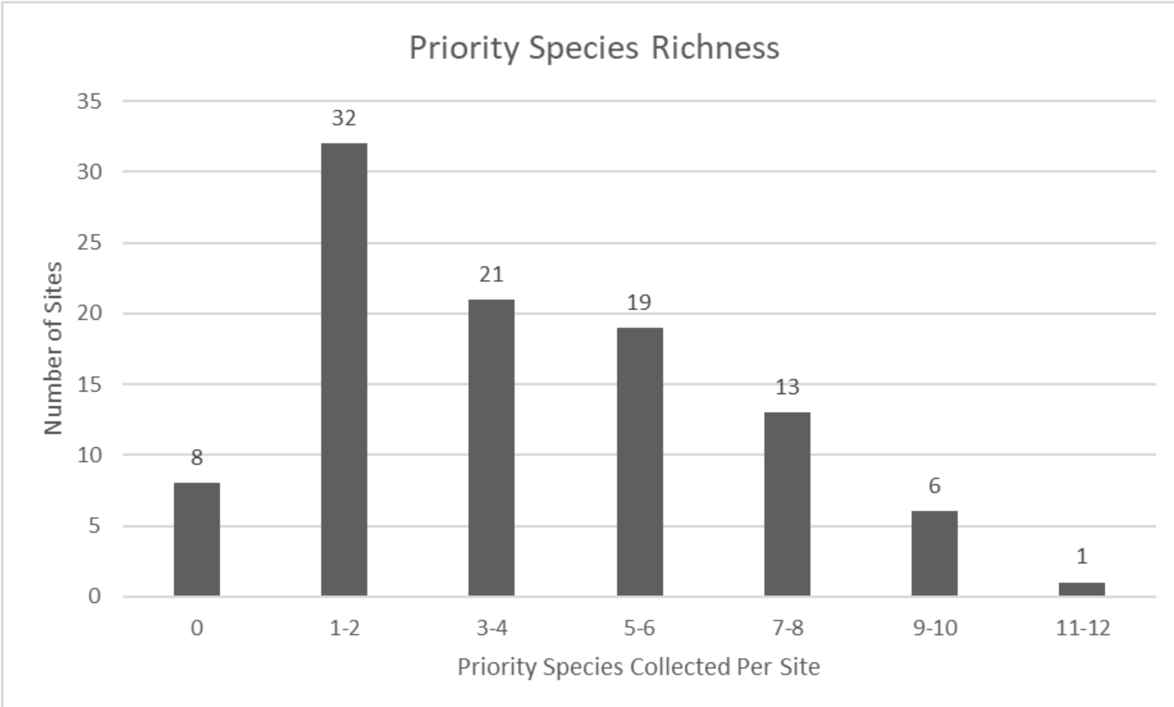



Figure 8: Frequency (number of sites) of Priority species richness categories in the Small River Assessment.

Table 3. Comparison of SWAP Priority species occurrence and richness in wadeable streams (South Carolina Stream Assessment; 2006-2011) and small rivers (Small River Assessment; 2016-2020) of South Carolina. Relative richness of Priority species refers to the proportion of total species observed at a given site that were SWAP Priority species.

| | **Wadeable Streams** | **Small Rivers** |
|---|---|---|
| Range of site watershed area | 4 – 150 km² | 150 – 2,000 km² |
| Total linear extent in South Carolina | 19,916 km | 3,168 km |
| Number of study sites | 397 | 100 |
| Mean native species richness | 12.1 | 19.3 |
| Percent of sites with Priority species observed | 58% | 92% |
| Grand total number of Priority species observed | 33 | 44 |
| Mean Priority species richness | 1.5 | 4.1 |
| Mean relative richness of Priority species | 10.4% | 20.2% |

Table 4. Number of site occurrences (% of sites in ecobasin) by ecobasin (SEP = Southeastern Plains and MACP = Middle Atlantic Coastal Plain) for SWAP Priority species in the Small River Assessment. Values of zero have been omitted.

| | **Savannah** | | | **ACE** | | **Santee** | | | **Pee Dee** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Uplands** | **SEP** | **MACP** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** |
| Swampfish | | | 1 (33%) | | 4 (28%) | | | | | 2 (14%) | |
| American Eel | | 2 (50%) | 1 (33%) | 9 (90%) | 11 (78%) | | 1 (25%) | | 1 (50%) | 13 (93%) | 4 (44%) |
| Highfin Carpsucker | | | | | | 1 (4%) | | | | | |
| Notchlip Redhorse | 5 (41%) | | | | | 13 (52%) | | | 1 (50%) | 3 (21%) | |
| V-Lip Redhorse | | | | | | 4 (16%) | | | | | |
| Banded Sunfish | | | | | 1 (7%) | | | | | 1 (7%) | |
| Bartram's Redeye Bass | 4 (33%) | | | | | 6 (24%) | | | | | |
| Blackbanded Sunfish | | 1 (25%) | | | | | | | | | |
| American Shad | | | | | | | | | | 1 (7%) | |
| Bluebarred Pygmy Sunfish | | | 1 (33%) | | | | | | | | |
| Flat Bullhead | 5 (41%) | | | | 1 (7%) | 20 (80%) | 1 (25%) | | 2 (100%) | 4 (28%) | |
| Snail Bullhead | 10 (83%) | 1 (25%) | | 2 (20%) | 2 (14%) | 10 (40%) | | | | 3 (21%) | |
| White Catfish | | | 1 (33%) | | 2 (14%) | 2 (8%) | | 2 (66%) | | | |
| Florida Gar | | | 2 (66%) | | | | | | | | |
| Bannerfin Shiner | | | | 1 (10%) | 1 (7%) | | | | | | |
| Central Stoneroller | 1 (8%) | | | | | | | | | | |
| Fieryblack Shiner | | | | | | 3 (12%) | 2 (50%) | | | 6 (42%) | |
| Greenfin Shiner | 2 (16%) | | | | | 23 (92%) | | | 2 (100%) | 3 (21%) | |
| Highback Chub | | | | | | 2 (8%) | | | | | |
| Highfin Shiner | 1 (8%) | | | | | 1 (4%) | | | 2 (100%) | 1 (7%) | |
| Ironcolor Shiner | | | | 4 (40%) | 7 (50%) | | | 1 (33%) | | | 3 (33%) |
| Lowland Shiner | | 2 (50%) | | 6 (60%) | 7 (50%) | | | | | | |
| Mirror Shiner | 1 (8%) | | | | | | | | | | |
| Redlip Shiner | | | | | | | | | 1 (50%) | | |
| Rosyface Chub | 11 (91%) | 1 (25%) | | | | 4 (16%) | | | | | |

| | Savannah | | | ACE | | Santee | | | Pee Dee | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Uplands** | **SEP** | **MACP** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** |
| Sandbar Shiner | 6 (50%) | | | | | 22 (88%) | | | 1 (50%) | 3 (21%) | |
| Santee Chub | | | | | | 16 (64%) | | | | | |
| Satinfin Shiner | | | | | | | | | 1 (50%) | | |
| Swallowtail Shiner | | | | | | 7 (28%) | | | 1 (50%) | 1 (7%) | |
| Tennessee Shiner | 1 (8%) | | | | | | | | | | |
| Thicklip Chub | | | | | | 4 (16%) | | | | | |
| Thinlip Chub | | | | | | | | | | 3 (21%) | |
| Warpaint Shiner | 2 (16%) | | | | | | | | | | |
| Whitemouth Shiner | | | | | | | | | 1 (50%) | | |
| Whitetail Shiner | 1 (8%) | | | | | | | | | | |
| Striped Bass | | | 1 (33%) | | 1 (7%) | 1 (4%) | | 1 (33%) | | | |
| Carolina Darter | | | | | | 1 (4%) | | | | | |
| Carolina Fantail Darter | | | | | | 1 (4%) | | | 1 (50%) | | |
| Christmas Darter | 6 (50%) | | | | | | | | | | |
| Piedmont Darter | | | | | | 20 (80%) | 1 (25%) | | 2 (100%) | 6 (42%) | |
| Savannah Darter | | 2 (50%) | | 2 (20%) | 2 (14%) | | | | | | |
| Sawcheek Darter | | | | 2 (20%) | 3 (21%) | | | | | 2 (14%) | 2 (22%) |
| Seagreen Darter | | | | | | 11 (44%) | 1 (25%) | | | | |
| Turquoise Darter | 5 (41%) | | | 1 (10%) | | | | | | | |

Table 5. Mean and range (in brackets) of relative abundance by ecobasin (SEP = Southeastern Plains and MACP = Middle Atlantic Coastal Plain) for SWAP Priority species in the Small River Assessment.

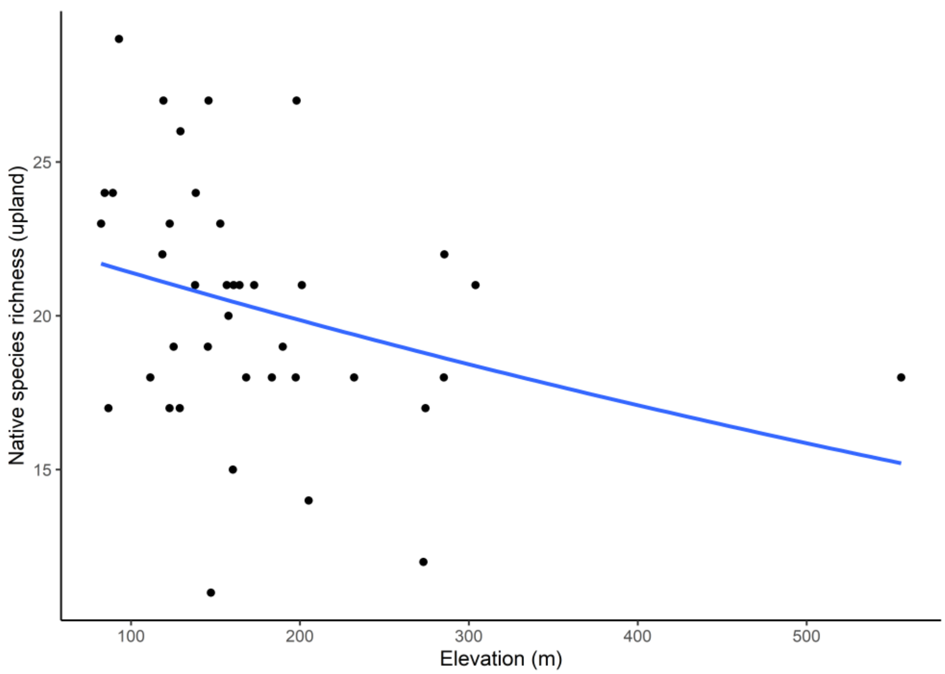
| | Savannah | | | ACE | | Santee | | | Pee Dee | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Uplands** | **SEP** | **MACP** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** |
| Swampfish | | | 0.003 [0-0.010] | | 0.004 [0-0.029] | | | | | 0.001 [0-0.010] | |
| American Eel | | 0.021 [0-0.073] | 0.003 [0-0.010] | 0.035 [0-0.085] | 0.020 [0-0.070] | | 0.002 [0-0.006] | | 0.003 [0-0.007] | 0.064 [0-0.237] | 0.008 [0-0.037] |
| Highfin Carpsucker | | | | | | <0.001 [0-0.006] | | | | | |
| Notchlip Redhorse | 0.002 [0-0.015] | | | | | 0.007 [0-0.038] | | | 0.005 [0-0.010] | 0.004 [0-0.038] | |
| V-Lip Redhorse | | | | | | <0.001 [0-0.003] | | | | | |
| Banded Sunfish | | | | | 0.002 [0-0.032] | | | | | <0.001 [0-0.005] | |
| Bartram's Redeye Bass | 0.008 [0-0.087] | | | | | 0.004 [0-0.063] | | | | | |
| Blackbanded Sunfish | | 0.005 [0-0.020] | | | | | | | | | |
| American Shad | | | | | | | | | | 0.006 [0-0.078] | |
| Bluebarred Pygmy Sunfish | | | 0.003 [0-0.010] | | | | | | | | |
| Flat Bullhead | 0.003 [0-0.010] | | | | <0.001 [0-0.005] | 0.009 [0-0.040] | 0.001 [0-0.003] | | 0.008 [0.003-0.013] | 0.003 [0-0.014] | |
| Snail Bullhead | 0.011 [0-0.031] | 0.002 [0-0.006] | | 0.003 [0-0.019] | <0.001 [0-0.002] | 0.025 [0-0.301] | | | | 0.002 [0-0.014] | |
| White Catfish | | | 0.015 [0-0.045] | | 0.005 [0-0.053] | <0.001 [0-0.002] | | 0.007 [0-0.018] | | | |
| Florida Gar | | | 0.013 [0-0.035] | | | | | | | | |
| Bannerfin Shiner | | | | 0.001 [0-0.013] | <0.001 [0-0.006] | | | | | | |
| Central Stoneroller | 0.003 [0-0.034] | | | | | | | | | | |

| | Savannah | | | ACE | | Santee | | | Pee Dee | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Uplands** | **SEP** | **MACP** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** |
| Fieryblack Shiner | | | | | | 0.016 [0-0.170] | 0.036 [0-0.125] | | | 0.056 [0-0.556] | |
| Greenfin Shiner | 0.011 [0-0.091] | | | | | 0.116 [0-0.263] | | | 0.074 [0.008-0.014] | 0.021 [0-0.240] | |
| Highback Chub | | | | | | 0.001 [0-0.012] | | | | | |
| Highfin Shiner | 0.003 [0-0.030] | | | | | <0.001 [0-0.002] | | | 0.077 [0.064-0.090] | 0.001 [0-0.018] | |
| Ironcolor Shiner | | | | 0.005 [0-0.020] | 0.038 [0-0.205] | | | 0.006 [0-0.018] | | | 0.030 [0-0.209] |
| Lowland Shiner | | 0.078 [0-0.263] | | 0.042 [0-0.255] | 0.034 [0-0.296] | | | | | | |
| Mirror Shiner | 0.003 [0-0.039] | | | | | | | | | | |
| Redlip Shiner | | | | | | | | | 0.061 [0-0.121] | | |
| Rosyface Chub | 0.088 [0-0.302] | 0.011 [0-0.043] | | | | 0.008 [0-0.088] | | | | | |
| Sandbar Shiner | 0.014 [0-0.133] | | | | | 0.047 [0-0.194] | | | 0.003 [0-0.007] | 0.003 [0-0.019] | |
| Santee Chub | | | | | | 0.014 [0-0.080] | | | | | |
| Satinfin Shiner | | | | | | | | | 0.009 [0-0.019] | | |
| Swallowtail Shiner | | | | | | 0.048 [0-0.277] | | | 0.137 [0-0.275] | 0.022 [0-0.303] | |
| Tennessee Shiner | 0.001 [0-0.008] | | | | | | | | | | |
| Thicklip Chub | | | | | | 0.004 [0-0.070] | | | | | |
| Thinlip Chub | | | | | | | | | | 0.008 [0-0.099] | |
| Warpaint Shiner | 0.010 [0-0.091] | | | | | | | | | | |
| Whitemouth Shiner | | | | | | | | | 0.063 [0-0.125] | | |
| Whitetail Shiner | 0.005 | | | | | | | | | | |

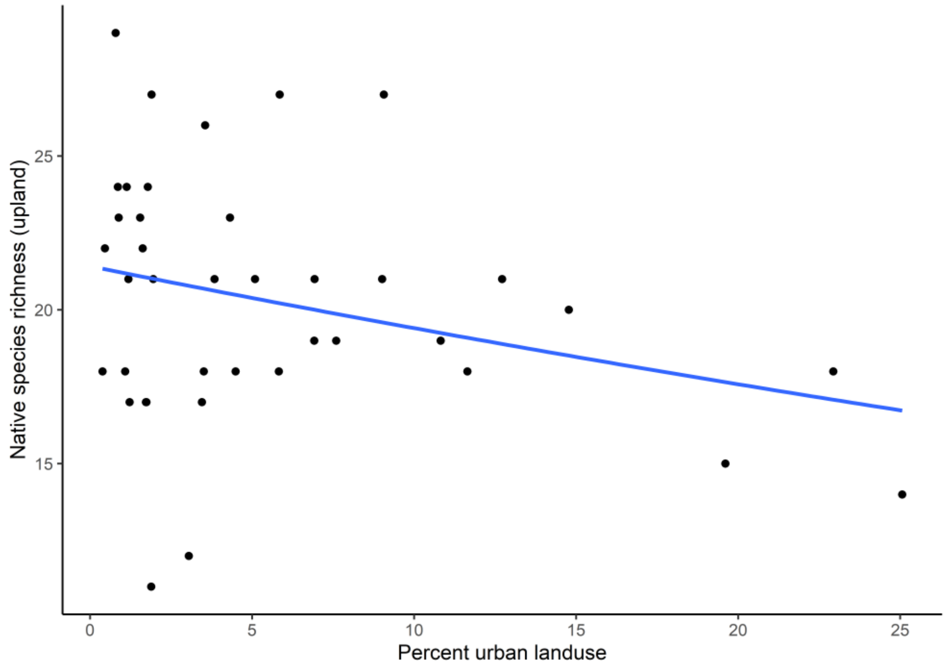
| | **Savannah** | | | **ACE** | | **Santee** | | | **Pee Dee** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Uplands** | **SEP** | **MACP** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** | **Uplands** | **SEP** | **MACP** |
| | [0-0.065] | | | | | | | | | | |
| Striped Bass | | | 0.018 [0-0.055] | | <0.001 [0-0.006] | <0.001 [0-0.012] | | 0.003 [0-0.008] | | | |
| Carolina Darter | | | | | | <0.001 [0-0.011] | | | | | |
| Carolina Fantail Darter | | | | | | 0.003 [0-0.079] | | | 0.009 [0-0.017] | | |
| Christmas Darter | 0.010 [0-0.080] | | | | | | | | | | |
| Piedmont Darter | | | | | | 0.009 [0-0.032] | 0.002 [0-0.009] | | 0.016 [0.007-0.025] | 0.008 [0-0.037] | |
| Savannah Darter | | 0.056 [0-0.186] | | 0.002 [0-0.012] | <0.001 [0-0.004] | | | | | | |
| Sawcheek Darter | | | | 0.002 [0-0.019] | 0.001 [0-0.011] | | | | | 0.001 [0-0.010] | 0.002 [0-0.012] |
| Seagreen Darter | | | | | | 0.019 [0-0.151] | 0.005 [0-0.019] | | | | |
| Turquoise Darter | 0.031 [0-0.170] | | | 0.001 [0-0.008] | | | | | | | |

Table 6. Candidate models to compare covariates predicting **upland native species richness**. Model rankings are based on Akaike's information criterion adjusted for small sample size (AICc), differences in AICc (ΔAICc), model weight (AICcWt), and number of parameters (K).

| Model | AICc | ΔAICc | AICcWt | K |
|---|---|---|---|---|
| Elevation | 221.43 | 0 | 0.27 | 2 |
| Urban | 221.64 | 0.21 | 0.24 | 2 |
| Forest | 223.56 | 2.13 | 0.09 | 2 |
| Temperature | 223.61 | 2.18 | 0.09 | 2 |
| Turbidity | 223.68 | 2.26 | 0.09 | 2 |
| Watershed area | 223.69 | 2.26 | 0.09 | 2 |
| Velocity | 224.08 | 2.65 | 0.07 | 2 |
| Dissolved oxygen | 224.12 | 2.69 | 0.07 | 2 |




a.

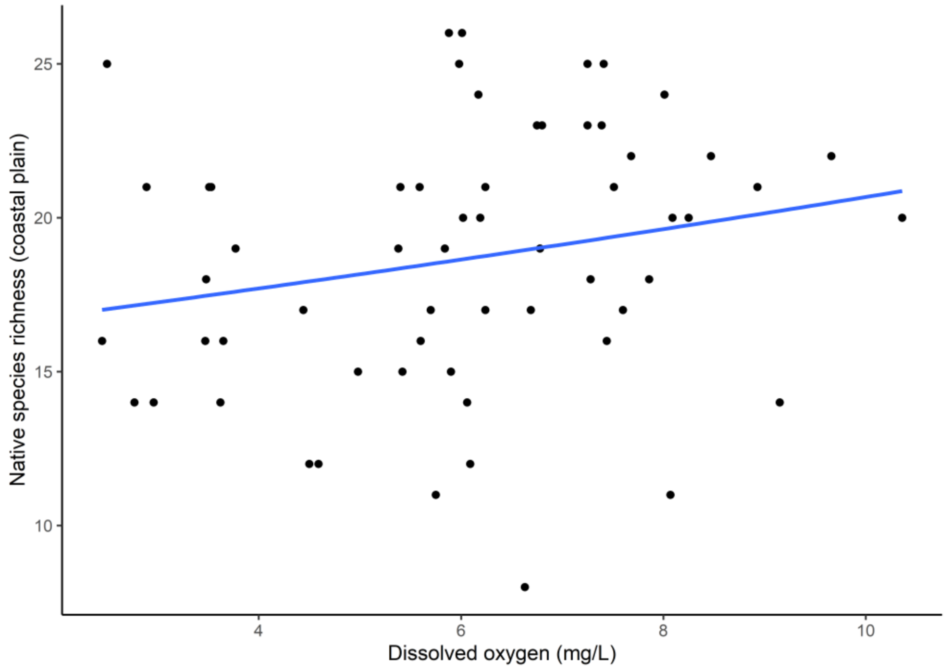



b.

Figure 9. Scatter plot showing relationship between native species richness in the uplands versus (a.) elevation, and (b.) watershed urban landuse/cover.

Table 7. Candidate models to compare covariates predicting **coastal plain native species richness**. Model rankings are based on Akaike's information criterion adjusted for small sample size (AICc), differences in AICc (ΔAICc), model weight (AICcWt), and number of parameters (K).

| **Model** | **AICc** | **ΔAICc** | **AICcWt** | **K** |
|---|---|---|---|---|
| Dissolved oxygen | 340.45 | 0 | 0.77 | 2 |
| Elevation | 344.06 | 3.61 | 0.13 | 2 |
| Temperature | 347.26 | 6.8 | 0.03 | 2 |
| Watershed area | 347.77 | 7.32 | 0.02 | 2 |
| Urban | 347.96 | 7.51 | 0.02 | 2 |
| Turbidity | 348.25 | 7.79 | 0.02 | 2 |
| Velocity | 348.56 | 8.11 | 0.01 | 2 |
| Forest | 348.59 | 8.14 | 0.01 | 2 |

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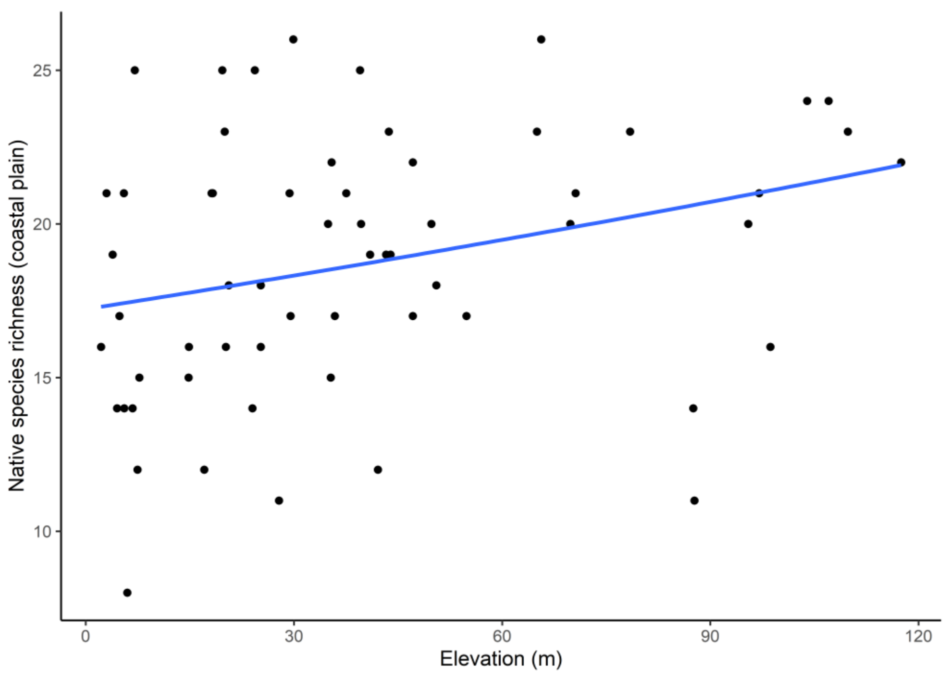
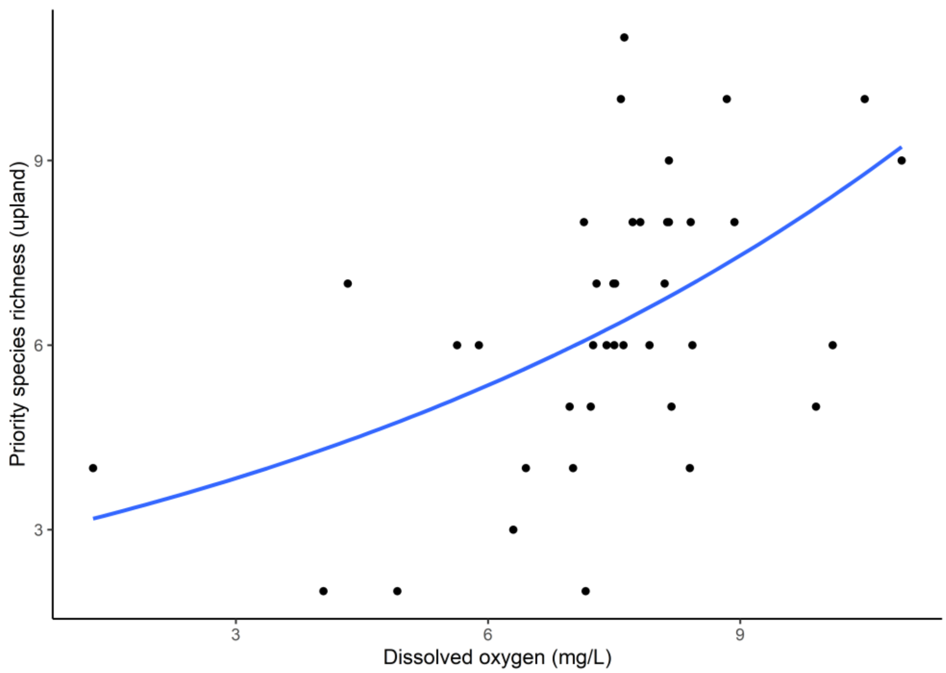



b.

