

Flow-Ecology Relationships

Saluda RBC, September 20th, 2023

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Biotic Index

- People cannot be in the stream all the time
- Fish can
- Biotic indices describe an aspect of a community



Biotic Index

Species Richness



Illustration credit: Virgil Beck (yellow bullhead); Ellen Edmonson & Hugh Chrisp (Northern hogsucker); and Joseph R. Tomelleri (yellowfin shiner)

Biotic Index






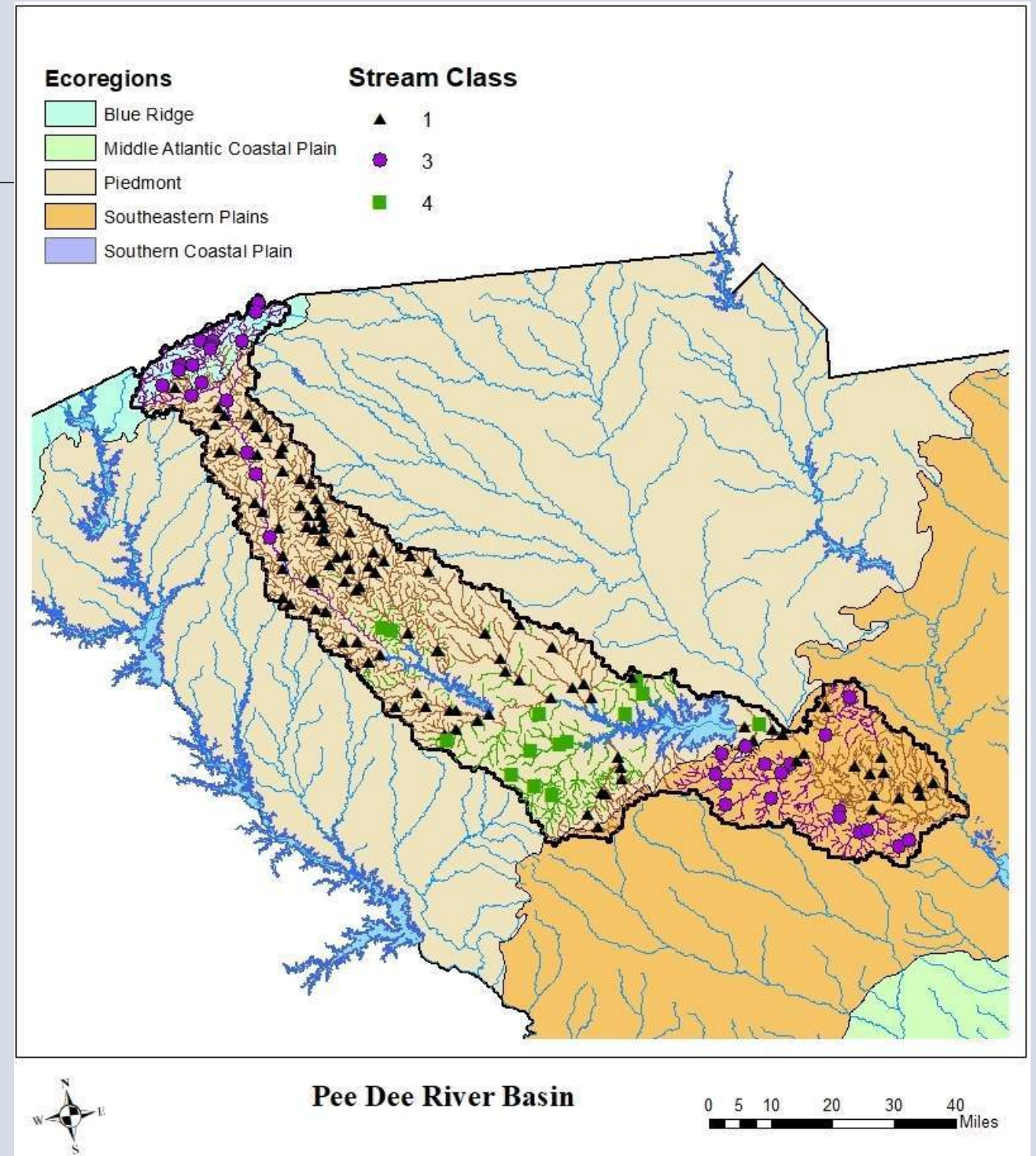
Tolerant species



Illustration credit: Duane River (Common Carp) and Joseph R. Tomelleri (Green Sunfish)