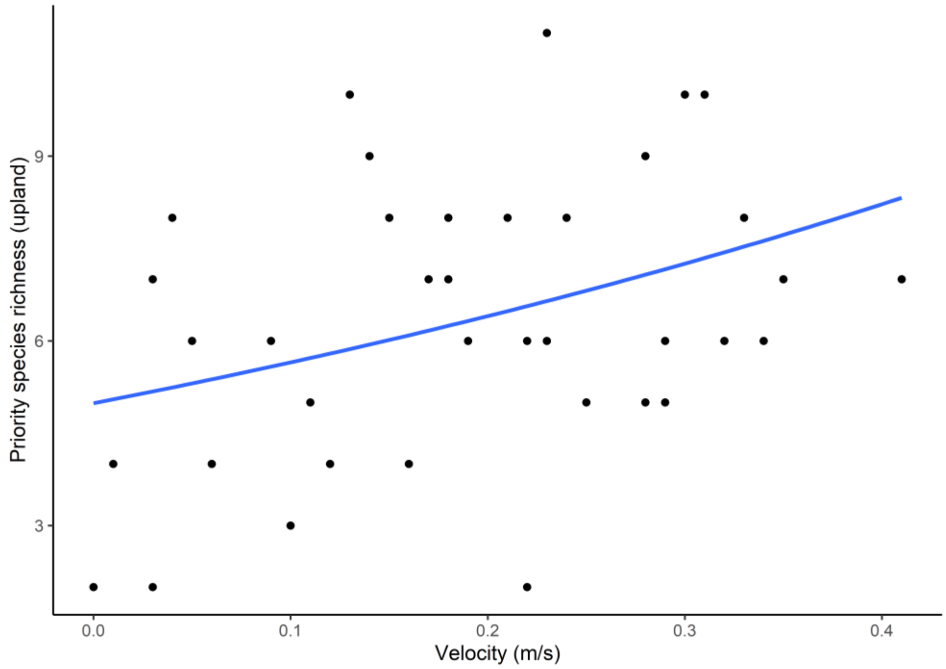
Figure 10. Scatter plot showing relationship between native species richness in the coastal plain versus (a.) dissolved oxygen, and (b.) elevation.

Table 8. Candidate models to compare covariates predicting **upland Priority species richness**. Model rankings are based on Akaike's information criterion adjusted for small sample size (AICc), differences in AICc (ΔAICc), model weight (AICcWt), and number of parameters (K).

| **Model** | **AICc** | **ΔAICc** | **AICcWt** | **K** |
|---|---|---|---|---|
| Dissolved oxygen | 171.3 | 0 | 0.77 | 2 |
| Velocity | 175.34 | 4.04 | 0.1 | 2 |
| Elevation | 177.48 | 6.18 | 0.03 | 2 |
| Temperature | 177.55 | 6.26 | 0.03 | 2 |
| Turbidity | 178.8 | 7.5 | 0.02 | 2 |
| Forest | 178.86 | 7.56 | 0.02 | 2 |
| Urban | 179.43 | 8.13 | 0.01 | 2 |
| Watershed area | 179.45 | 8.16 | 0.01 | 2 |




a.

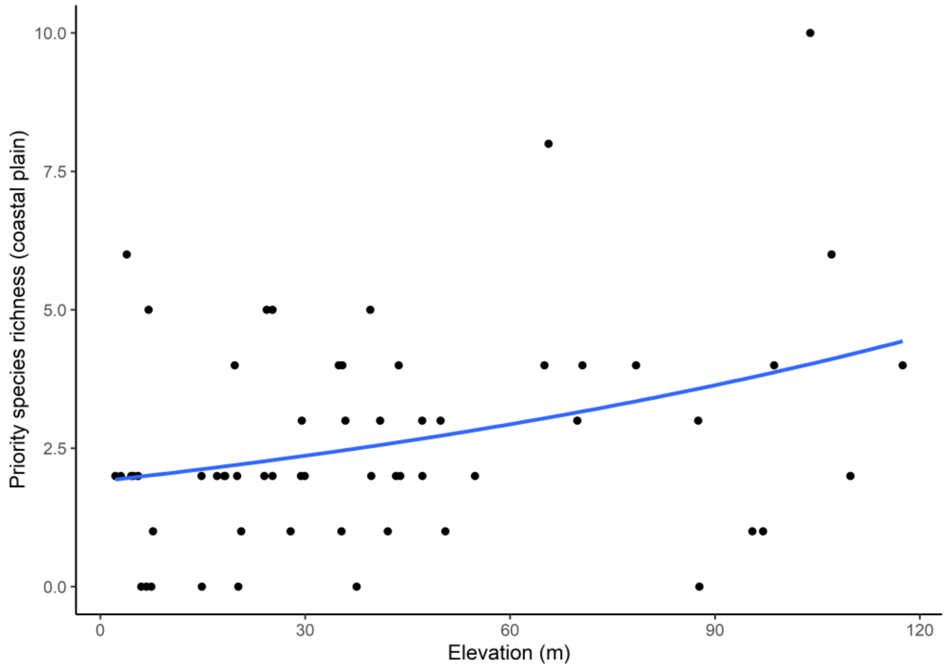



b.

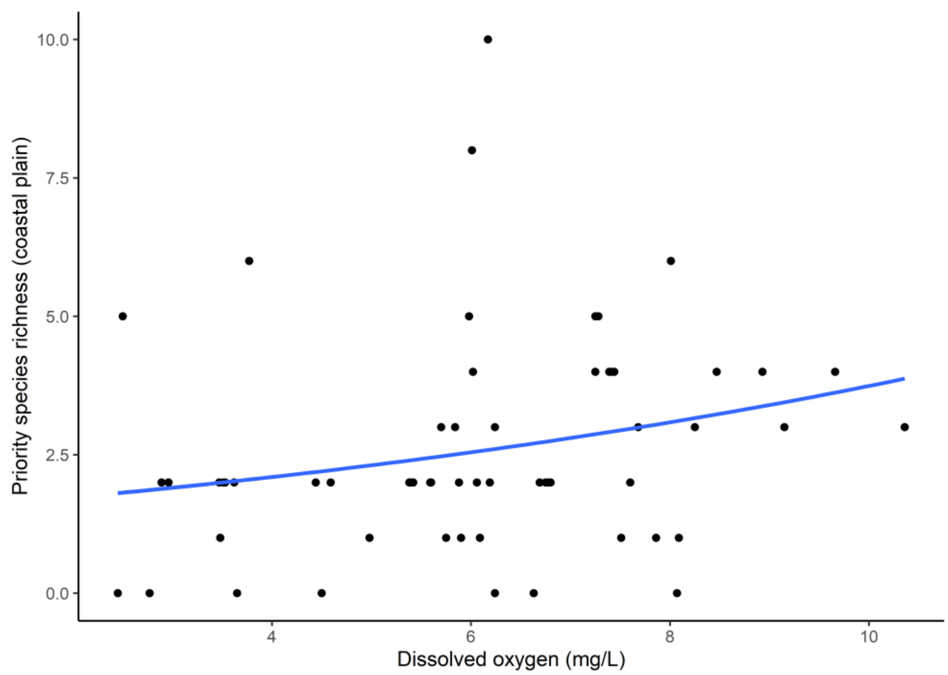
Figure 11. Scatter plot showing relationships between SWAP-listed species richness in the uplands versus (a.) dissolved oxygen, and (b.) mean water velocity.

Table 9. Candidate models to compare covariates predicting **coastal plain Priority species richness**. Model rankings are based on Akaike's information criterion adjusted for small sample size (AICc), differences in AICc (ΔAICc), model weight (AICcWt), and number of parameters (K).

| Model | AICc | ΔAICc | AICcWt | K |
|---|---|---|---|---|
| Elevation | 234.63 | 0 | 0.48 | 2 |
| Dissolved oxygen | 234.85 | 0.22 | 0.43 | 2 |
| Watershed area | 240.28 | 5.64 | 0.03 | 2 |
| Urban | 240.86 | 6.22 | 0.02 | 2 |
| Turbidity | 240.95 | 6.32 | 0.02 | 2 |
| Forest | 242.12 | 7.49 | 0.01 | 2 |
| Velocity | 242.55 | 7.92 | 0.01 | 2 |
| Temperature | 242.65 | 8.01 | 0.01 | 2 |




a.

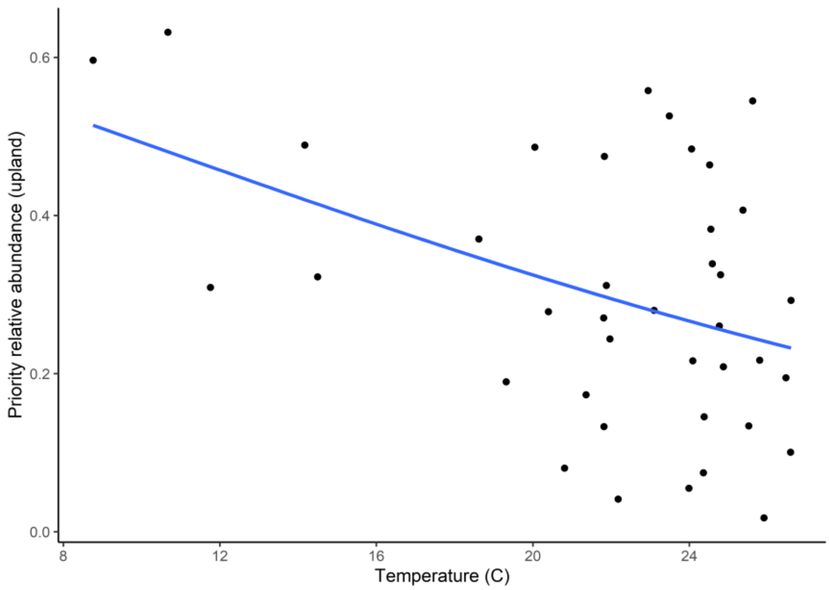



b.

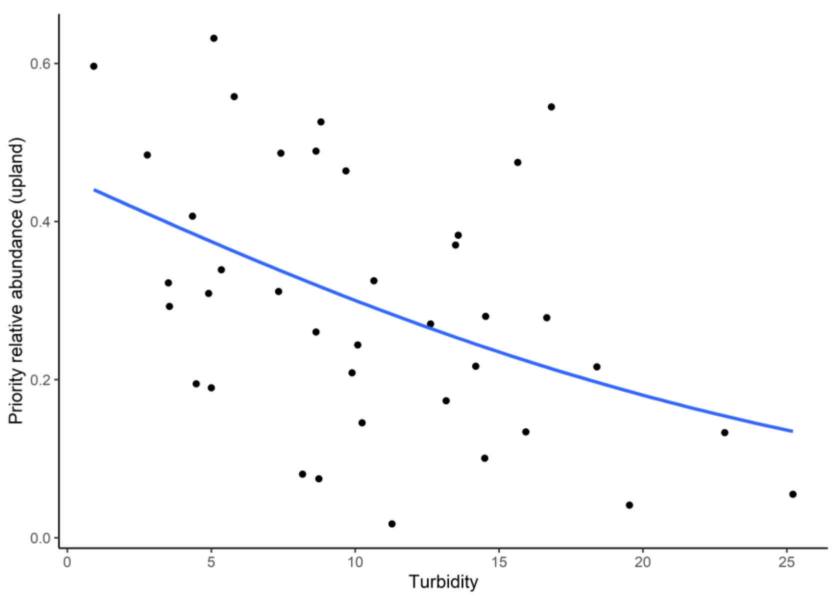
Figure 12. Scatter plot showing relationships between SWAP-listed species richness in the coastal plain versus (a.) elevation, and (b.) dissolved oxygen.

Table 10. Candidate models to compare covariates predicting **upland Priority species relative abundances**. Model rankings are based on Akaike's information criterion adjusted for small sample size (AICc), differences in AICc (ΔAICc), model weight (AICcWt), and number of parameters (K).

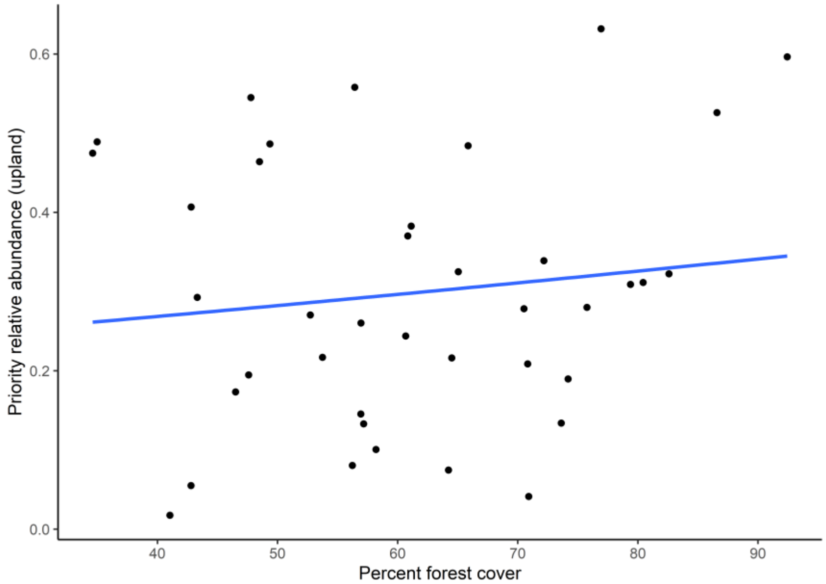
| Model | AICc | ΔAICc | AICcWt | K |
|---|---|---|---|---|
| Temperature | 38.5 | 0 | 0.22 | 2 |
| Elevation | 39.03 | 0.53 | 0.17 | 2 |
| Turbidity | 39.16 | 0.66 | 0.16 | 2 |
| Forest | 39.8 | 1.3 | 0.12 | 2 |
| Dissolved oxygen | 40.02 | 1.52 | 0.1 | 2 |
| Watershed area | 40.26 | 1.76 | 0.09 | 2 |
| Velocity | 40.54 | 2.04 | 0.08 | 2 |
| Urban | 41.08 | 2.58 | 0.06 | 2 |




a.




b.

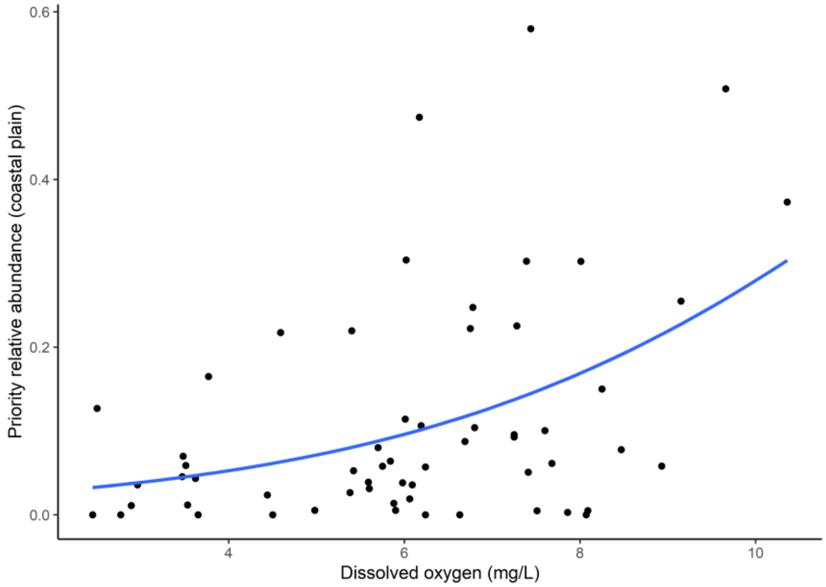



c.

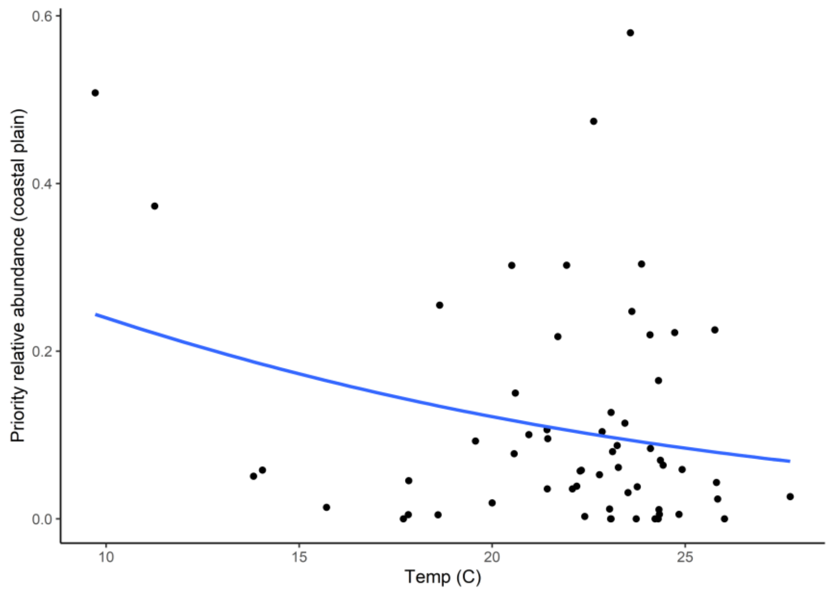
Figure 13. Scatter plot showing relationships between SWAP-listed species relative abundance in the uplands versus (a.) temperature, (b.) turbidity, and (c.) watershed forest landuse/cover.

Table 11. Candidate models to compare covariates predicting **coastal plain Priority species relative abundances**. Model rankings are based on Akaike's information criterion adjusted for small sample size (AICc), differences in AICc (ΔAICc), model weight (AICcWt), and number of parameters (K).

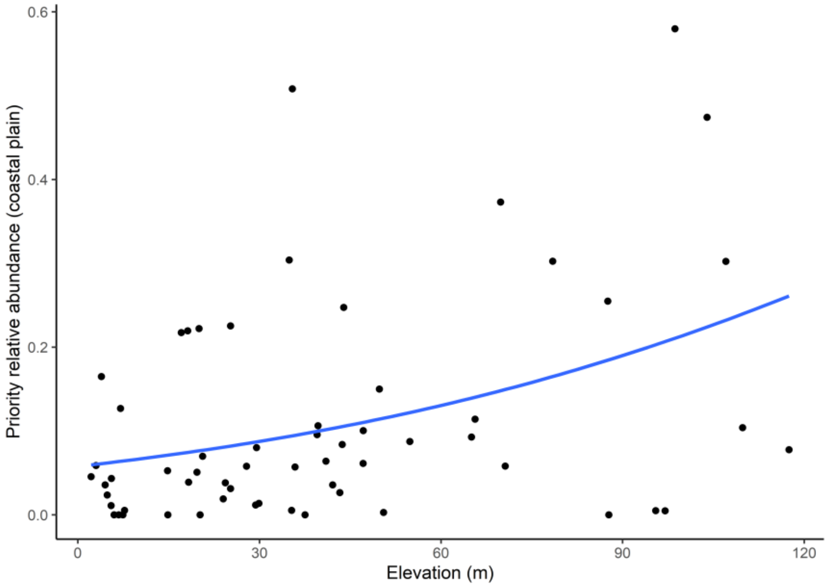
| Model | AICc | ΔAICc | AICcWt | K |
|---|---|---|---|---|
| Dissolved oxygen | 23.82 | 0 | 0.3 | 2 |
| Temperature | 24.96 | 1.13 | 0.17 | 2 |
| Elevation | 25.45 | 1.63 | 0.13 | 2 |
| Watershed area | 26.34 | 2.52 | 0.09 | 2 |
| Forest | 26.45 | 2.63 | 0.08 | 2 |
| Urban | 26.47 | 2.64 | 0.08 | 2 |
| Velocity | 26.48 | 2.66 | 0.08 | 2 |
| Turbidity | 26.66 | 2.83 | 0.07 | 2 |


0.6
0.4
0.2
0.0
Priority relative abundance (coastal plain)
4
6
8
10
Dissolved oxygen (mg/L)

a.


0.6
0.4
0.2
0.0
Priority relative abundance (coastal plain)
10
15
20
25
Temp (C)

b.




c.

Figure 14. Scatter plot showing relationships between SWAP-listed species relative abundance in the coastal plain versus (a.) dissolved oxygen, (b.) temperature, and (c.) elevation.

Appendix A. List of Small River Assessment sites. Ecoregion codes are: SEPlains = Southeastern Plains; MidAtlCP = Middle Atlantic Coastal Plain.

| Site ID | River | Watershed Area ($km^2$) | Sample date | Latitude | Longitude | Basin | Ecoregion |
|---|---|---|---|---|---|---|---|
| 252776 | North Fork Edisto River | 213 | 7/24/2018 | 33.78312 | -81.44566 | ACE | SEPlains |
| 278955 | South Fork Edisto River | 466 | 10/5/2017 | 33.63527 | -81.56065 | ACE | SEPlains |
| 281300 | Shaw Creek | 194 | 10/8/2018 | 33.59866 | -81.66947 | ACE | SEPlains |
| 285848 | North Fork Edisto River | 1090 | 10/3/2017 | 33.57671 | -81.03810 | ACE | SEPlains |
| 289050 | Caw Caw Swamp | 158 | 10/24/2018 | 33.55660 | -80.87422 | ACE | SEPlains |
| 289956 | South Fork Edisto River | 919 | 10/4/2017 | 33.55424 | -81.48260 | ACE | SEPlains |
| 298448 | Dean Swamp Creek | 163 | 10/1/2019 | 33.49443 | -81.32174 | ACE | SEPlains |
| 301280 | Four Hole Swamp | 503 | 7/30/2020 | 33.36245 | -80.55863 | ACE | SEPlains |
| 313310 | South Fork Edisto River | 1911 | 8/18/2020 | 33.38048 | -81.11024 | ACE | SEPlains |
| 341540 | Salkehatchie River | 275 | 6/1/2020 | 33.20793 | -81.35361 | ACE | SEPlains |
| 325554 | North Fork Edisto River | 1885 | 6/28/2018 | 33.35221 | -80.88570 | ACE | MidAtlCP |
| 333531 | Sandy Run | 143 | 6/3/2020 | 33.29509 | -80.29015 | ACE | MidAtlCP |
| 339662 | Wadboo Creek | 321 | 7/18/2019 | 33.19784 | -79.94669 | ACE | MidAtlCP |
| 340318 | Four Hole Swamp | 1419 | 6/27/2018 | 33.19789 | -80.32865 | ACE | MidAtlCP |
| 343059 | Lemon Creek | 142 | 9/26/2018 | 33.21517 | -80.98949 | ACE | MidAtlCP |
| 349192 | Little Salkehatchie River | 160 | 6/8/2020 | 33.19184 | -81.06042 | ACE | MidAtlCP |
| 361937 | Salkehatchie River | 881 | 7/26/2018 | 32.98882 | -81.05122 | ACE | MidAtlCP |
| 367352 | Little Salkehatchie River | 619 | 10/23/2018 | 33.03807 | -80.88709 | ACE | MidAtlCP |
| 367987 | Buckhead Creek | 215 | 6/3/2020 | 33.00539 | -80.85605 | ACE | MidAtlCP |
| 378377 | Coosawhatchie River | 238 | 3/21/2019 | 32.90448 | -81.22756 | ACE | MidAtlCP |
| 383836 | Little Salkehatchie River | 1111 | 7/25/2018 | 32.88532 | -80.87173 | ACE | MidAtlCP |
| 389906 | Horseshoe Creek | 224 | 4/25/2019 | 32.78836 | -80.52908 | ACE | MidAtlCP |
| 392407 | Ashepoo River | 376 | 7/14/2020 | 32.77247 | -80.60591 | ACE | MidAtlCP |
| 395816 | Coosawhatchie River | 1000 | 8/5/2020 | 32.69797 | -80.96615 | ACE | MidAtlCP |
| 46644 | Thompson Creek | 190 | 5/9/2019 | 34.80664 | -80.17265 | PeeDee | Uplands |
| 60715 | Lynches River | 277 | 7/11/2018 | 34.71867 | -80.48658 | PeeDee | Uplands |
| 71514 | Thompson Creek | 880 | 9/11/2019 | 34.65761 | -79.88440 | PeeDee | SEPlains |
| 72675 | Bear Creek | 160 | 9/10/2019 | 34.65861 | -80.04503 | PeeDee | SEPlains |
| 84157 | Black Creek | 150 | 8/14/2019 | 34.63200 | -80.18128 | PeeDee | SEPlains |
| 84802 | Crooked Creek | 167 | 5/8/2019 | 34.60808 | -79.73606 | PeeDee | SEPlains |
| 85585 | Lynches River | 570 | 9/12/2019 | 34.60692 | -80.40101 | PeeDee | SEPlains |
| 106417 | Little Lynches River | 162 | 6/17/2019 | 34.51023 | -80.52534 | PeeDee | SEPlains |
| 133818 | Buck Swamp | 239 | 8/12/2020 | 34.33584 | -79.40819 | PeeDee | SEPlains |
| 134047 | Little Pee Dee River | 1427 | 6/18/2019 | 34.36379 | -79.35169 | PeeDee | SEPlains |
| 151636 | Black Creek | 1155 | 8/15/2018 | 34.25717 | -79.69670 | PeeDee | SEPlains |
| 161514 | Lynches River | 1724 | 8/14/2018 | 34.24759 | -80.21280 | PeeDee | SEPlains |
| 175015 | Jeffries Creek | 344 | 8/21/2019 | 34.13547 | -79.63240 | PeeDee | SEPlains |

| Site ID | River | Watershed Area ($km^2$) | Sample date | Latitude | Longitude | Basin | Ecoregion |
|---|---|---|---|---|---|---|---|
| 212342 | Rocky Bluff Swamp | 139 | 6/10/2020 | 33.96464 | -80.30168 | PeeDee | SEPlains |
| 221139 | Black River | 248 | 6/10/2020 | 33.94802 | -80.17949 | PeeDee | SEPlains |
| 257182 | Sammy Swamp | 191 | 8/18/2020 | 33.76229 | -80.27783 | PeeDee | SEPlains |
| 183813 | Mitchell Swamp | 155 | 8/31/2020 | 34.10103 | -79.02043 | PeeDee | MidAtlCP |
| 196846 | Sparrow Swamp | 370 | 6/19/2019 | 34.04238 | -79.88570 | PeeDee | MidAtlCP |
| 222159 | Kingston Lake | 151 | 8/31/2020 | 33.90512 | -78.96340 | PeeDee | MidAtlCP |
| 236464 | Pudding Swamp | 168 | 4/23/2019 | 33.85169 | -80.04408 | PeeDee | MidAtlCP |
| 241199 | Kingston Lake | 344 | 4/24/2019 | 33.84593 | -79.03427 | PeeDee | MidAtlCP |
| 243900 | Lake Swamp | 422 | 6/23/2020 | 33.82894 | -79.46562 | PeeDee | MidAtlCP |
| 261439 | Black River | 1266 | 6/6/2019 | 33.72125 | -80.04181 | PeeDee | MidAtlCP |
| 266446 | Pocotaligo River | 1064 | 6/4/2019 | 33.70655 | -80.04989 | PeeDee | MidAtlCP |
| 278913 | Black Mingo Creek | 569 | 6/5/2019 | 33.61393 | -79.42857 | PeeDee | MidAtlCP |
| 14073 | South Saluda River | 269 | 08/16/2016 | 35.01594 | -82.53924 | Santee | Uplands |
| 22175 | North Saluda River | 193 | 10/25/2016 | 34.97763 | -82.52370 | Santee | Uplands |
| 24557 | Lawsons Fork Creek | 220 | 05/30/2017 | 34.94331 | -81.78841 | Santee | Uplands |
| 26184 | Thicketty Creek | 293 | 06/13/2017 | 34.93373 | -81.59247 | Santee | Uplands |
| 31549 | Bullock Creek | 264 | 06/01/2017 | 34.91294 | -81.42412 | Santee | Uplands |
| 34587 | Pacolet River | 1300 | 8/24/2018 | 34.87166 | -81.53170 | Santee | Uplands |
| 36457 | South Tyger River | 293 | 08/04/2016 | 34.84534 | -82.06246 | Santee | Uplands |
| 36535 | Fishing Creek | 212 | 07/19/2017 | 34.86351 | -81.06938 | Santee | Uplands |
| 43414 | Saluda River | 873 | 06/15/2017 | 34.80322 | -82.47414 | Santee | Uplands |
| 51726 | North Tyger River | 448 | 08/03/2016 | 34.76731 | -81.94053 | Santee | Uplands |
| 54759 | Enoree River | 458 | 11/3/2017 | 34.75232 | -82.10682 | Santee | Uplands |
| 54849 | Fishing Creek | 578 | 07/19/2017 | 34.75339 | -80.99174 | Santee | Uplands |
| 55441 | Tyger River | 912 | 10/16/2017 | 34.73521 | -81.88905 | Santee | Uplands |
| 60921 | Cane Creek | 205 | 07/18/2017 | 34.72428 | -80.80984 | Santee | Uplands |
| 81633 | Sandy River | 388 | 08/09/2016 | 34.59162 | -81.39146 | Santee | Uplands |
| 85935 | Rocky Creek | 326 | 07/18/2017 | 34.58428 | -80.94138 | Santee | Uplands |
| 86220 | Enoree River | 927 | 9/5/2017 | 34.59378 | -81.85527 | Santee | Uplands |
| 94825 | Tyger River | 1803 | 9/7/2018 | 34.58442 | -81.59223 | Santee | Uplands |
| 107072 | Duncan Creek | 306 | 07/20/2016 | 34.49039 | -81.59259 | Santee | Uplands |
| 120002 | Rabon Creek | 315 | 06/28/2016 | 34.38232 | -82.10234 | Santee | Uplands |
| 120920 | Reedy River | 614 | 07/12/2017 | 34.40775 | -82.14474 | Santee | Uplands |
| 122116 | Saluda River | 1494 | 06/28/2017 | 34.40382 | -82.23583 | Santee | Uplands |
| 134474 | Little River | 218 | 07/26/2016 | 34.35065 | -81.89339 | Santee | Uplands |
| 156994 | Little River | 562 | 10/26/2017 | 34.25389 | -81.23459 | Santee | Uplands |
| 199483 | Little Saluda River | 269 | 9/21/2017 | 34.02859 | -81.72765 | Santee | Uplands |
| 156518 | Twentyfive Mile Creek | 262 | 6/6/2018 | 34.23677 | -80.74146 | Santee | SEPlains |
| 161918 | Big Pine Tree Creek | 163 | 7/6/2018 | 34.22725 | -80.60476 | Santee | SEPlains |

| Site ID | River | Watershed Area ($km^2$) | Sample date | Latitude | Longitude | Basin | Ecoregion |
|---|---|---|---|---|---|---|---|
| 223988 | Gills Creek | 181 | 6/5/2018 | 33.92788 | -80.98171 | Santee | SEPlains |
| 282194 | Halfway Swamp | 178 | 8/28/2018 | 33.60601 | -80.64202 | Santee | SEPlains |
| 334988 | Echaw Creek | 184 | 7/17/2019 | 33.25219 | -79.57560 | Santee | MidAtlCP |
| 335045 | Wadmacon Creek | 188 | 7/16/2019 | 33.27708 | -79.54524 | Santee | MidAtlCP |
| 344244 | Wambaw Creek | 163 | 9/25/2019 | 33.17698 | -79.49749 | Santee | MidAtlCP |
| 26306 | Chattooga River | 323 | 11/10/2016 | 34.90683 | -83.18093 | Savannah | Uplands |
| 38462 | Little River | 190 | 11/02/2016 | 34.83544 | -82.97375 | Savannah | Uplands |
| 38604 | Twelvemile Creek | 220 | 06/29/2016 | 34.82750 | -82.74700 | Savannah | Uplands |
| 80771 | Three and Twenty Creek | 211 | 07/07/2016 | 34.59993 | -82.77204 | Savannah | Uplands |
| 123324 | Rocky River | 285 | 07/06/2016 | 34.39655 | -82.57025 | Savannah | Uplands |
| 169080 | Little River | 383 | 07/27/2016 | 34.16755 | -82.49583 | Savannah | Uplands |
| 202204 | Little River | 800 | 07/28/2016 | 34.01326 | -82.46822 | Savannah | Uplands |
| 204321 | Hard Labor Creek | 169 | 07/19/2016 | 34.00399 | -82.20989 | Savannah | Uplands |
| 229560 | Stevens Creek | 554 | 08/01/2017 | 33.87779 | -82.23246 | Savannah | Uplands |
| 241934 | Turkey Creek | 572 | 07/13/2017 | 33.82809 | -82.11529 | Savannah | Uplands |
| 256067 | Stevens Creek | 1386 | 5/16/2019 | 33.76241 | -82.17281 | Savannah | Uplands |
| 272062 | Horn Creek | 189 | 08/03/2017 | 33.66290 | -82.07068 | Savannah | Uplands |
| 289498 | Horse Creek | 161 | 6/1/2020 | 33.55444 | -81.81408 | Savannah | SEPlains |
| 303972 | Horse Creek | 378 | 7/29/2019 | 33.48451 | -81.89934 | Savannah | SEPlains |
| 312702 | Upper Three Runs | 180 | 6/8/2020 | 33.41901 | -81.60821 | Savannah | SEPlains |
| 321833 | Hollow Creek | 223 | 3/20/2019 | 33.36163 | -81.81165 | Savannah | SEPlains |
| 408734 | Boggy Branch | 240 | 7/23/2020 | 32.57272 | -81.31023 | Savannah | MidAtlCP |
| 413942 | Cypress Creek | 222 | 7/9/2020 | 32.48392 | -81.15760 | Savannah | MidAtlCP |
| 423882 | New River | 420 | 7/16/2020 | 32.25037 | -81.00513 | Savannah | MidAtlCP |

Appendix B. Taxonomic list of fishes collected in the Small River Assessment (2016-2020), with number of occurrences (number of sites; maximum 100). State Wildlife Action Plan Priority species are denoted in bold. Non-native status is denoted with Common Name (Redear Sunfish and Channel Catfish are not native to most South Carolina drainages).

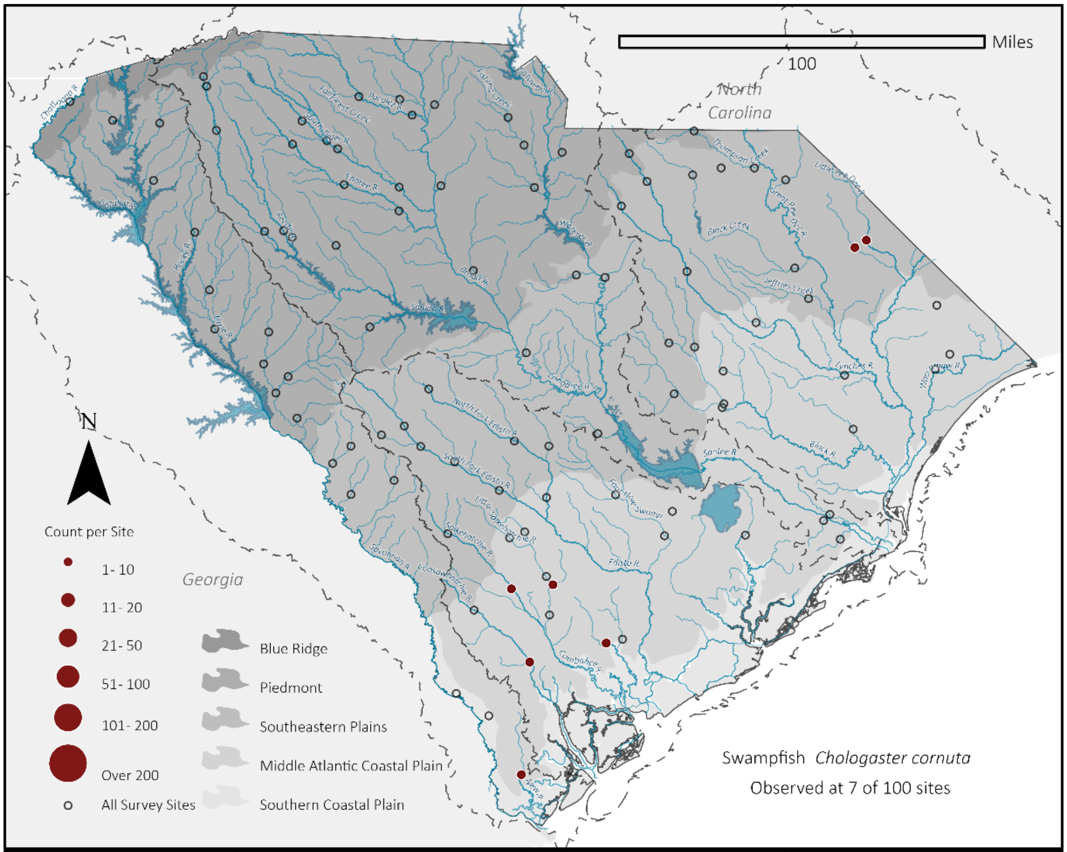
| **FAMILY/ Common Name** | **Scientific Name** | **SWAP Priority** | **Occurrences** |
|---|---|---|---|
| FAMILY ACHIRIDAE | | | |
| Hogchoker | *Trinectes maculatus* | | 10 |
| FAMILY AMBLYOPSIDAE | | | |
| **Swampfish** | ***Chologaster cornuta*** | **Moderate** | 7 |
| FAMILY AMIIDAE | | | |
| Bowfin | *Amia calva* | | 30 |
| FAMILY ANGUILLIDAE | | | |
| **American Eel** | ***Anguilla rostrata*** | **Highest** | 42 |
| FAMILY APHREDODERIDAE | | | |
| Pirate Perch | *Aphredoderus sayanus* | | 63 |
| FAMILY ATHERINIDAE | | | |
| Golden Silverside | *Labidesthes vanhyningi* | | 31 |
| FAMILY CATOSTOMIDAE | | | |
| **Highfin Carpsucker** | ***Carpiodes velifer*** | **Highest** | 1 |
| White Sucker | *Catostomus commersoni* | | 2 |
| Creek Chubsucker | *Erimyzon oblongus* | | 34 |
| Lake Chubsucker | *Erimyzon sucetta* | | 4 |
| Northern Hog Sucker | *Hypentelium nigricans* | | 32 |
| Spotted Sucker | *Minytrema melanops* | | 37 |
| **Notchlip Redhorse** | ***Moxostoma collapsum*** | **Moderate** | 22 |
| Shorthead Redhorse | *Moxostoma macrolepidotum* | | 3 |
| **V-Lip Redhorse** | ***Moxostoma pappillosum*** | **Moderate** | 4 |
| Striped Jumprock | *Scartomyzon rupiscartes* | | 16 |
| Brassy Jumprock | *Scartomyzon sp.* | | 27 |
| FAMILY CENTRARCHIDAE | | | |
| Mud Sunfish | *Acantharchus pomotis* | | 11 |
| Flier | *Centrarchus macropterus* | | 21 |
| **Blackbanded Sunfish** | ***Enneacanthus chaetodon*** | **High** | 1 |
| Bluespotted Sunfish | *Enneacanthus gloriosus* | | 19 |
| **Banded Sunfish** | ***Enneacanthus obesus*** | **Moderate** | 2 |
| Redbreast Sunfish | *Lepomis auritus* | | 89 |
| Hybrid Redbreast Sunfish x Green Sunfish (non-native) | | | 1 |
| Green Sunfish (non-native) | *Lepomis cyanellus* | | 26 |
| Hybrid Pumpkinseed x Green Sunfish (non-native) | | | 1 |
| Pumpkinseed | *Lepomis gibbosus* | | 33 |
| Warmouth | *Lepomis gulosus* | | 71 |

| **FAMILY/ Common Name** | **Scientific Name** | **SWAP Priority** | **Occurrences** |
|---|---|---|---|
| Hybrid Warmouth x Bluegill | | | 1 |
| Bluegill | *Lepomis macrochirus* | | 92 |
| Hybrid Bluegill x Green Sunfish (non-native) | | | 3 |
| Hybrid Bluegill x Redear Sunfish (non-native) | | | 2 |
| Dollar Sunfish | *Lepomis marginatus* | | 41 |
| Hybrid Dollar Sunfish x Spotted Sunfish | | | 1 |
| Redear Sunfish (non-native) | *Lepomis microlophus* | | 49 |
| Spotted Sunfish | *Lepomis punctatus* | | 47 |
| Smallmouth Bass (non-native) | *Micropterus dolomieu* | | 5 |
| Alabama Bass (non-native) | *Micropterus henshalli* | | 5 |
| Hybrid Bartram's Redeye Bass x Alabama Bass (non-native) | | | 5 |
| Largemouth Bass | *Micropterus salmoides* | | 85 |
| **Bartram's Redeye Bass** | ***Micropterus sp. cf. cataractae*** | **Highest** | 10 |
| Hybrid Bartram's Redeye Bass x Shoal Bass (non-native) | | | 1 |
| Black Crappie | *Pomoxis nigromaculatus* | | 15 |
| FAMILY CLUPEIDAE | | | |
| **American Shad** | ***Alosa sapidissima*** | **Highest** | 1 |
| Gizzard Shad | *Dorosoma cepedianum* | | 5 |
| FAMILY CYPRINIDAE | | | |
| Grass Carp (non-native) | *Ctenopharyngodon idella* | | 1 |
| Common Carp (non-native) | *Cyprinus carpio* | | 6 |
| FAMILY ELASSOMATIDAE | | | |
| **Bluebarred Pygmy Sunfish** | ***Elassoma okatie*** | **Highest** | 1 |
| Banded Pygmy Sunfish | *Elassoma zonatum* | | 11 |
| FAMILY ESOCIDAE | | | |
| Redfin Pickerel | *Esox americanus* | | 56 |
| Chain Pickerel | *Esox niger* | | 23 |
| FAMILY ICTALURIDAE | | | |
| **Snail Bullhead** | ***Ameiurus brunneus*** | **Moderate** | 28 |
| **White Catfish** | ***Ameiurus catus*** | **Moderate** | 8 |
| Yellow Bullhead | *Ameiurus natalis* | | 22 |
| Brown Bullhead | *Ameiurus nebulosus* | | 1 |
| **Flat Bullhead** | ***Ameiurus platycephalus*** | **Moderate** | 33 |
| Blue Catfish (non-native) | *Ictalurus furcatus* | | 4 |
| Channel Catfish (non-native) | *Ictalurus punctatus* | | 21 |

| **FAMILY/ Common Name** | **Scientific Name** | **SWAP Priority** | **Occurrences** |
|---|---|---|---|
| Tadpole Madtom | *Noturus gyrinus* | | 12 |
| Margined Madtom | *Noturus insignis* | | 39 |
| Speckled Madtom | *Noturus leptacanthus* | | 18 |
| Flathead Catfish (non-native) | *Pylodictis olivaris* | | 8 |
| FAMILY LEPISOSTEIDAE | | | |
| Longnose Gar | *Lepisosteus osseus* | | 33 |
| **Florida Gar** | ***Lepisosteus platyrhincus*** | **Moderate** | 2 |
| FAMILY LEUCISCIDAE | | | |
| **Central Stoneroller** | ***Campostoma anomalum michauxi*** | **Moderate** | 1 |
| **Satinfin Shiner** | ***Cyprinella analostana*** | **Moderate** | 1 |
| **Greenfin Shiner** | ***Cyprinella chloristia*** | **Moderate** | 30 |
| **Whitetail Shiner** | ***Cyprinella galactura*** | **Moderate** | 1 |
| **Thicklip Chub** | ***Cyprinella labrosa*** | **Moderate** | 4 |
| **Bannerfin Shiner** | ***Cyprinella leedsi*** | **High** | 2 |
| Whitefin Shiner | *Cyprinella nivea* | | 37 |
| **Fieryblack Shiner** | ***Cyprinella pyrrhomelas*** | **Moderate** | 11 |
| **Thinlip Chub** | ***Cyprinella sp. cf. zanema*** | **Highest** | 3 |
| **Santee Chub** | ***Cyprinella zanema*** | **High** | 16 |
| Eastern Silvery Minnow | *Hybognathus regius* | | 19 |
| **Highback Chub** | ***Hybopsis hypsinotus*** | **Moderate** | 2 |
| **Rosyface Chub** | ***Hybopsis rubrifrons*** | **Moderate** | 16 |
| **Warpaint Shiner** | ***Luxilus coccogenis*** | **Moderate** | 2 |
| Bluehead Chub | *Nocomis leptocephalus* | | 38 |
| River Chub | *Nocomis micropogon* | | 1 |
| Golden Shiner | *Notemigonus crysoleucas* | | 29 |
| **Whitemouth Shiner** | ***Notropis alborus*** | **Moderate** | 1 |
| **Highfin Shiner** | ***Notropis altipinnis*** | **Moderate** | 5 |
| **Ironcolor Shiner** | ***Notropis chalybaeus*** | **Moderate** | 15 |
| **Redlip Shiner** | ***Notropis chiliticus*** | **Moderate** | 1 |
| Greenhead Shiner | *Notropis chlorocephalus* | | 13 |
| Dusky Shiner | *Notropis cummingsae* | | 38 |
| Spottail Shiner | *Notropis hudsonius* | | 36 |
| **Tennessee Shiner** | ***Notropis leuciodus*** | **Moderate** | 1 |
| Yellowfin Shiner | *Notropis lutipinnis* | | 15 |
| Taillight Shiner | *Notropis maculatus* | | 9 |
| Coastal Shiner | *Notropis petersoni* | | 48 |
| **Swallowtail Shiner** | ***Notropis procne*** | **Moderate** | 9 |
| **Sandbar Shiner** | ***Notropis scepticus*** | **Moderate** | 32 |
| **Mirror Shiner** | ***Notropis spectrunculus*** | **Moderate** | 1 |
| Pugnose Minnow | *Opsopoeodus emiliae* | | 12 |
| **Lowland Shiner** | ***Pteronotropis stonei*** | **Moderate** | 15 |
| Creek Chub | *Semotilus atromaculatus* | | 13 |

| **FAMILY/ Common Name** | **Scientific Name** | **SWAP Priority** | **Occurrence s** |
|---|---|---|---|
| FAMILY MORONIDAE | | | |
| White Perch (non-native) | *Morone americana* | | 1 |
| **Striped Bass** | ***Morone saxatilis*** | **Moderate** | 4 |
| FAMILY MUGILIDAE | | | |
| Striped Mullet | *Mugil cephalus* | | 3 |
| FAMILY PERCIDAE | | | |
| **Carolina Fantail Darter** | ***Etheostoma brevispinum*** | **High** | 2 |
| **Carolina Darter** | ***Etheostoma collis*** | **High** | 1 |
| **Savannah Darter** | ***Etheostoma fricksium*** | **Highest** | 6 |
| Swamp Darter | *Etheostoma fusiforme* | | 5 |
| **Christmas Darter** | ***Etheostoma hopkinsi*** | **Highest** | 6 |
| **Turquoise Darter** | ***Etheostoma inscriptum*** | **High** | 6 |
| Tessellated Darter | *Etheostoma olmstedi* | | 59 |
| **Sawcheek Darter** | ***Etheostoma serrifer*** | **Moderate** | 9 |
| **Seagreen Darter** | ***Etheostoma thalassinum*** | **High** | 12 |
| Yellow Perch | *Perca flavescens* | | 8 |
| **Piedmont Darter** | ***Percina crassa*** | **High** | 29 |
| Blackbanded Darter | *Percina nigrofasciata* | | 28 |
| FAMILY POECILIIDAE | | | |
| Eastern Mosquitofish | *Gambusia holbrooki* | | 67 |
| Least Killifish | *Heterandria formosa* | | 2 |
| FAMILY UMBRIDAE | | | |
| Eastern Mudminnow | *Umbra pygmaea* | | 7 |

# Appendix C
# Priority Species Maps



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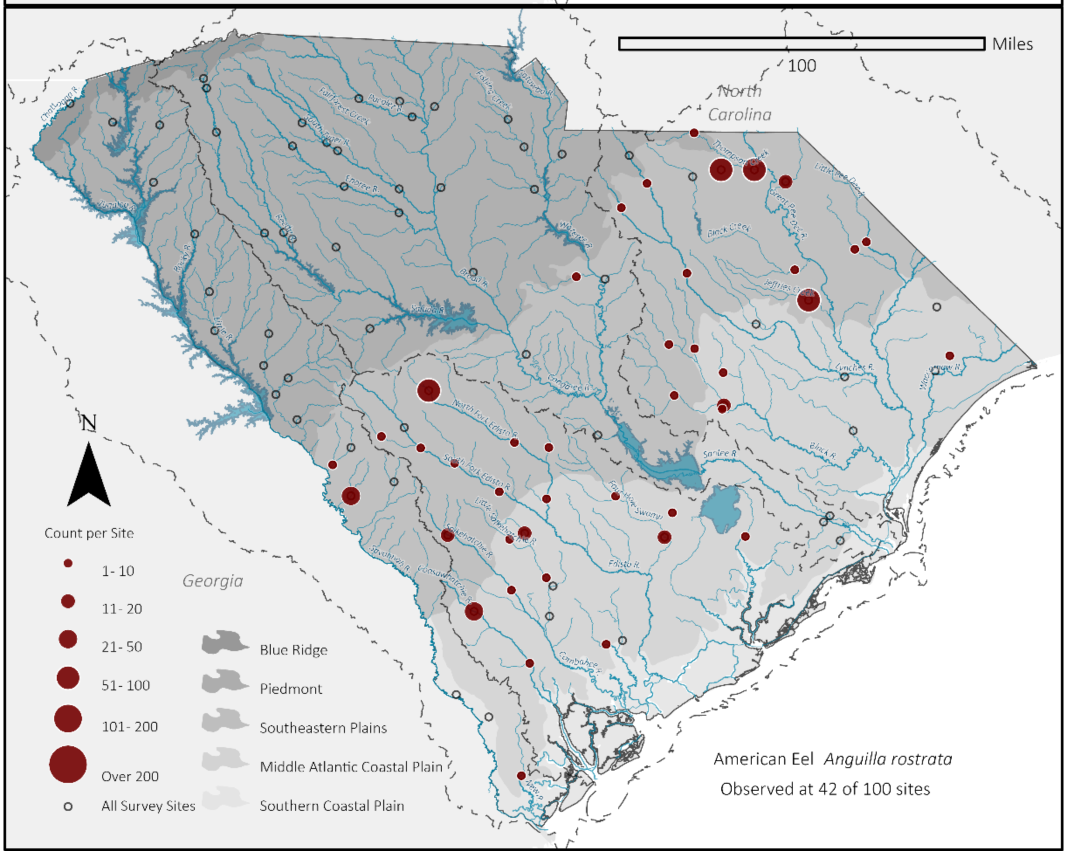
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Swampfish *Chologaster cornuta*
Observed at 7 of 100 sites