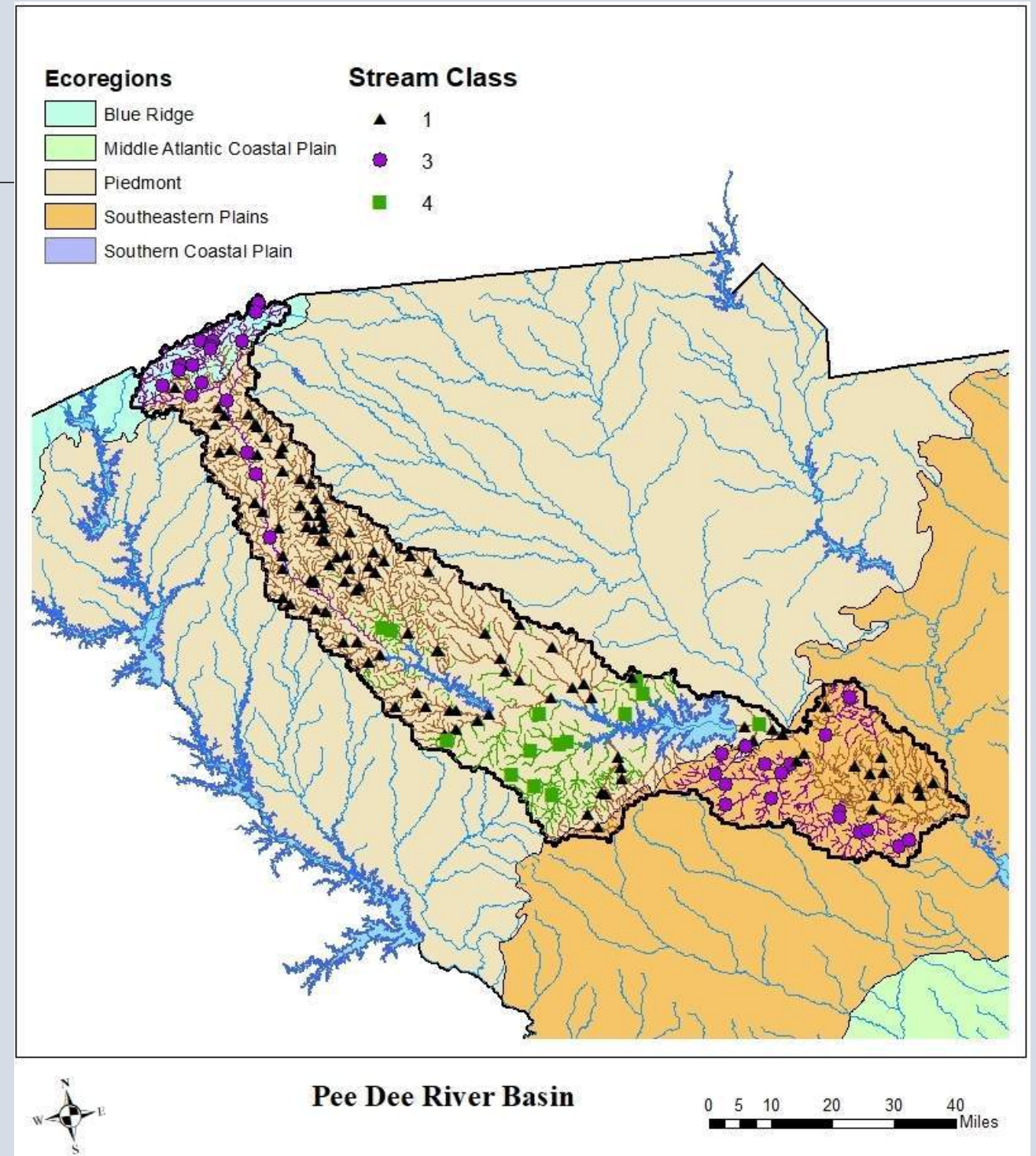
Ecoregions

-  • Blue Ridge: Mountainous
-  • Piedmont: Rolling hills
-  • Southeastern plains: Flatter, well drained sandy soils