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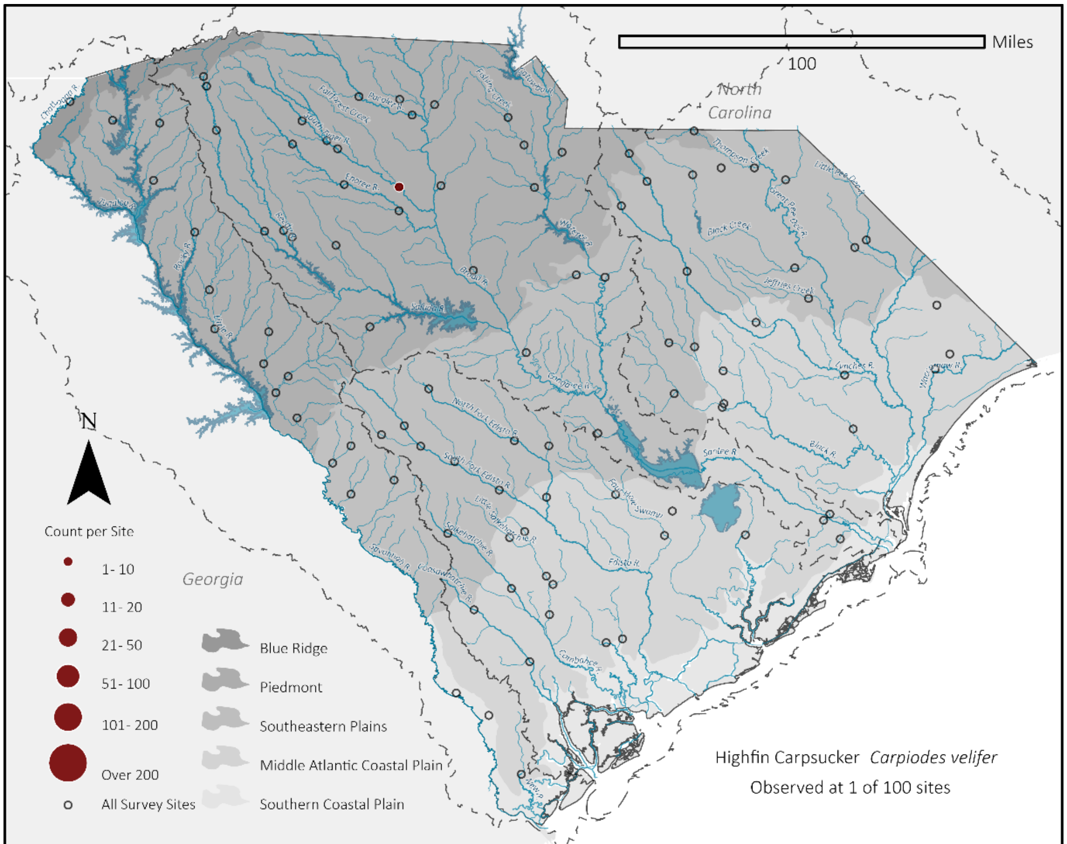
American Eel *Anguilla rostrata*
Observed at 42 of 100 sites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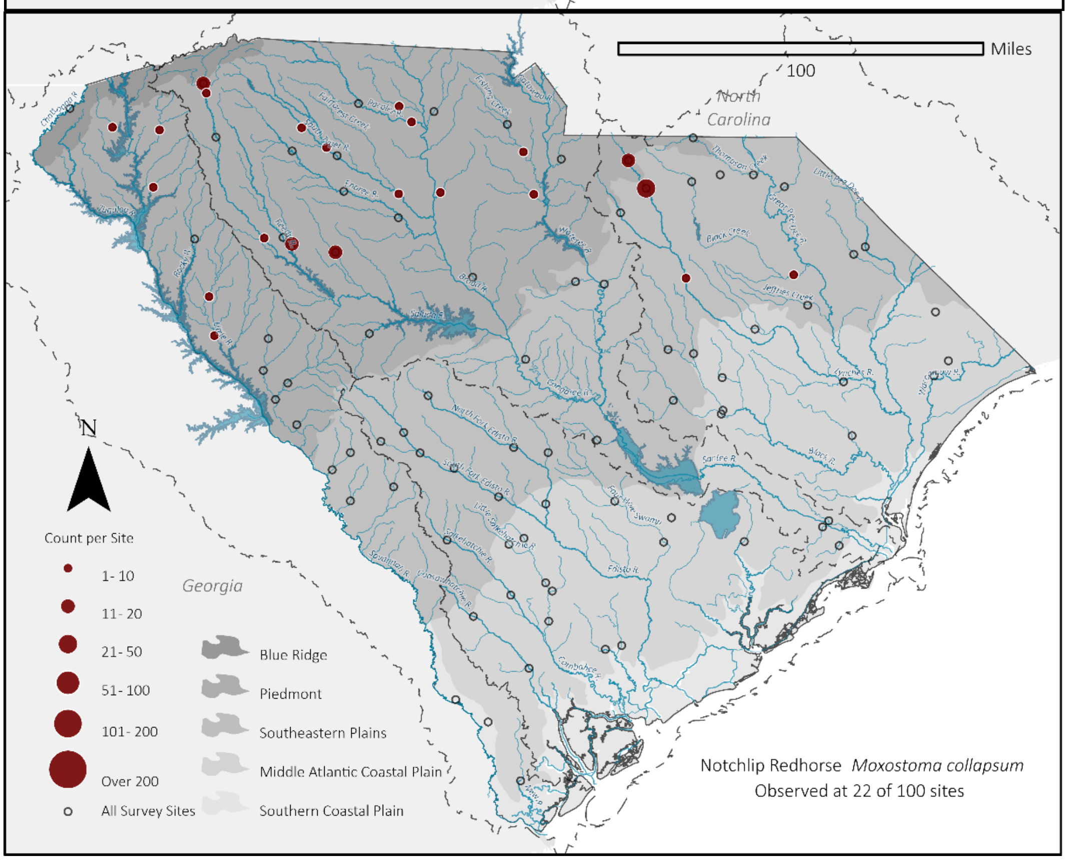
Highfin Carpsucker *Carpiodes velifer*
Observed at 1 of 100 sites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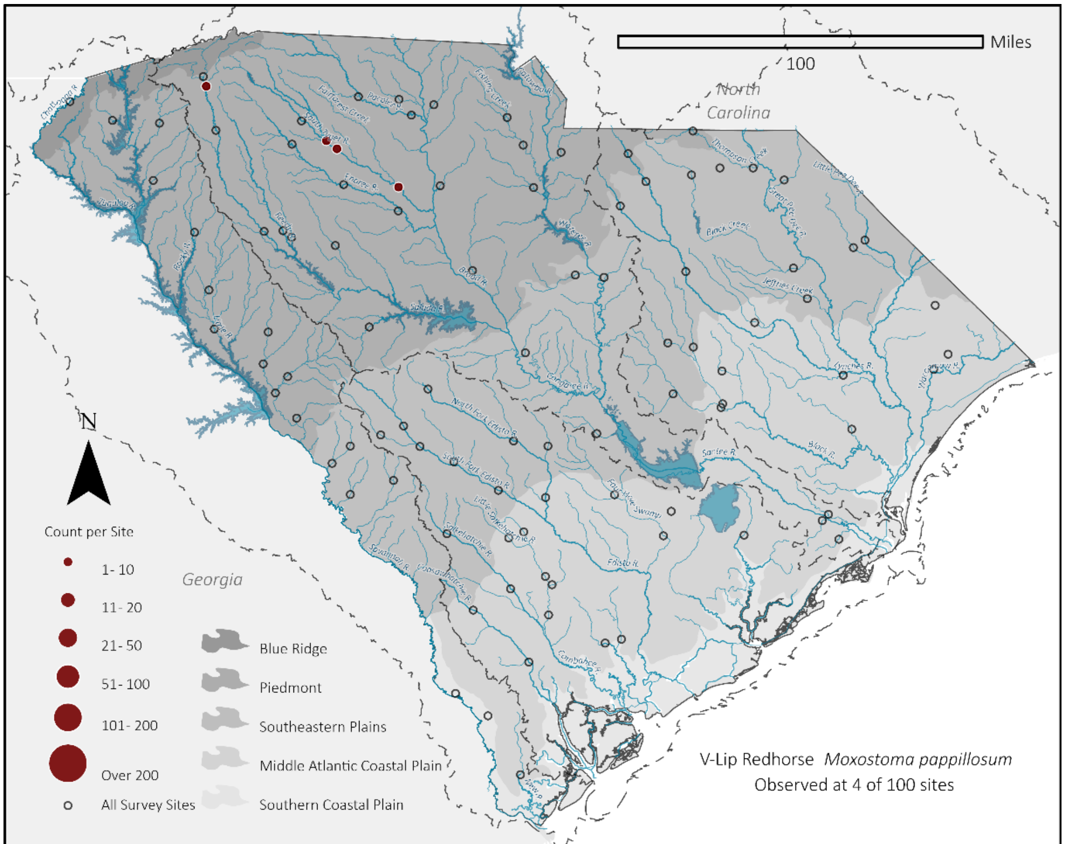
Notchlip Redhorse *Moxostoma collapsum*
Observed at 22 of 100 sites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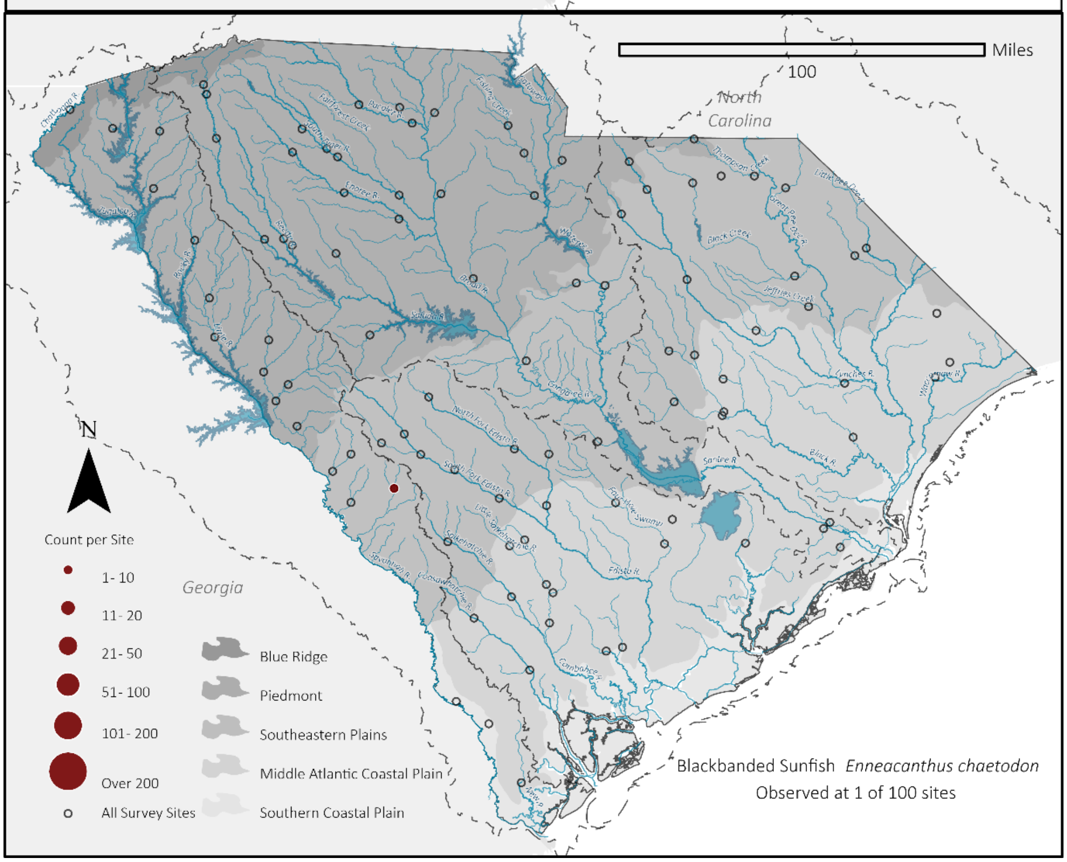
V-Lip Redhorse *Moxostoma pappillosum*
Observed at 4 of 100 sites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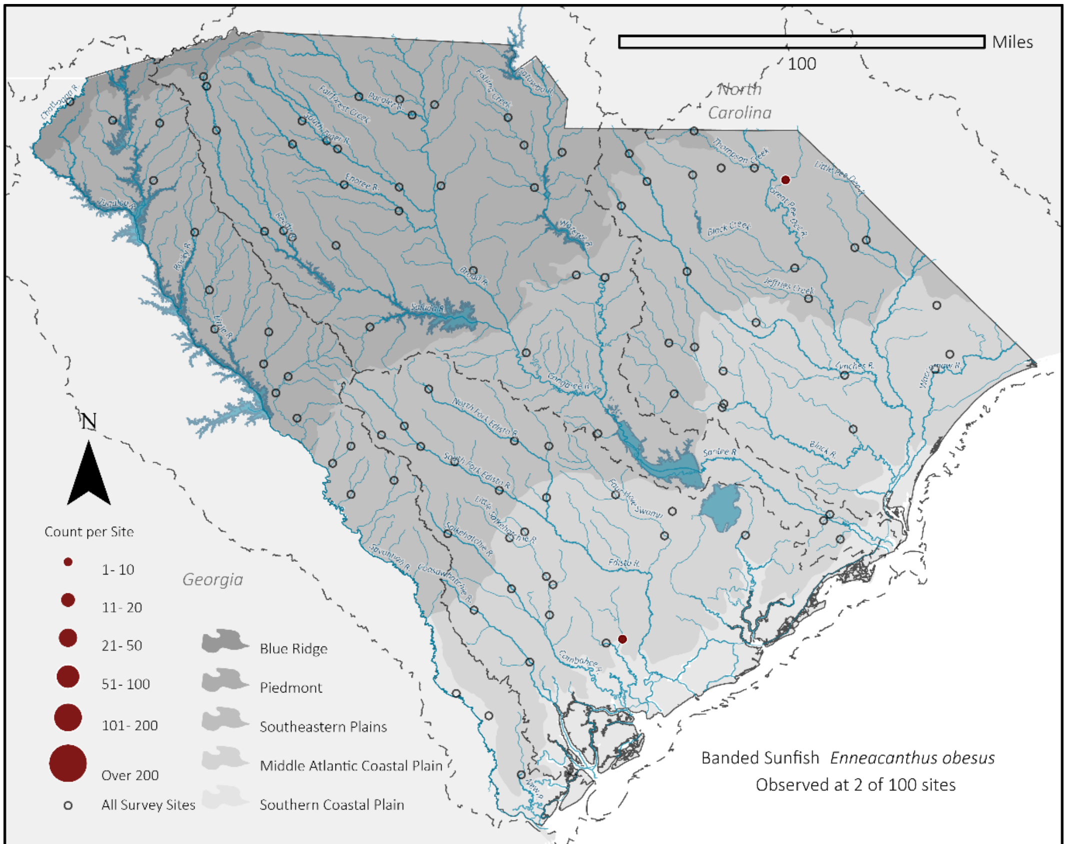
Southern Coastal Plain
Blackbanded Sunfish *Enneacanthus chaetodon*
Observed at 1 of 100 sites



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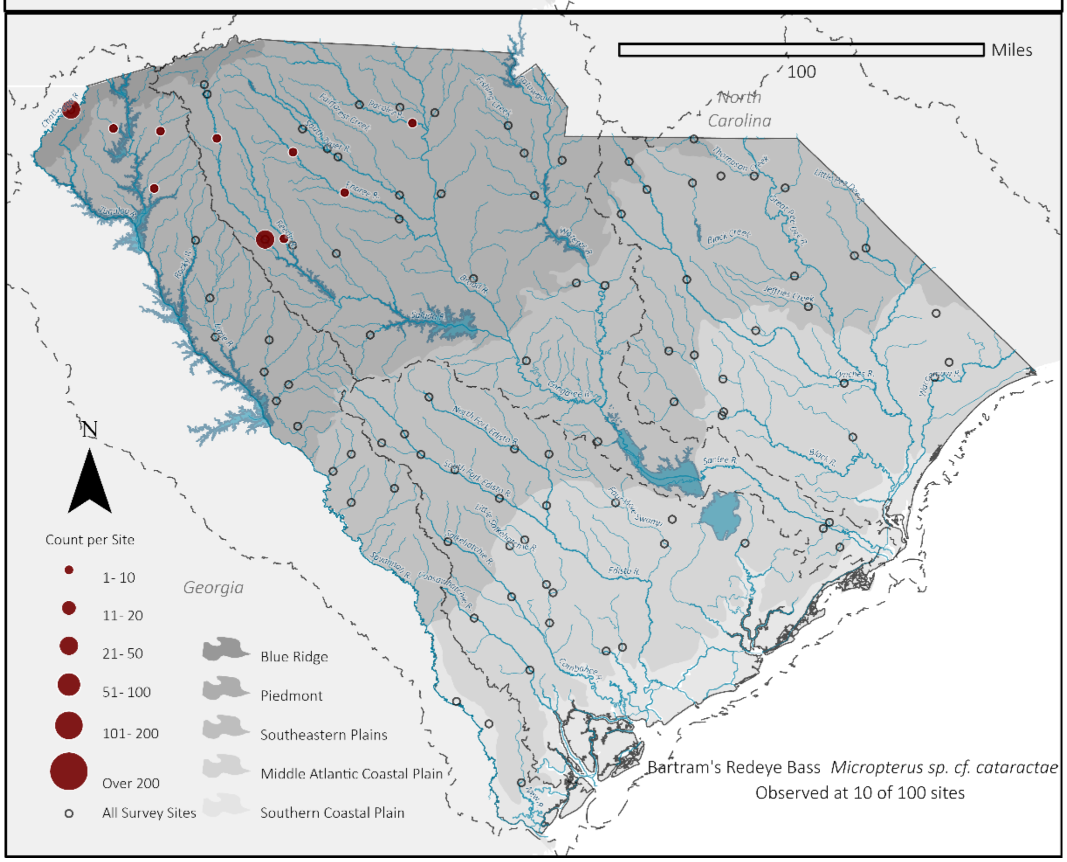
Middle Atlantic Coastal Plain
Southern Coastal Plain
Banded Sunfish *Enneacanthus obesus*
Observed at 2 of 100 sites

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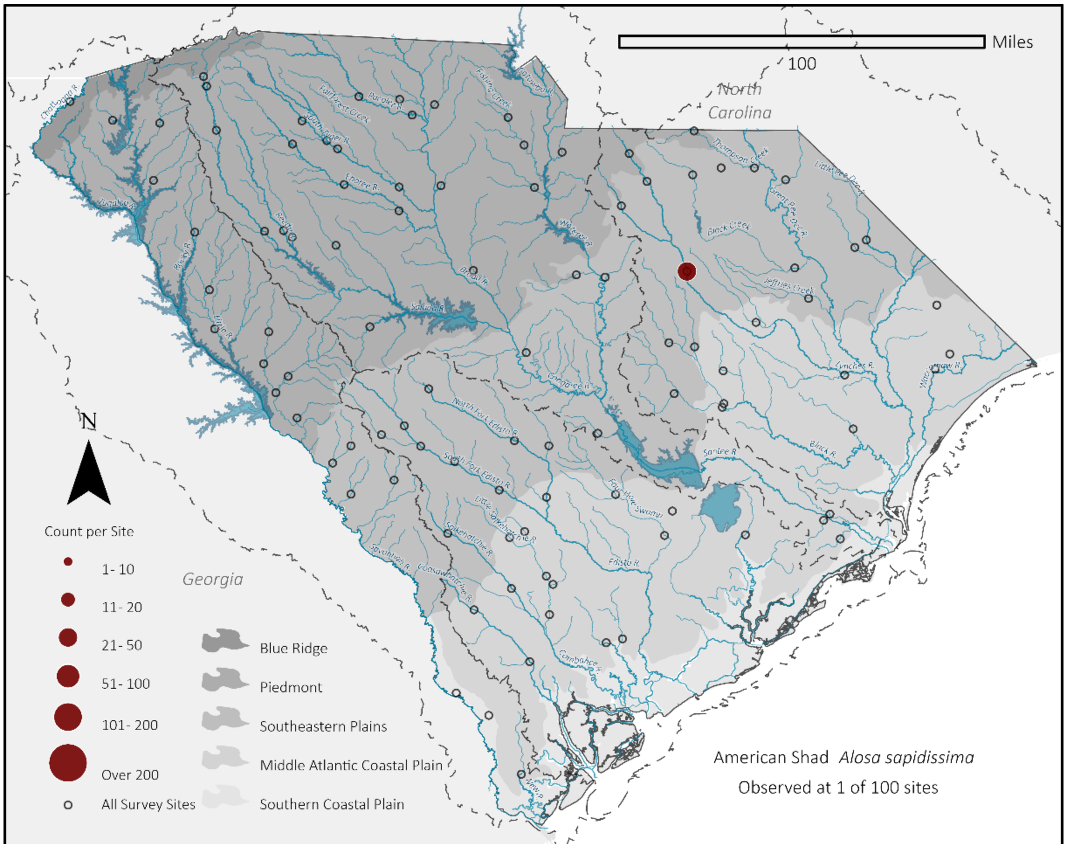
Southern Coastal Plain
Bartram's Redeye Bass *Micropterus sp. cf. cataractae*
Observed at 10 of 100 sites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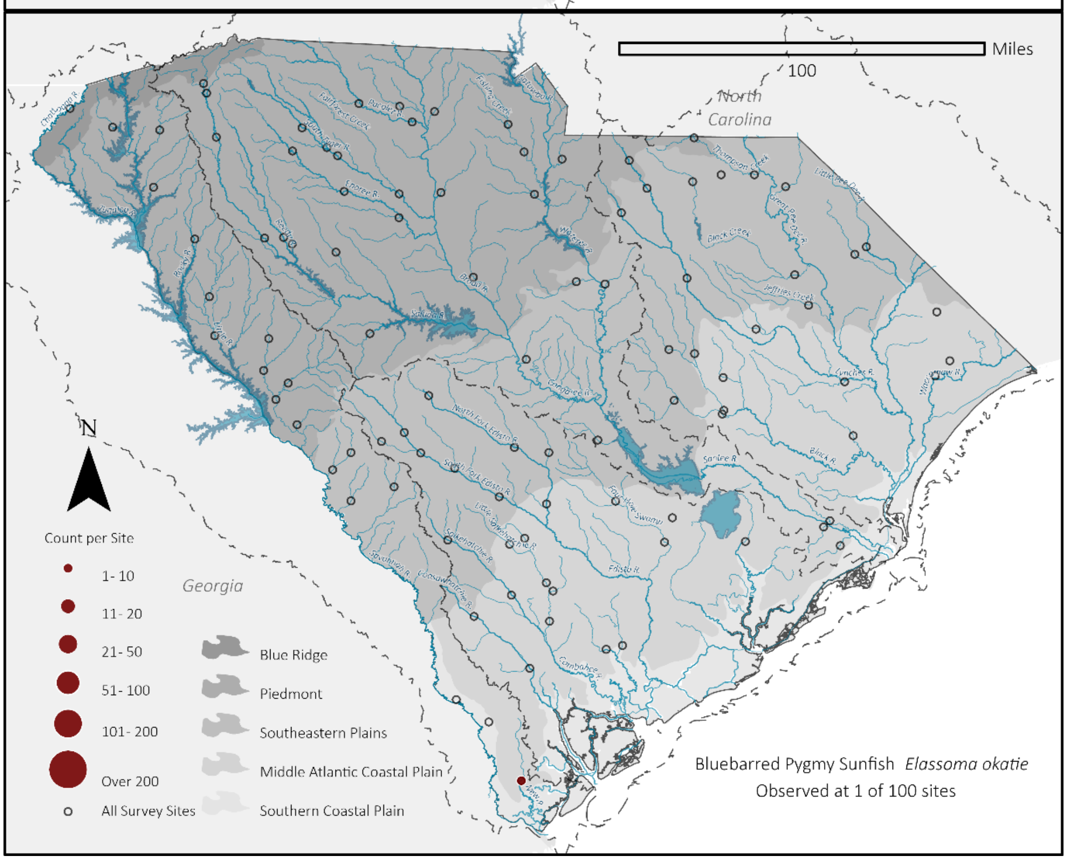
Middle Atlantic Coastal Plain
Southern Coastal Plain
American Shad *Alosa sapidissima*
Observed at 1 of 100 sites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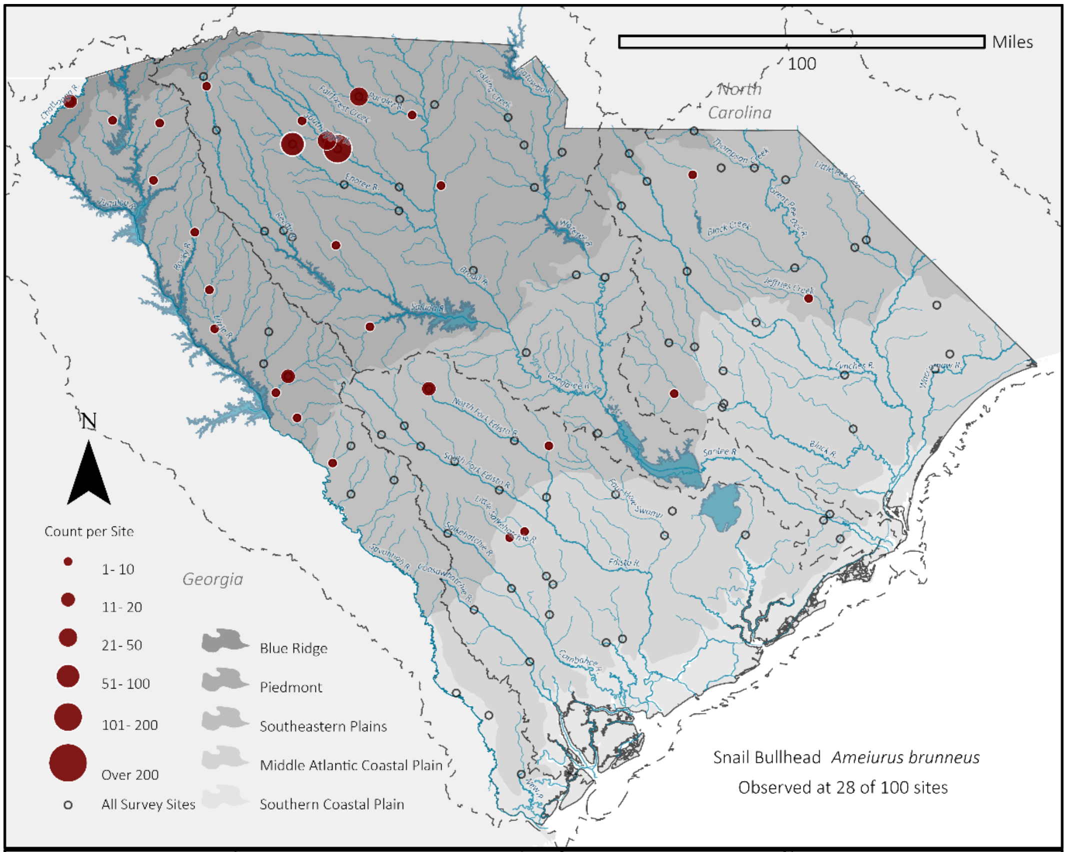
Middle Atlantic Coastal Plain
Southern Coastal Plain
Bluebarred Pygmy Sunfish *Elassoma okatie*
Observed at 1 of 100 sites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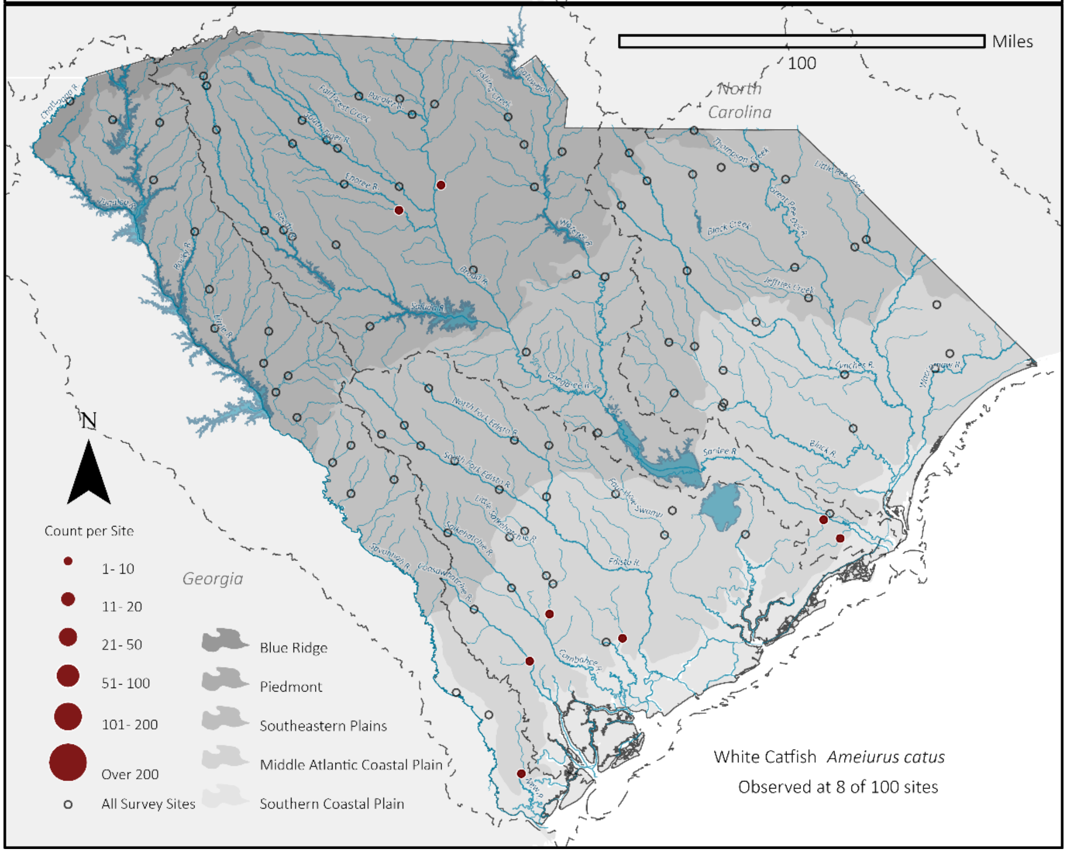
Southern Coastal Plain
Snail Bullhead *Ameiurus brunneus*
Observed at 28 of 100 sites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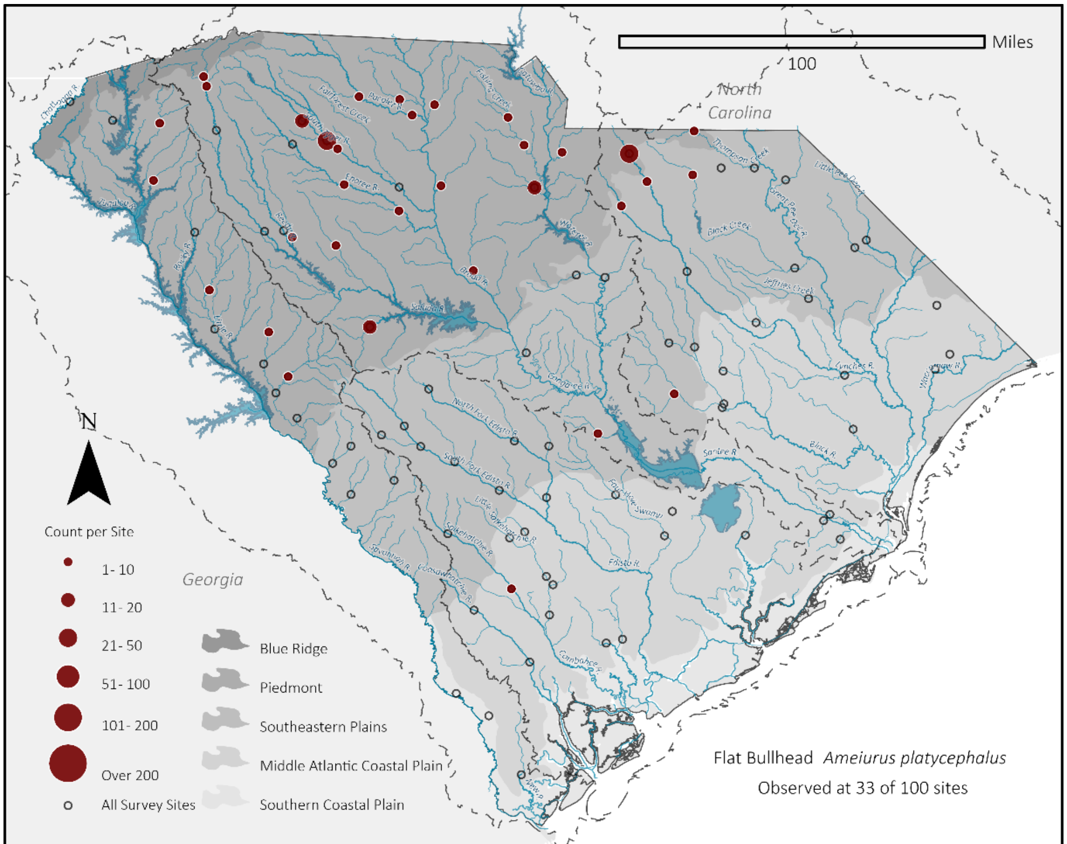
Southern Coastal Plain
White Catfish *Ameiurus catus*
Observed at 8 of 100 sites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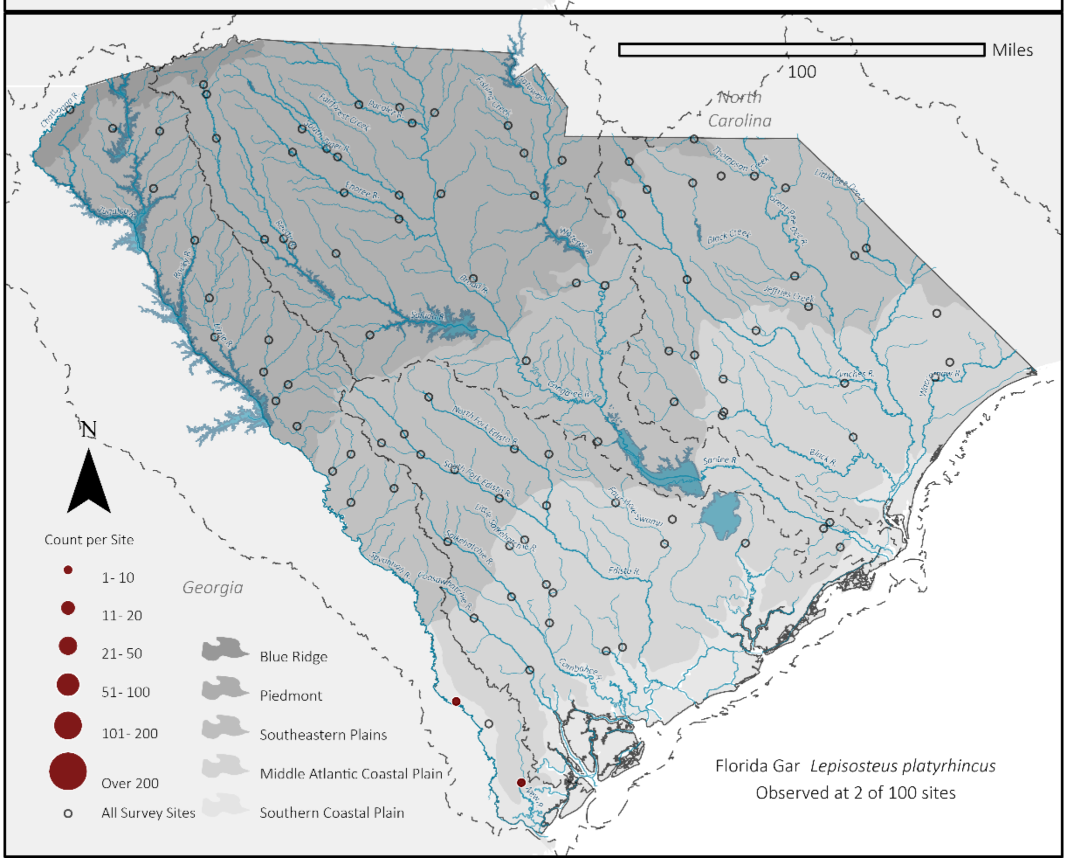
Southern Coastal Plain
Flat Bullhead *Ameiurus platycephalus*
Observed at 33 of 100 sites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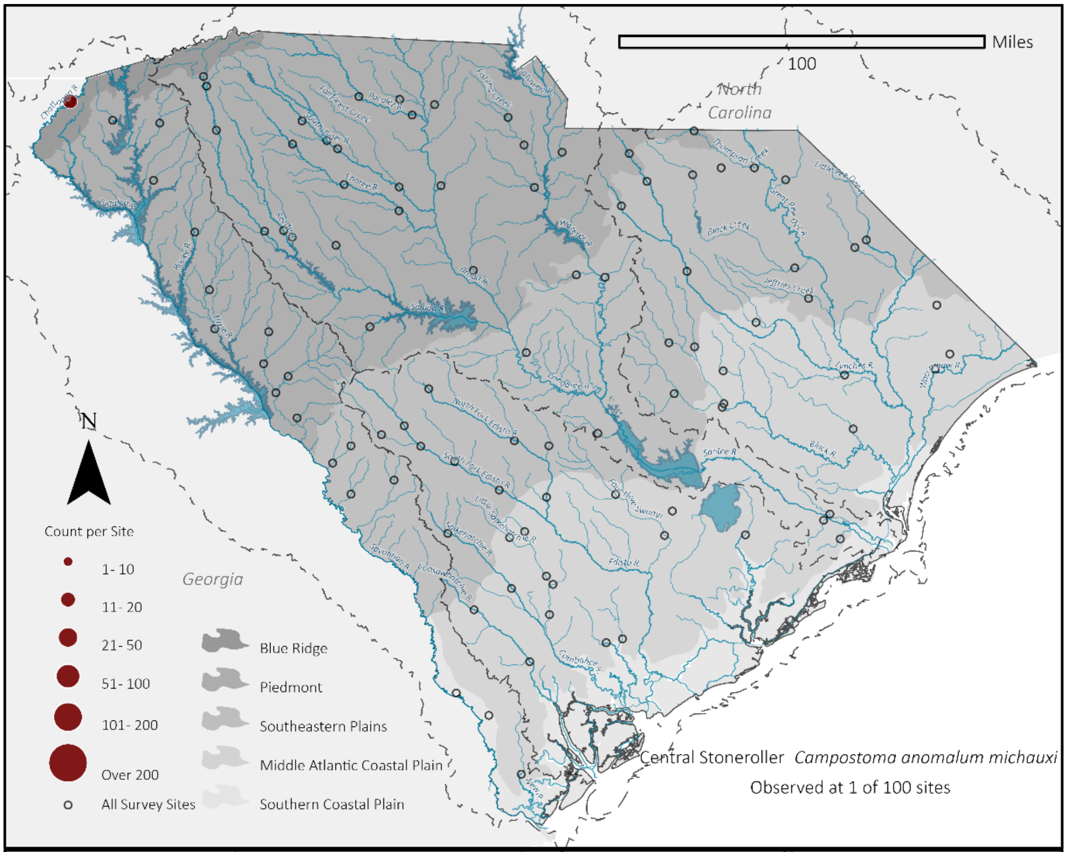
Middle Atlantic Coastal Plain
Southern Coastal Plain
Florida Gar *Lepisosteus platyrhincus*
Observed at 2 of 100 sites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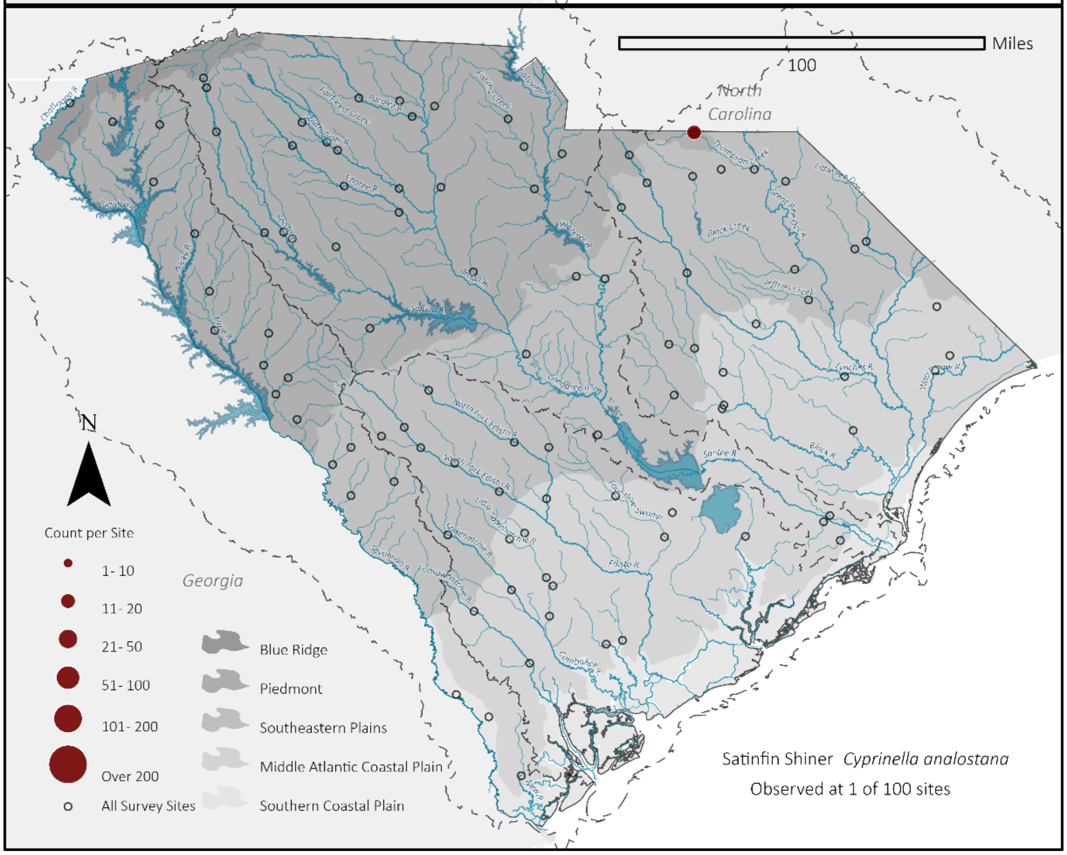
Southern Coastal Plain
Central Stoneroller *Campostoma anomalum michauxi*
Observed at 1 of 100 sites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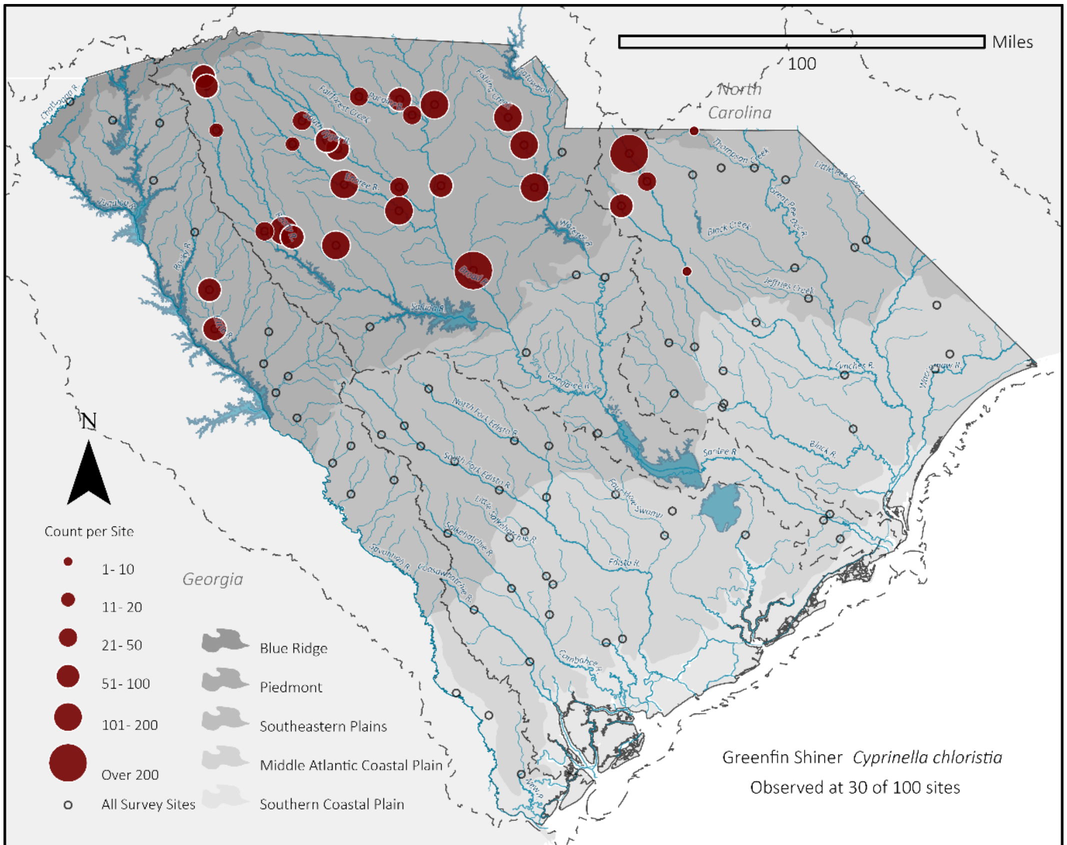
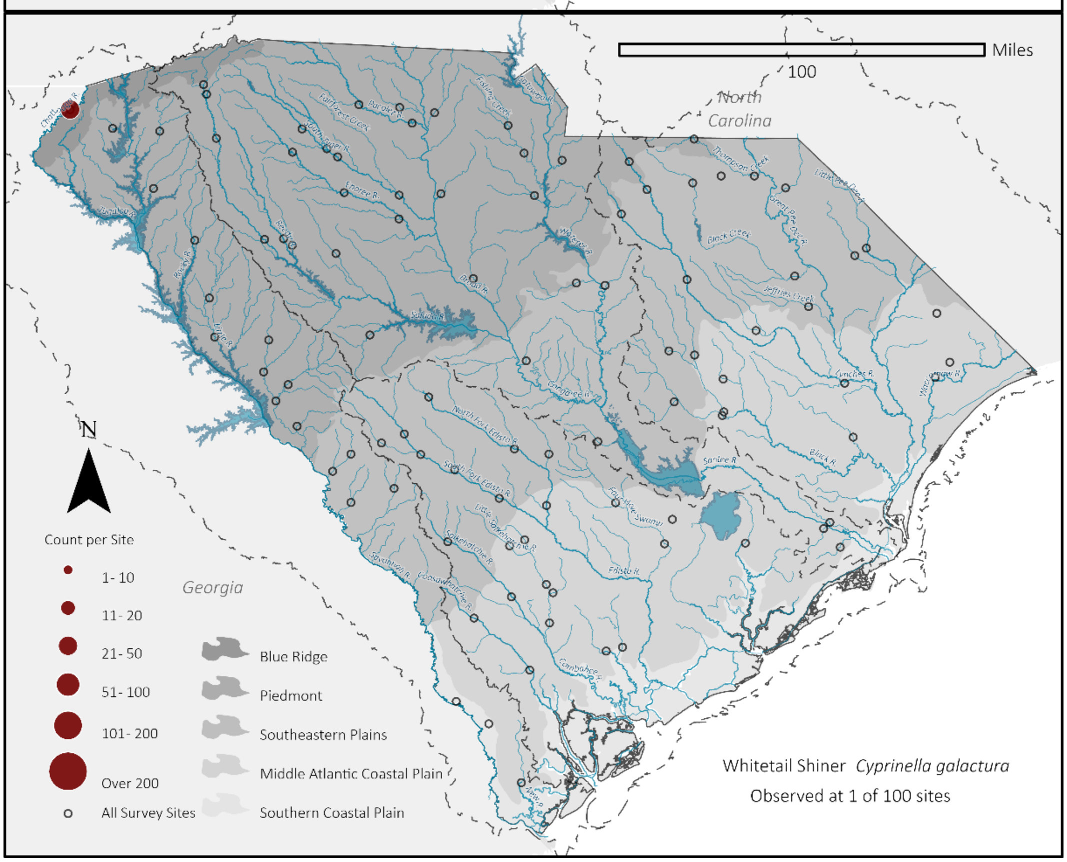
Middle Atlantic Coastal Plain
Southern Coastal Plain
Satinfin Shiner *Cyprinella analostana*
Observed at 1 of 100 sites


Miles
100
North
Carolina
Georgia
N
Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Greenfin Shiner *Cyprinella chloristia*
Observed at 30 of 100 sites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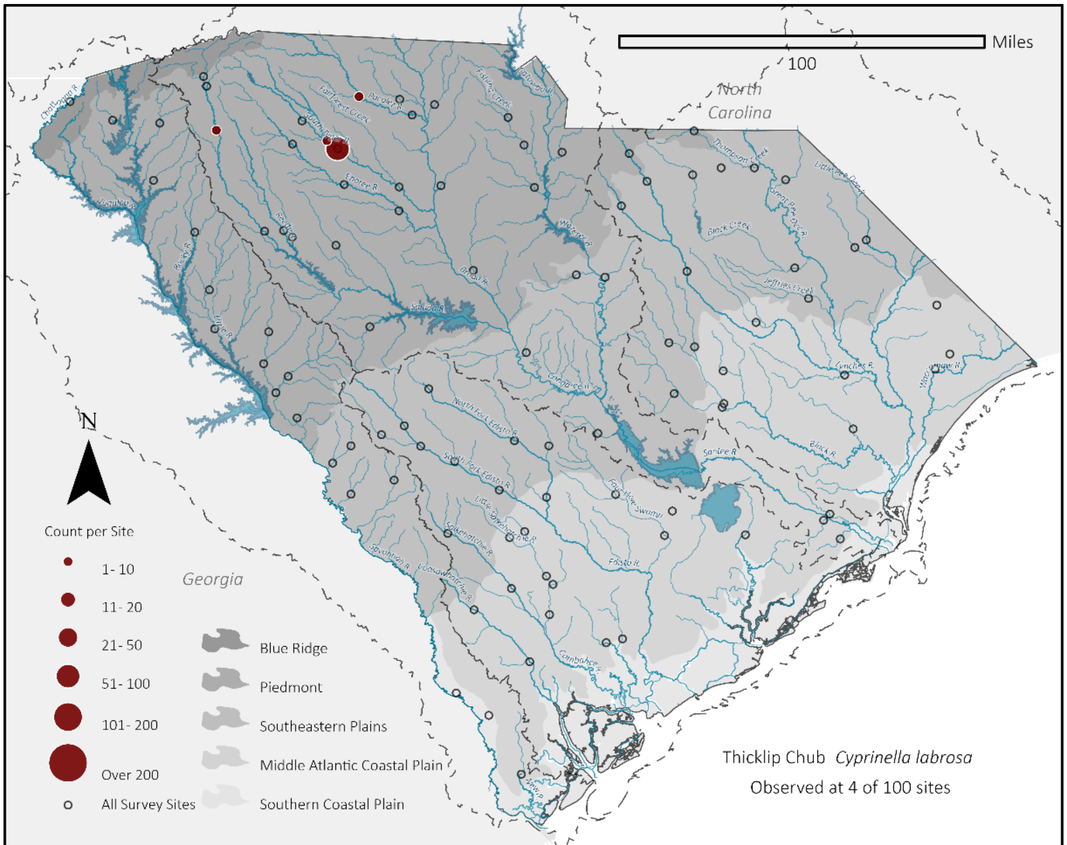
Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Whitetail Shiner *Cyprinella galactura*
Observed at 1 of 100 sites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Count per Site
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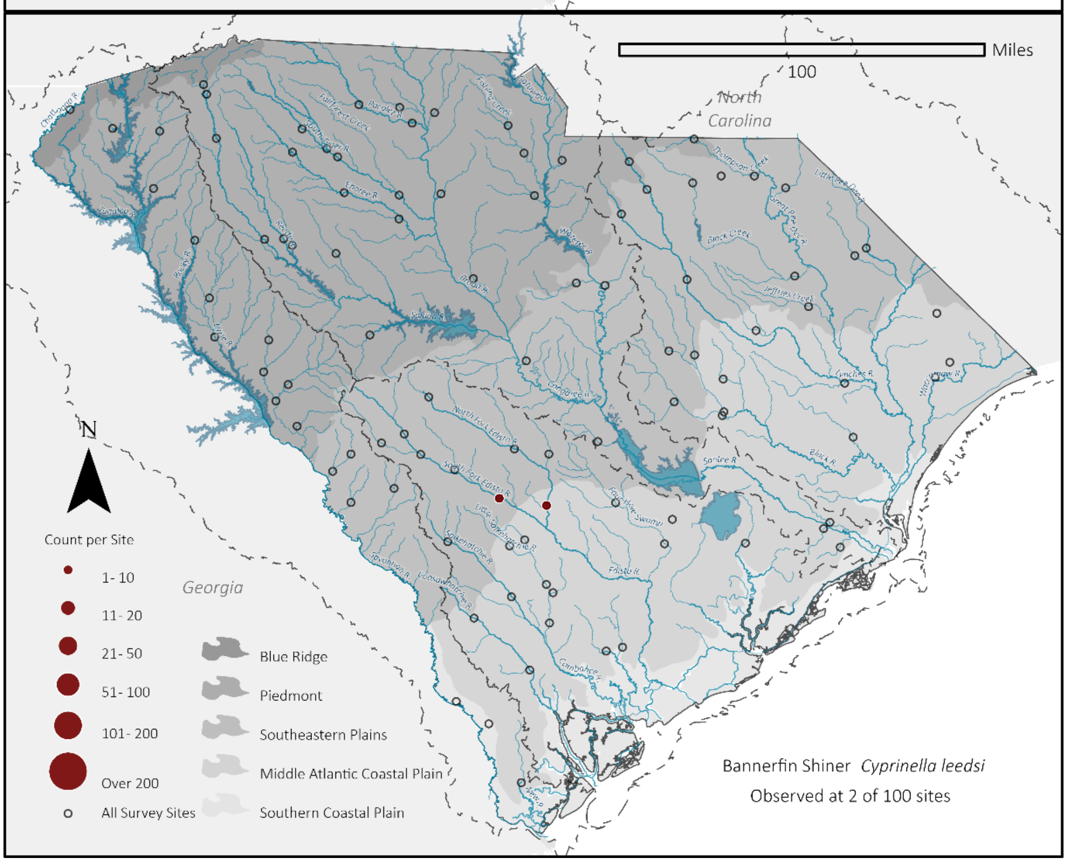
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Thicklip Chub *Cyprinella labrosa*
Observed at 4 of 100 sites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Count per Site
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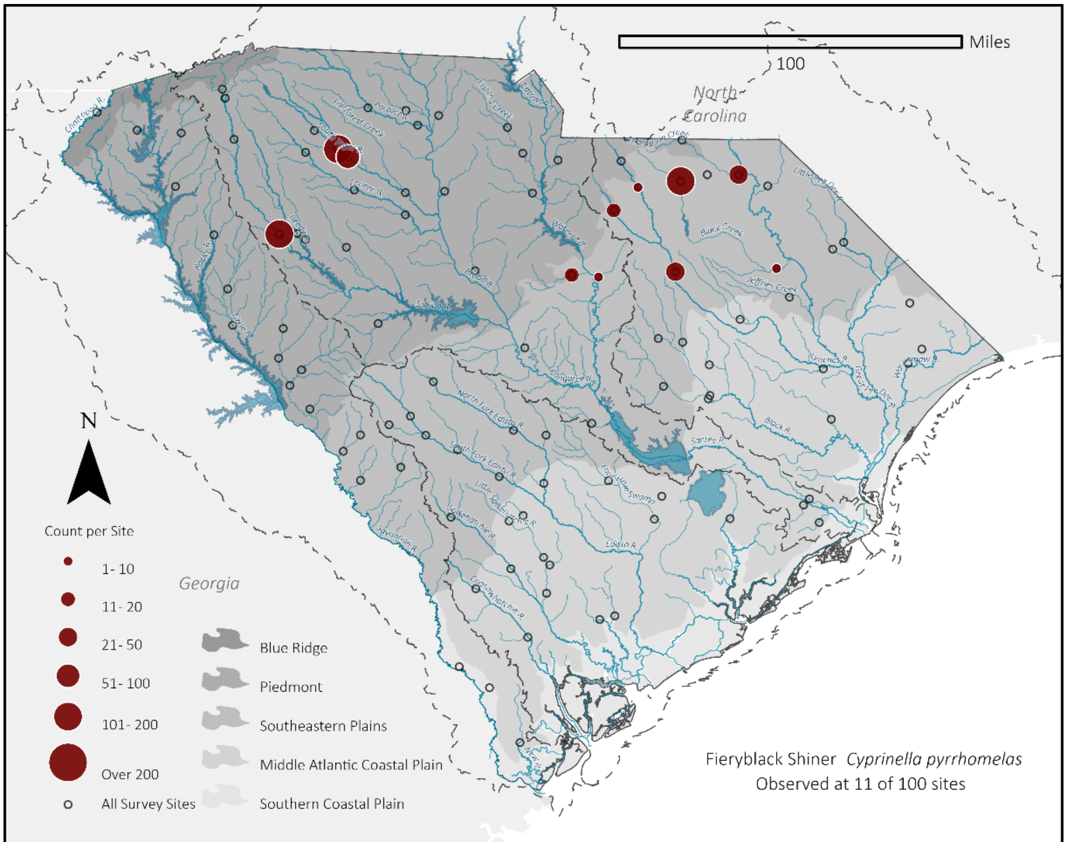
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Bannerfin Shiner *Cyprinella leedsi*
Observed at 2 of 100 sites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Count per Site
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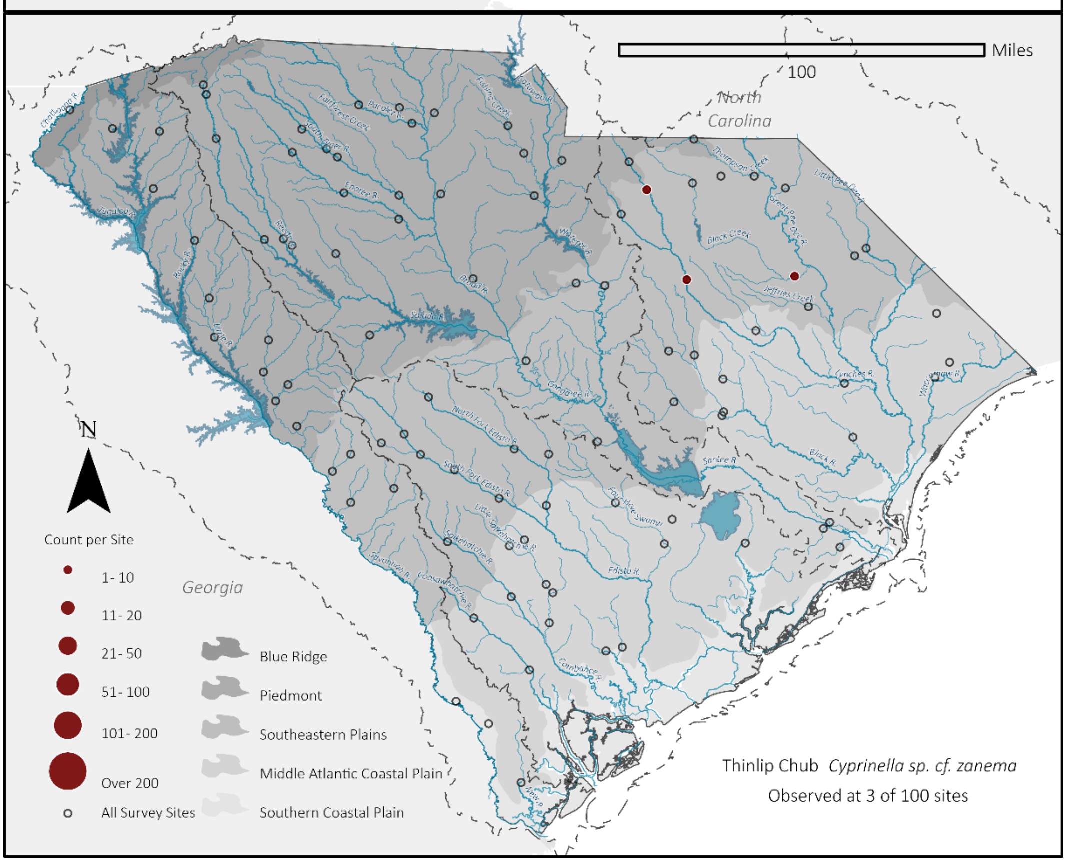
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Fieryblack Shiner *Cyprinella pyrrhomelas*
Observed at 11 of 100 sites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Georgia
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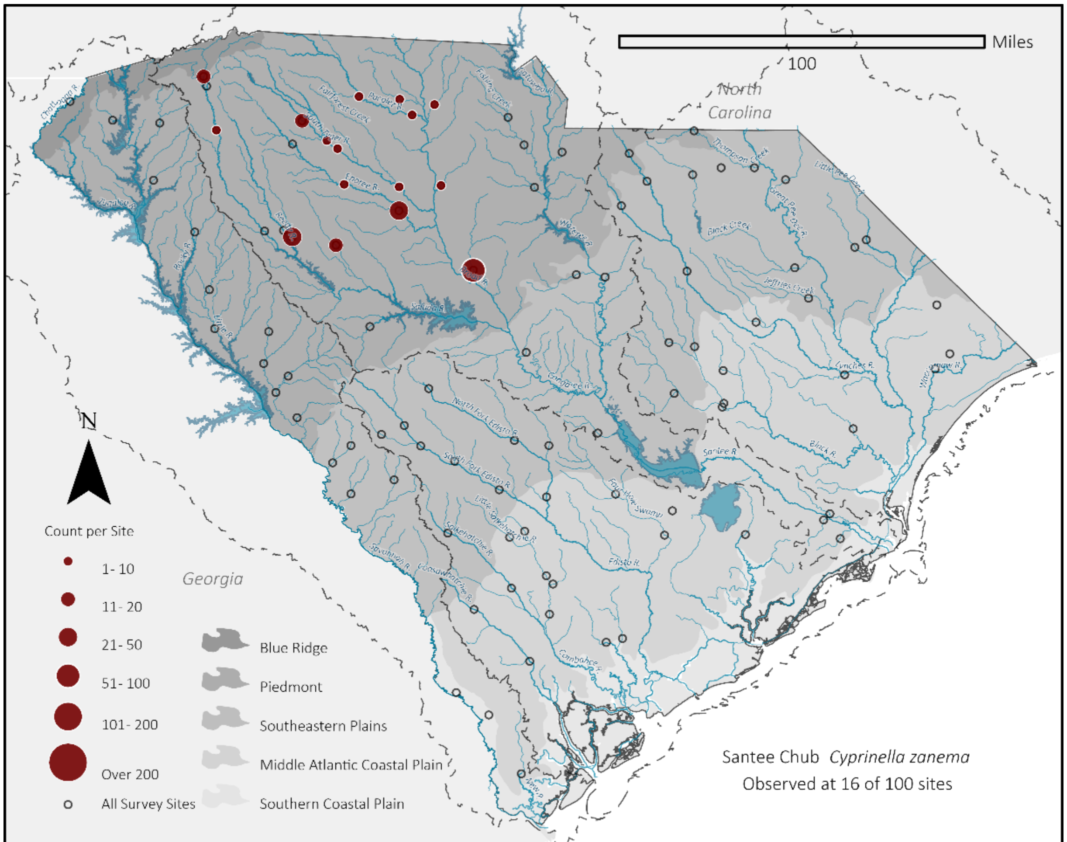
Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Thinlip Chub *Cyprinella sp. cf. zanema*
Observed at 3 of 100 sites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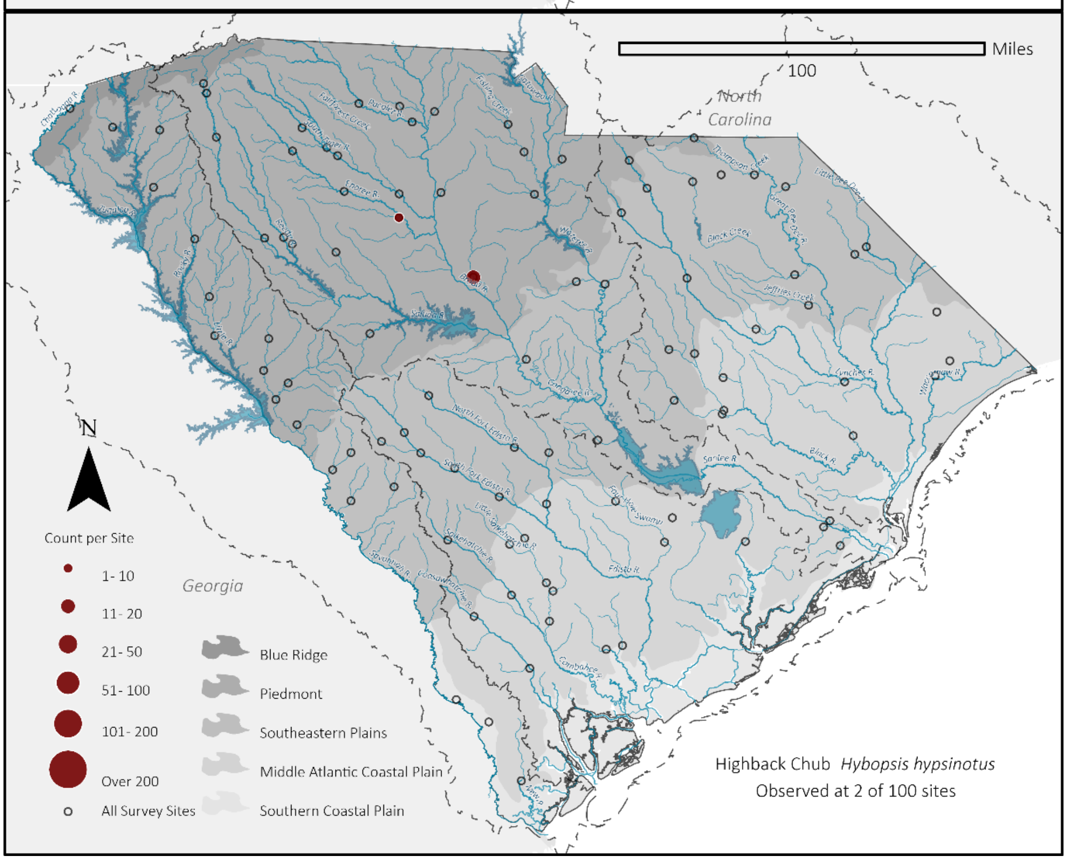
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Santee Chub *Cyprinella zanema*
Observed at 16 of 100 sites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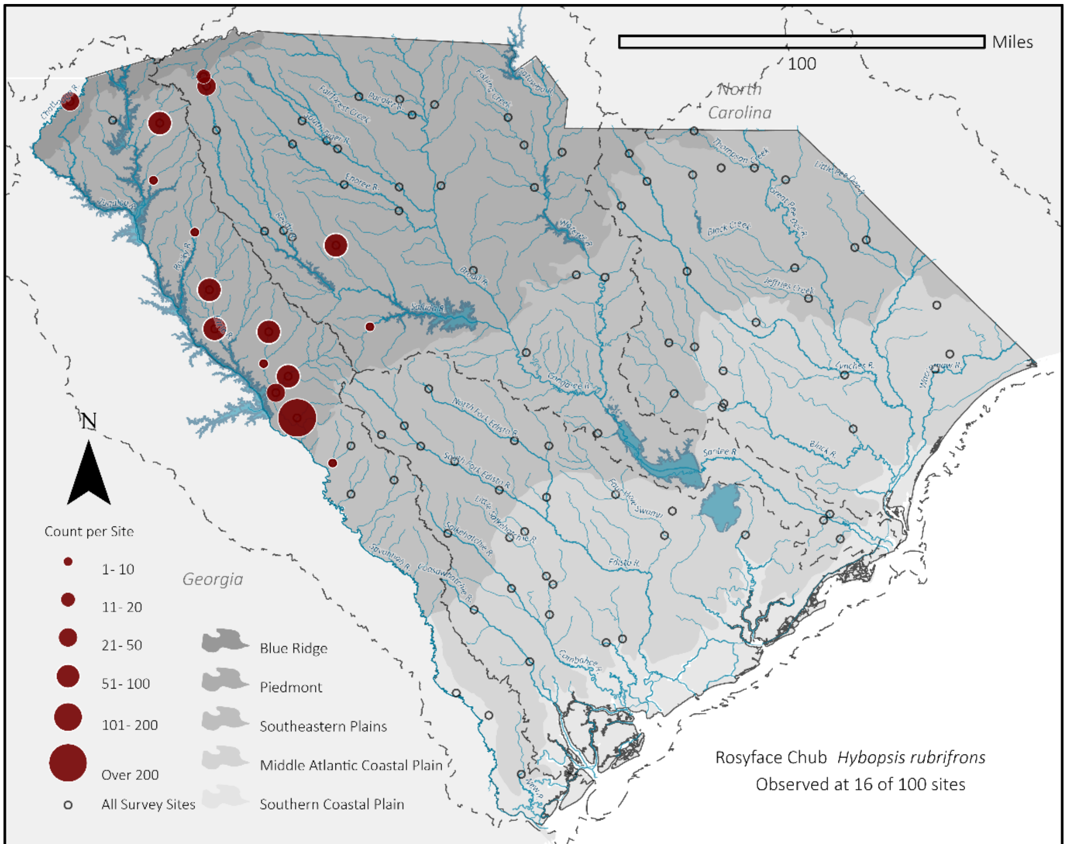
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Highback Chub *Hybopsis hypsinotus*
Observed at 2 of 100 sites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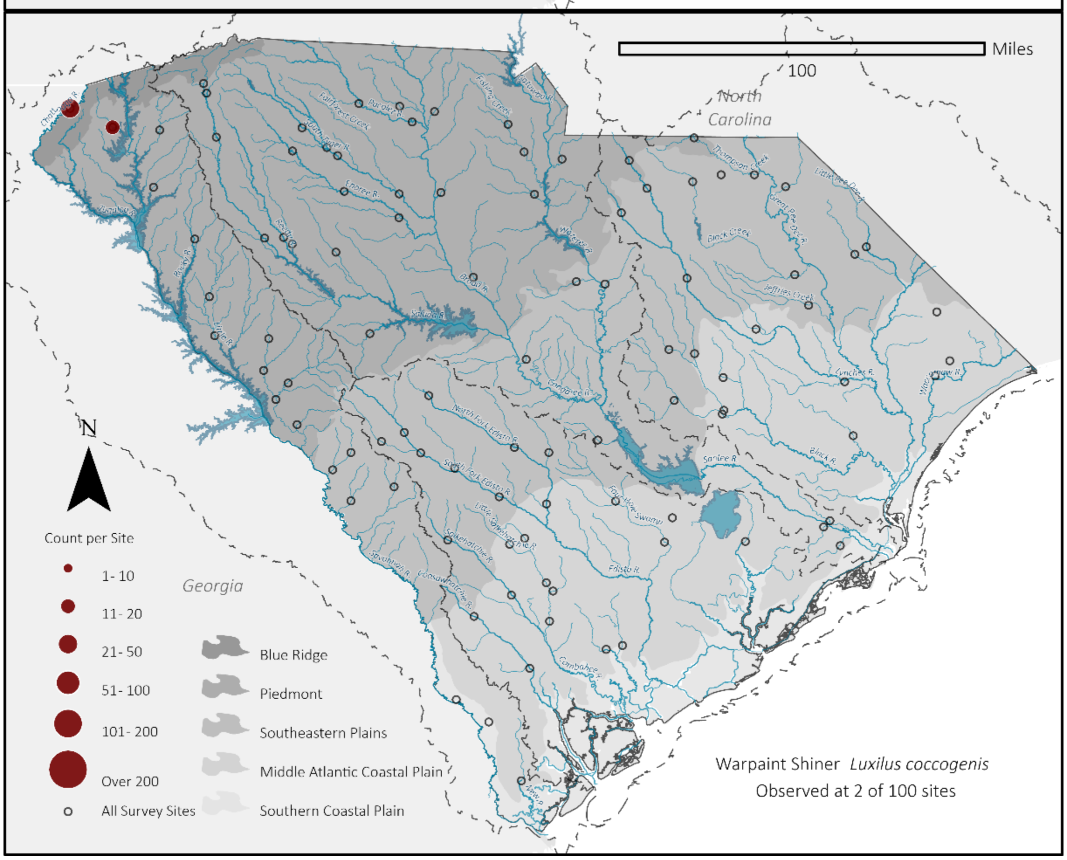
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Rosyface Chub *Hybopsis rubrifrons*
Observed at 16 of 100 sites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101- 200
Over 200
All Survey Sites
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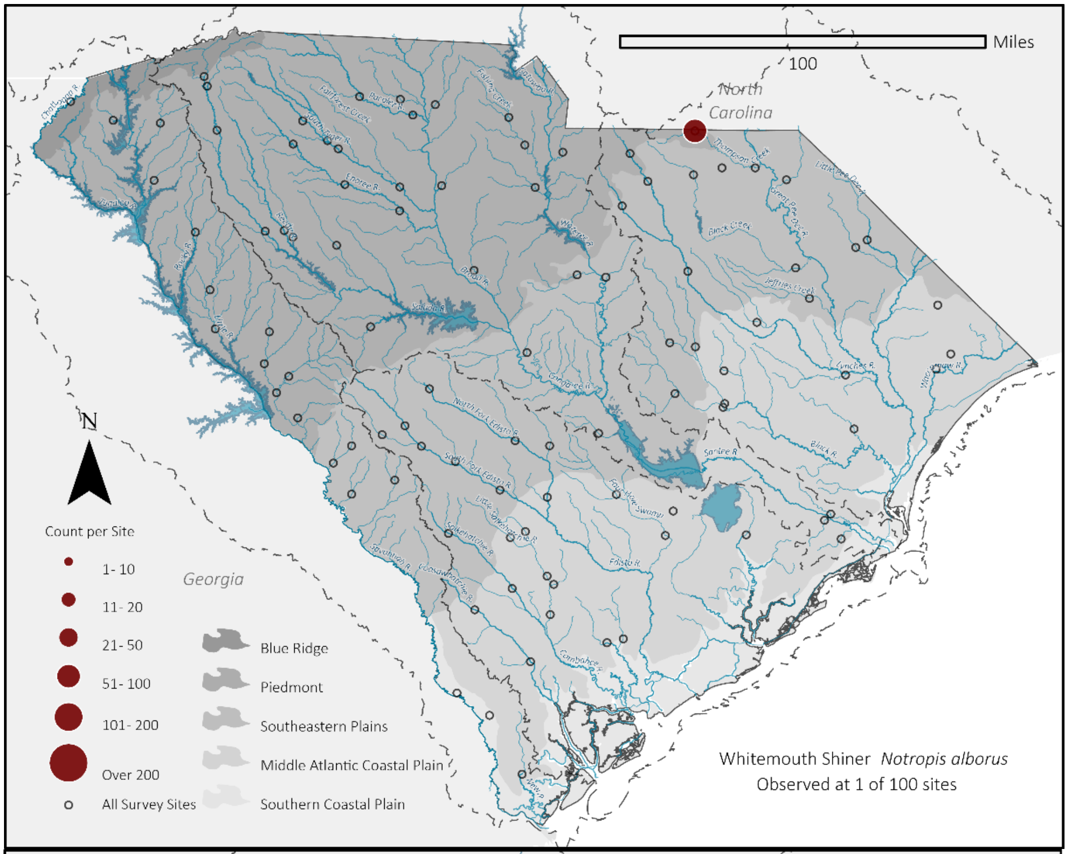
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Warpaint Shiner *Luxilus coccogenis*
Observed at 2 of 100 sites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51- 100
101- 200
Over 200
All Survey Sites
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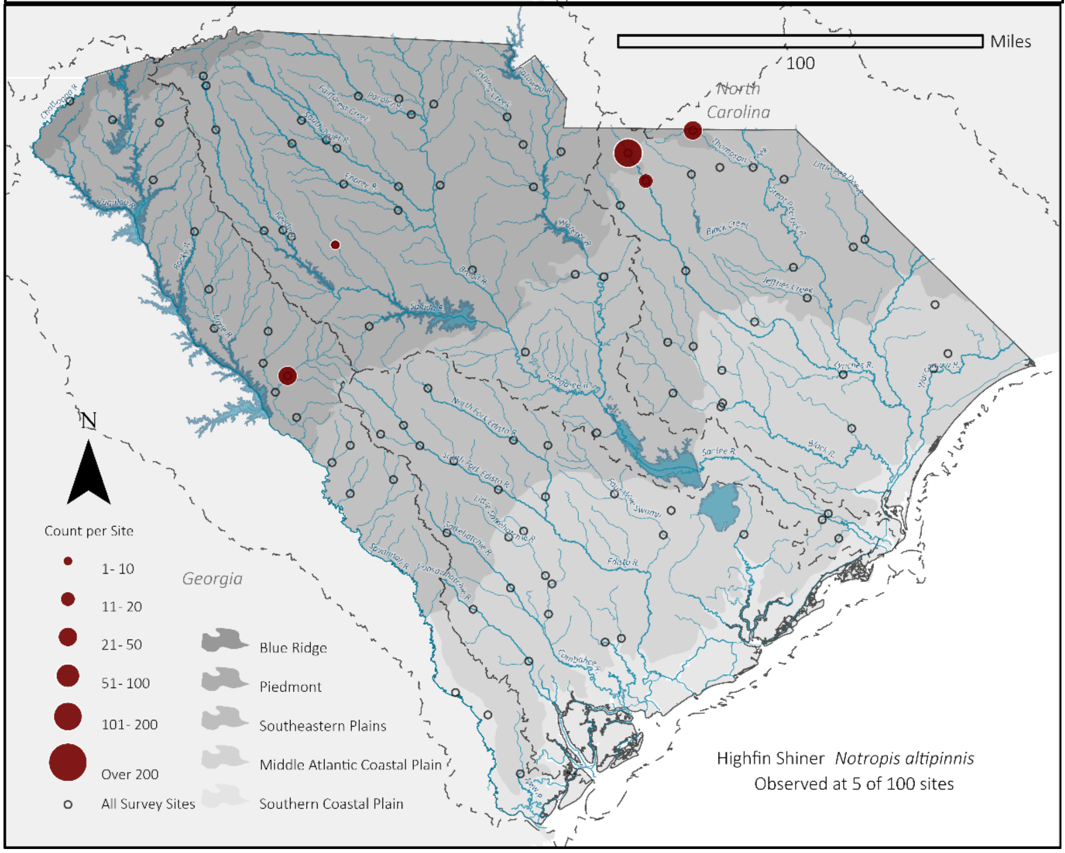
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Whitemouth Shiner *Notropis alborus*
Observed at 1 of 100 sites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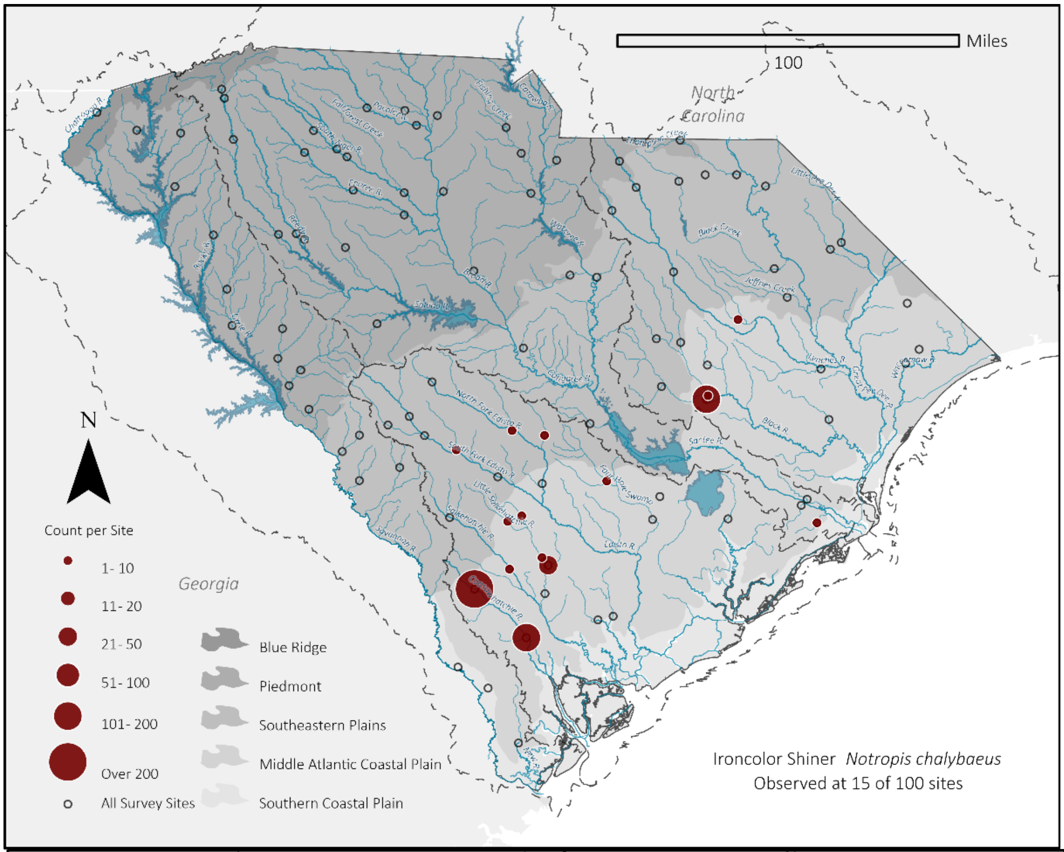
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Highfin Shiner *Notropis altipinnis*
Observed at 5 of 100 sites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Georgia
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Count per Site
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11- 20
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51- 100
101- 200
Over 200
All Survey Sites
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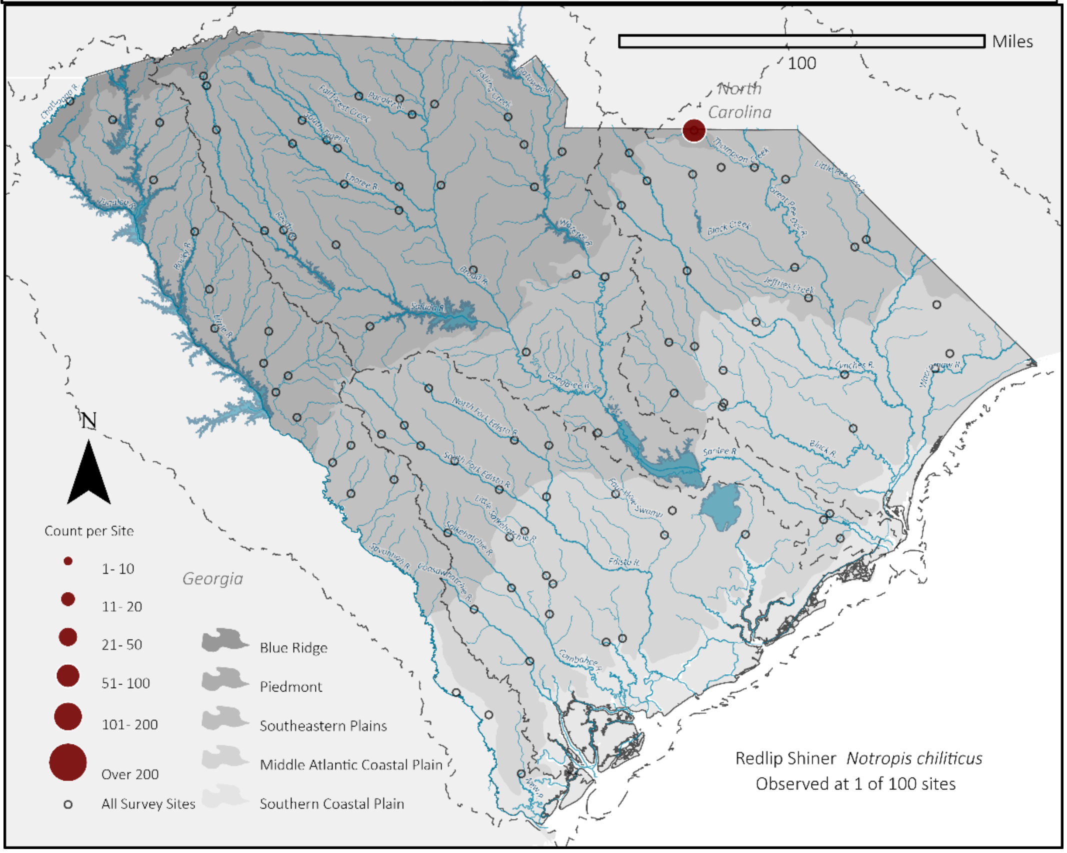
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Ironcolor Shiner *Notropis chalybaeus*
Observed at 15 of 100 sites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11- 20
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51- 100
101- 200
Over 200
All Survey Sites
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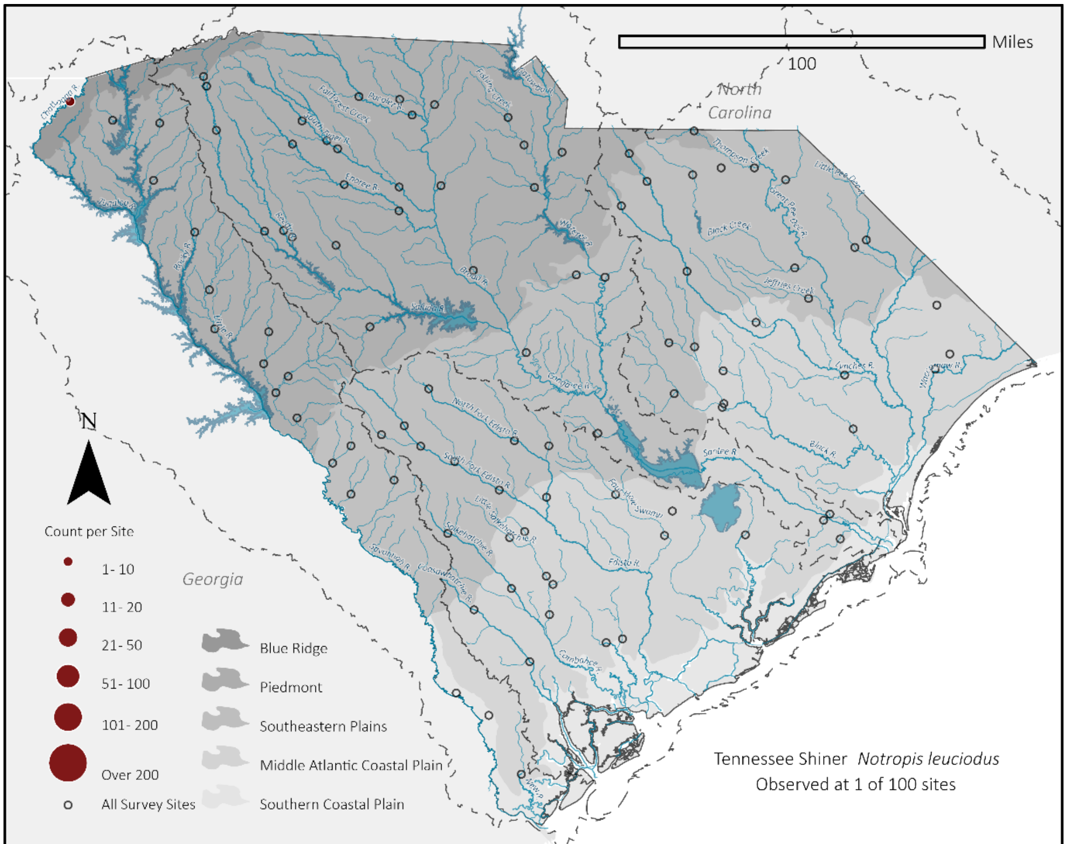
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Redlip Shiner *Notropis chiliticus*
Observed at 1 of 100 sites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Count per Site
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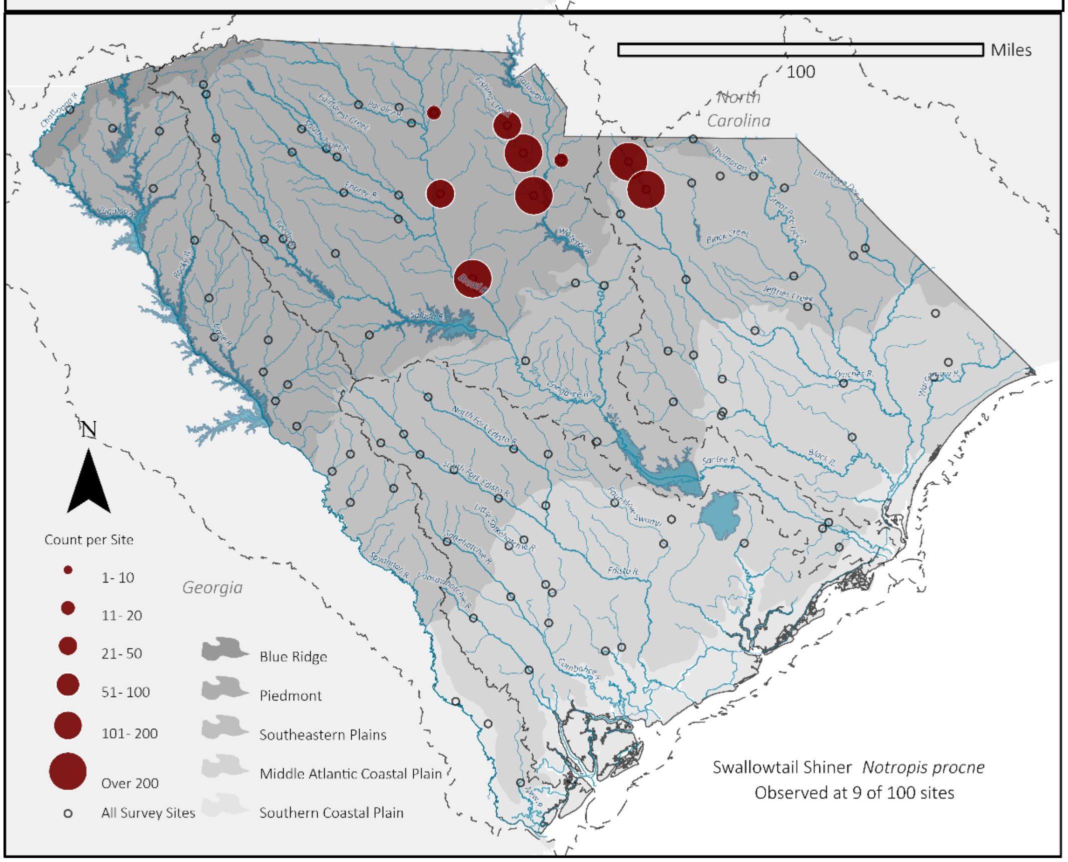
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Tennessee Shiner *Notropis leuciodus*
Observed at 1 of 100 sites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Georgia
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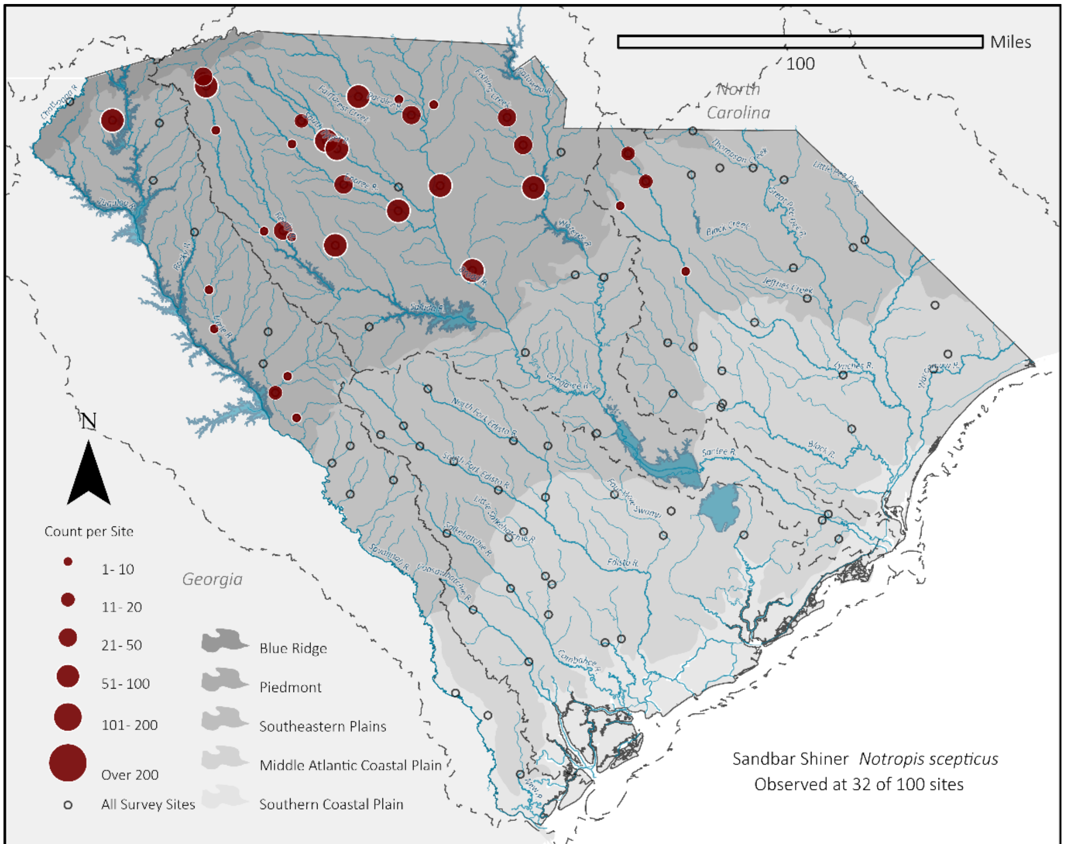
Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Swallowtail Shiner *Notropis procne*
Observed at 9 of 100 sites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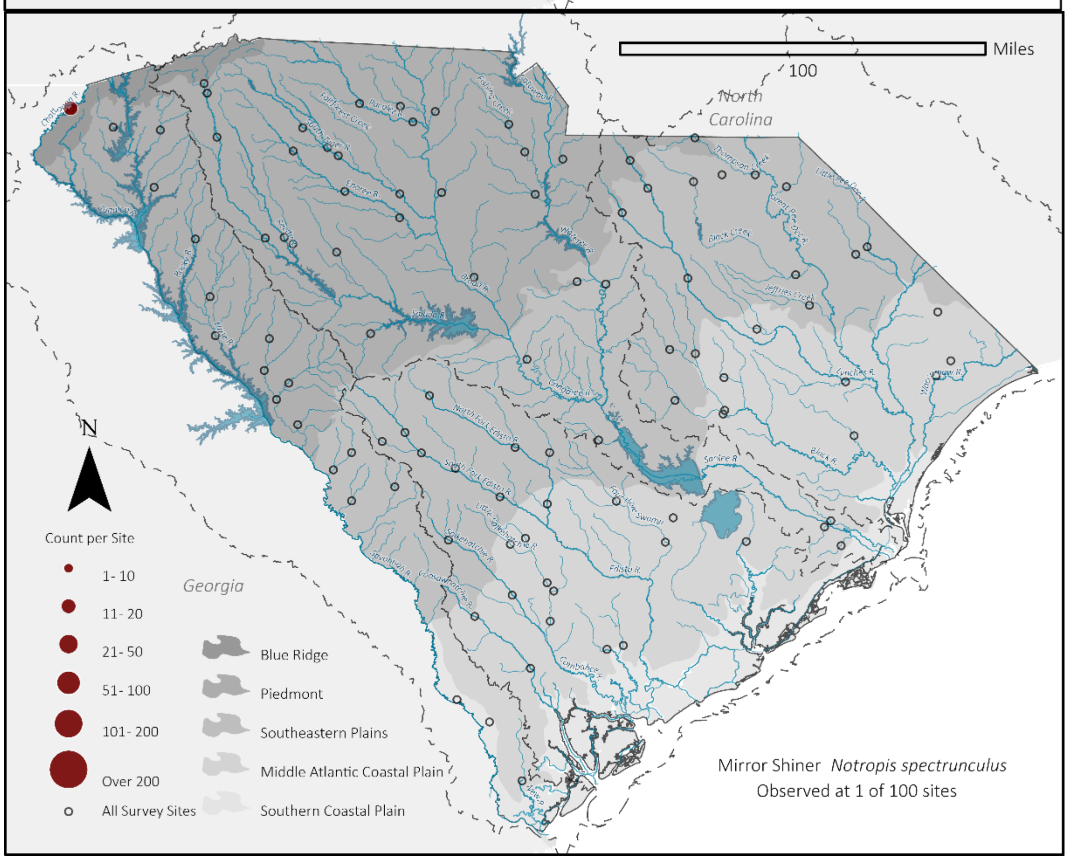
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Sandbar Shiner *Notropis scepticus*
Observed at 32 of 100 sites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Count per Site
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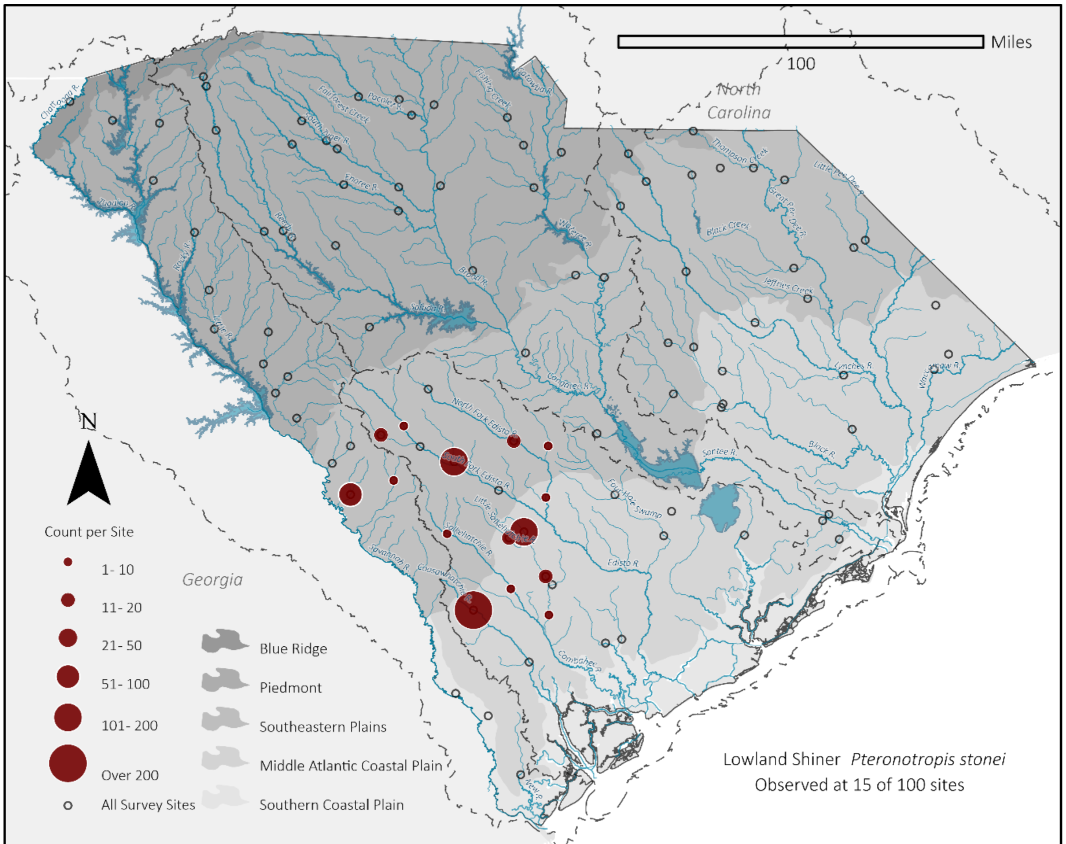
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Mirror Shiner *Notropis spectrunculus*
Observed at 1 of 100 sites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Count per Site
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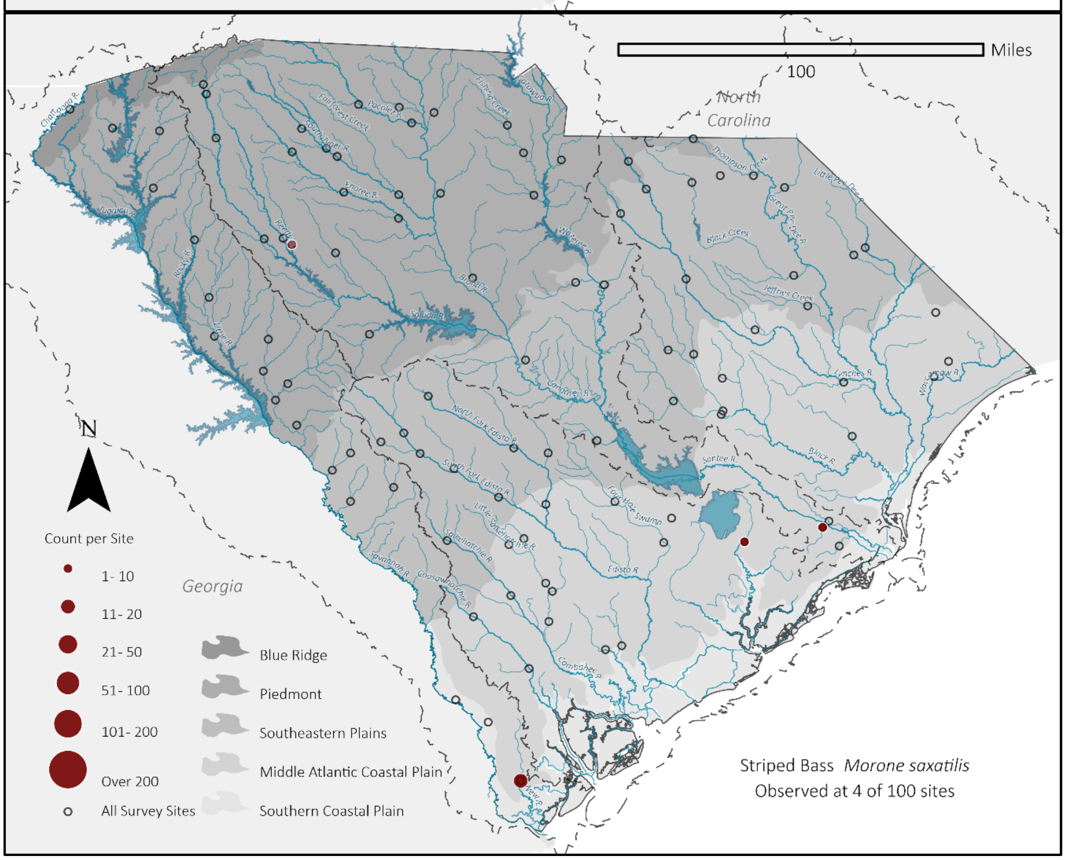
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Lowland Shiner *Pteronotropis stonei*
Observed at 15 of 100 sites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Georgia
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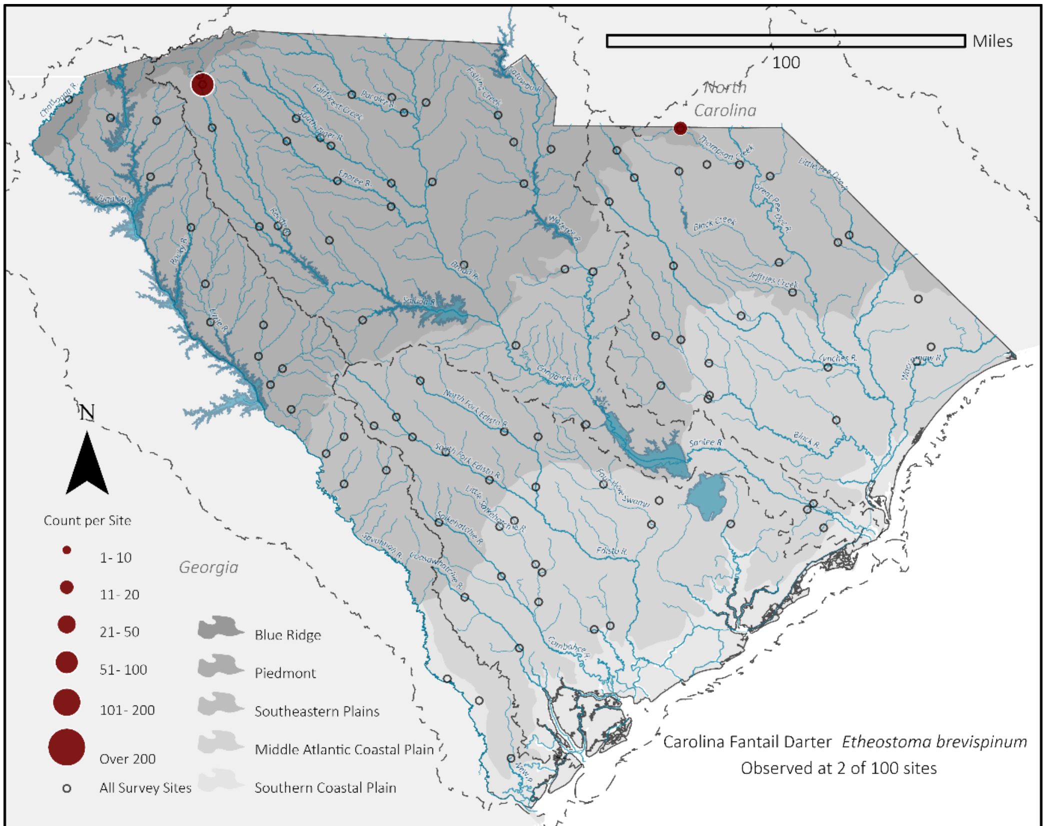
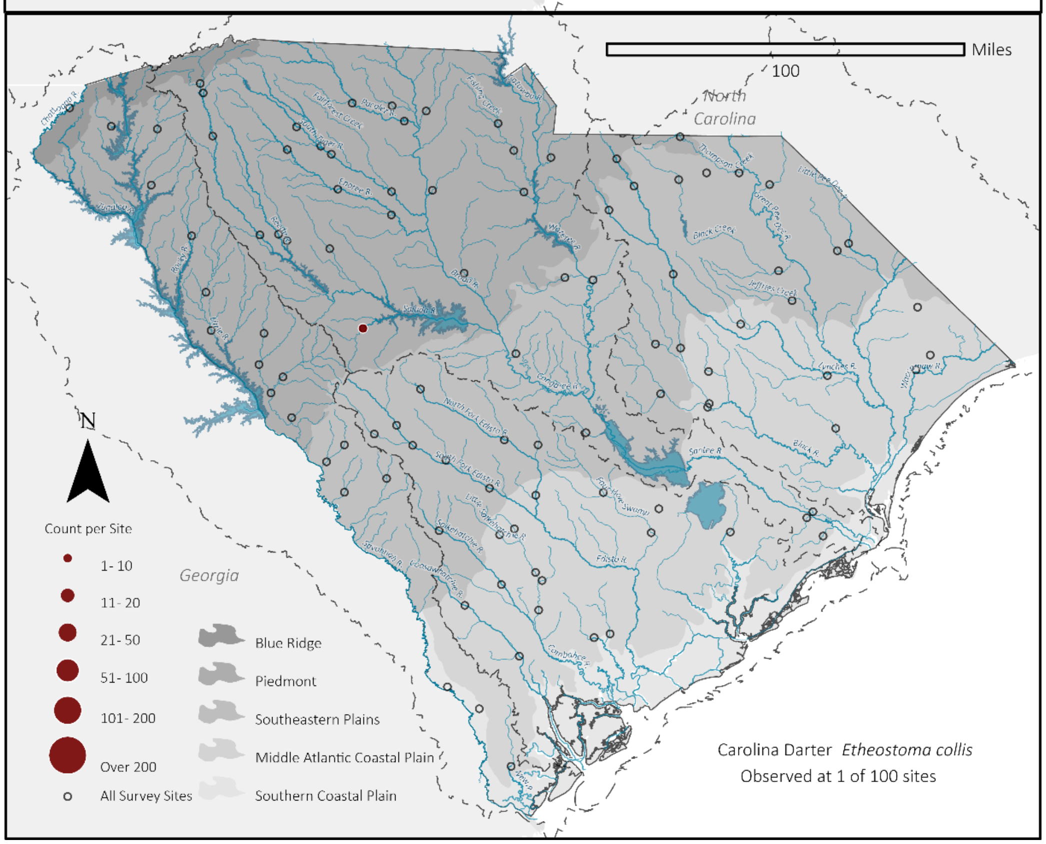
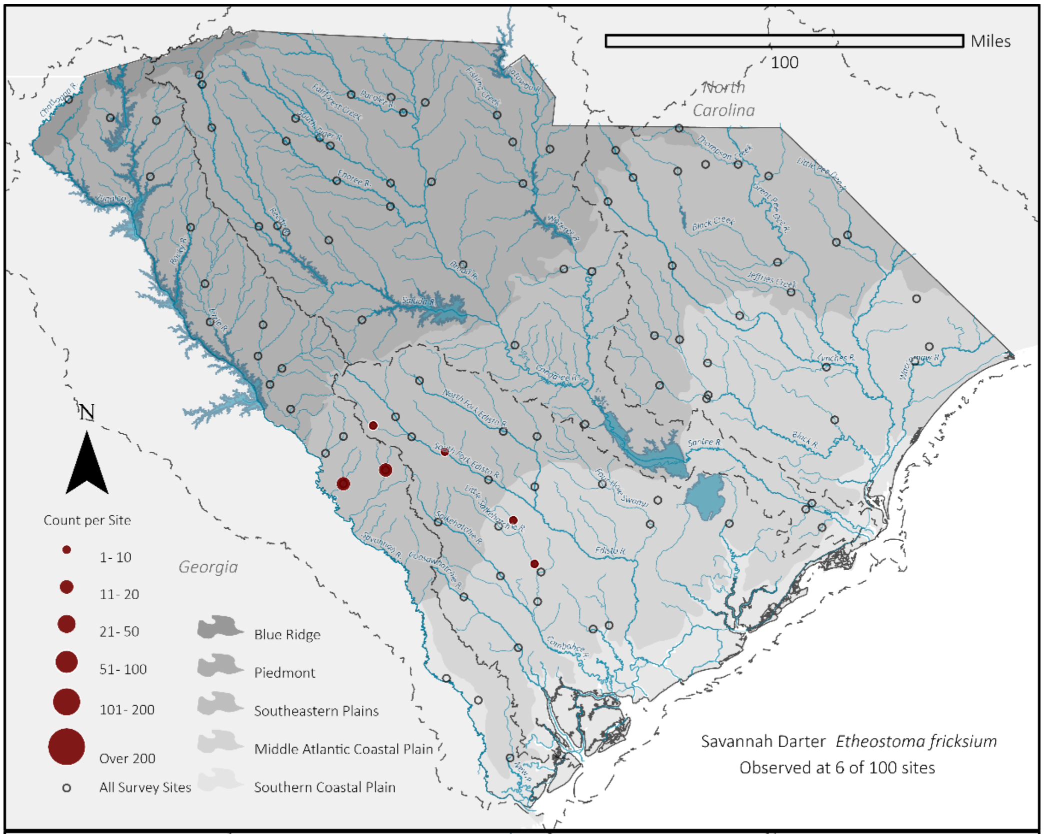
Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Striped Bass *Morone saxatilis*
Observed at 4 of 100 sites




Carolina Fantail Darter *Etheostoma brevispinum*
Observed at 2 of 100 sites




Carolina Darter *Etheostoma collis*
Observed at 1 of 100 sites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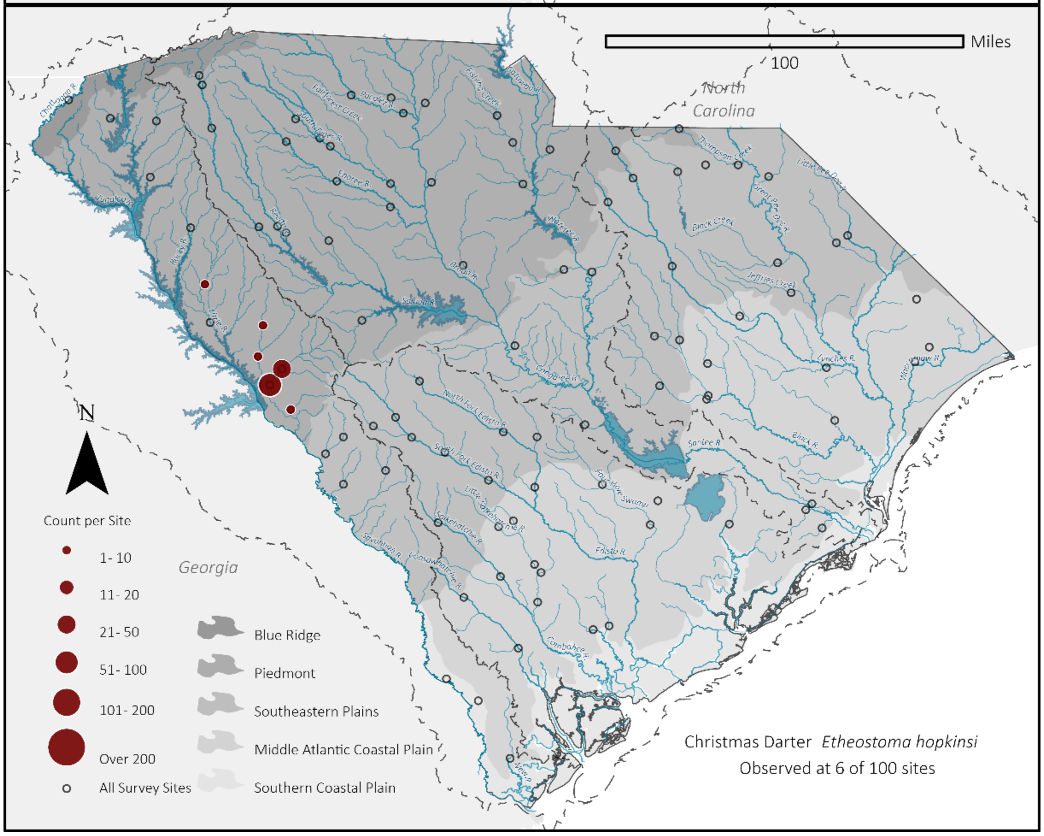
Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Savannah Darter *Etheostoma fricksium*
Observed at 6 of 100 sites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Count per Site
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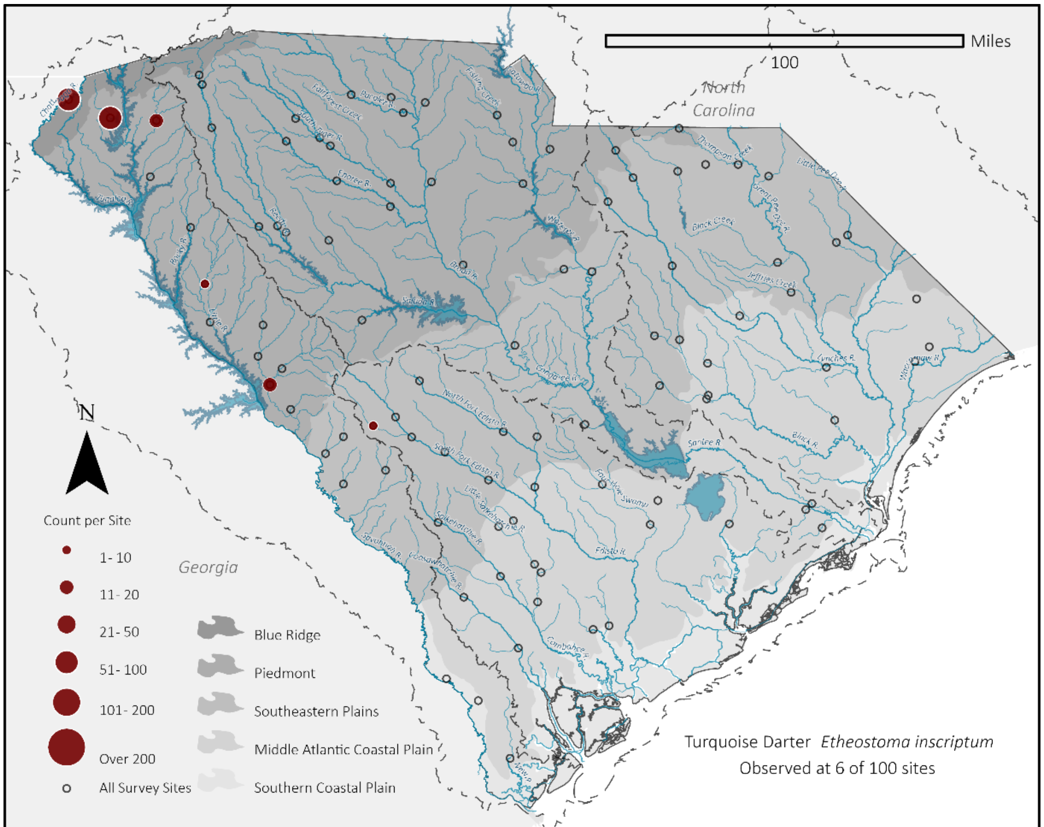
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Christmas Darter *Etheostoma hopkinsi*
Observed at 6 of 100 sites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Count per Site
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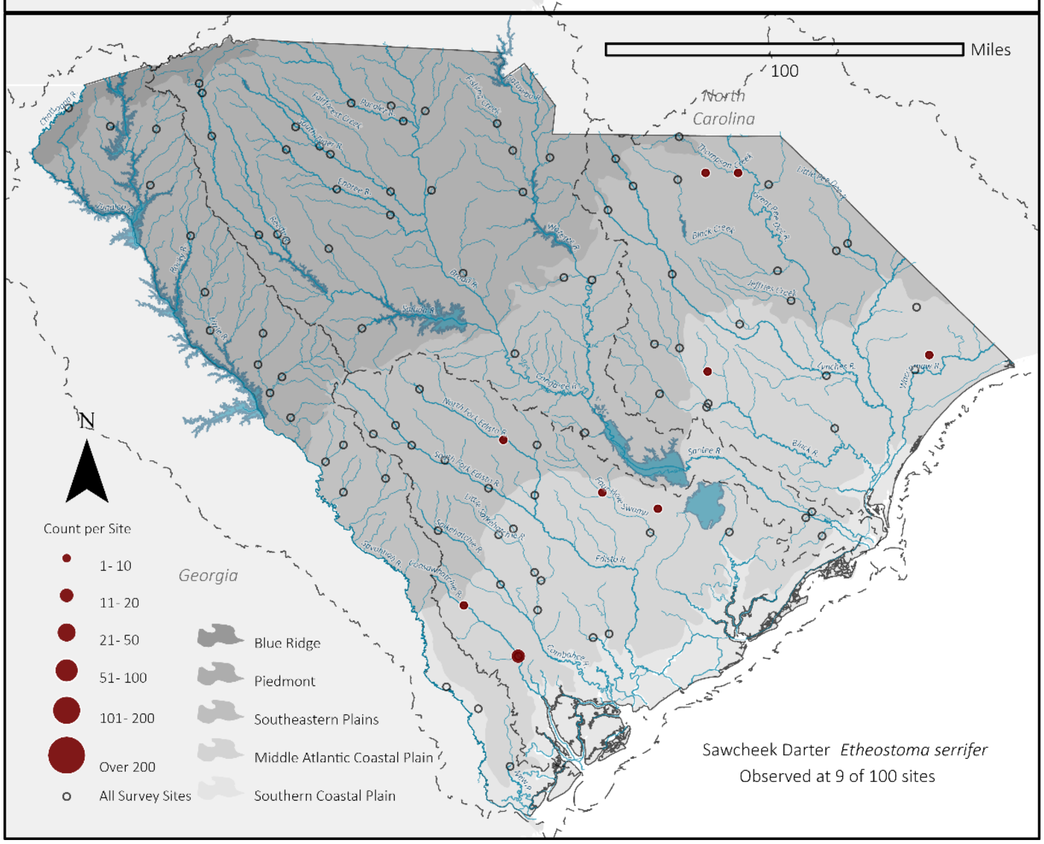
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Turquoise Darter *Etheostoma inscriptum*
Observed at 6 of 100 sites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11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
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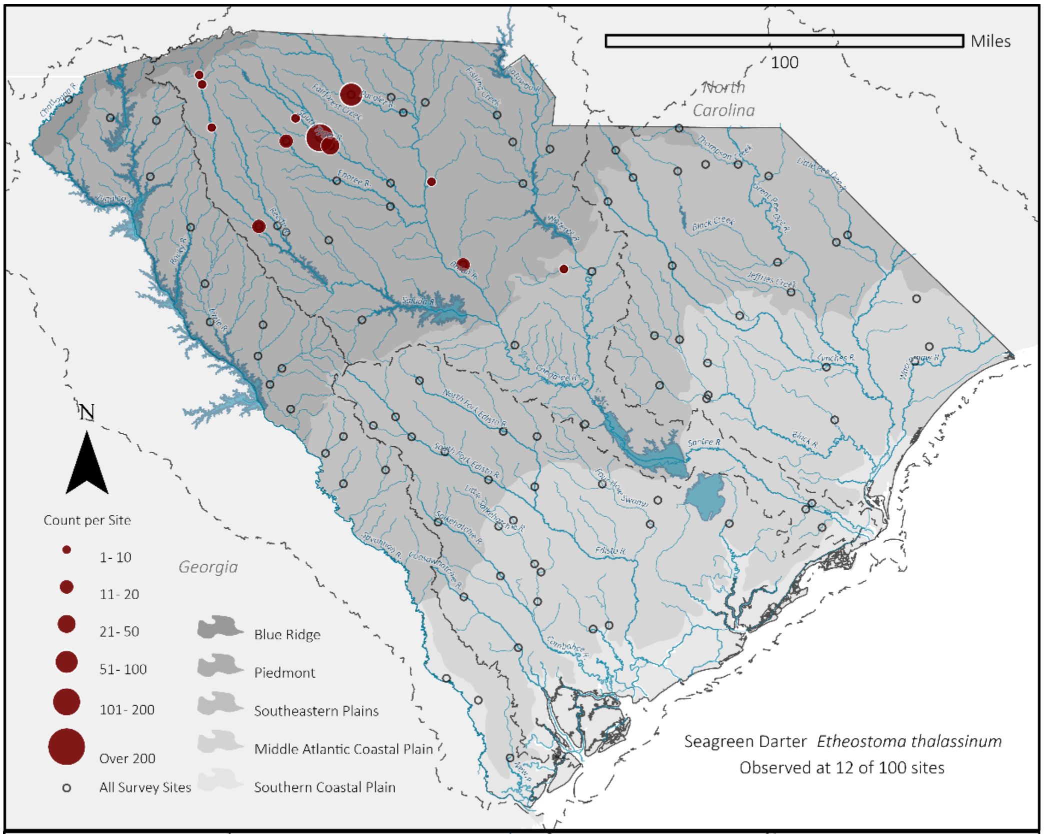
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Sawcheek Darter *Etheostoma serrifer*
Observed at 9 of 100 sites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Count per Site
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11- 20
21- 50
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101- 200
Over 200
All Survey Sites
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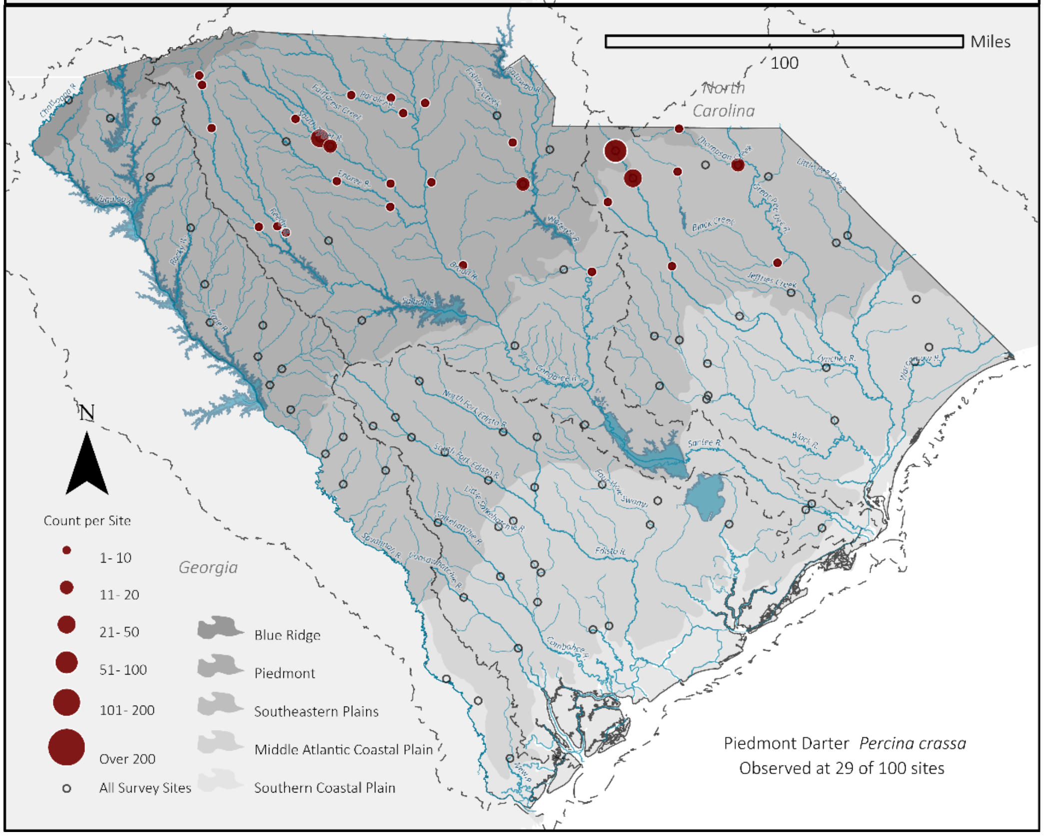
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Seagreen Darter *Etheostoma thalassinum*
Observed at 12 of 100 sites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Count per Site
1- 10
11- 20
21- 50
51- 100
101- 200
Over 200
All Survey Sites
Blue Ridge
Piedmont
Southeastern Plains
Middle Atlantic Coastal Plain
Southern Coastal Plain
Piedmont Darter *Percina crassa*
Observed at 29 of 100 sites