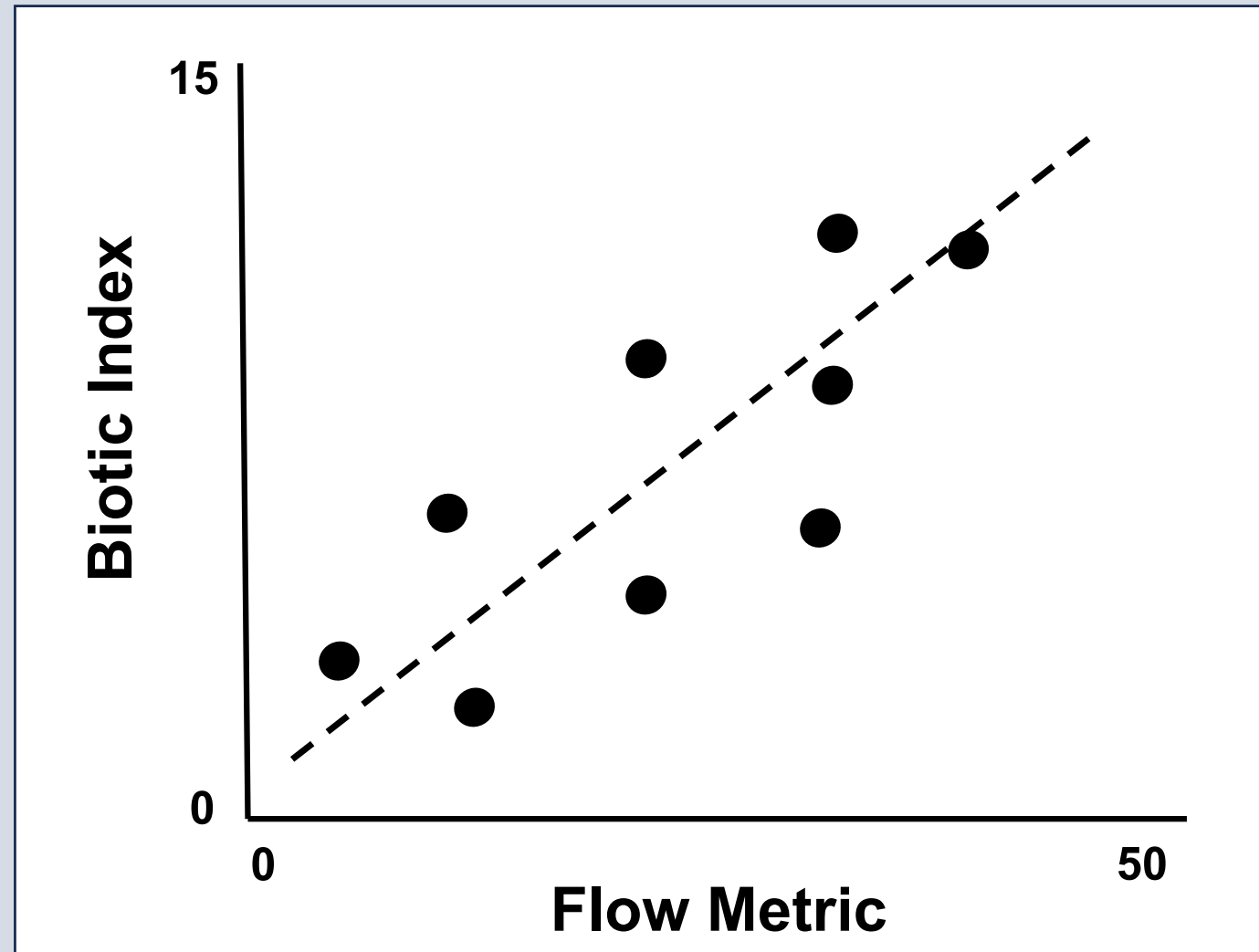


Stream Classes

- ▲ • 1: Perennial runoff: moderately stable flow and distinct seasonal extremes
- • 3: Stable baseflow: high precipitation, sustained high baseflows, and moderately high run-off
- • 4: Perennial flashy: moderately stable flow with high flow variability



Flow-ecology relationships



Use of the relationships



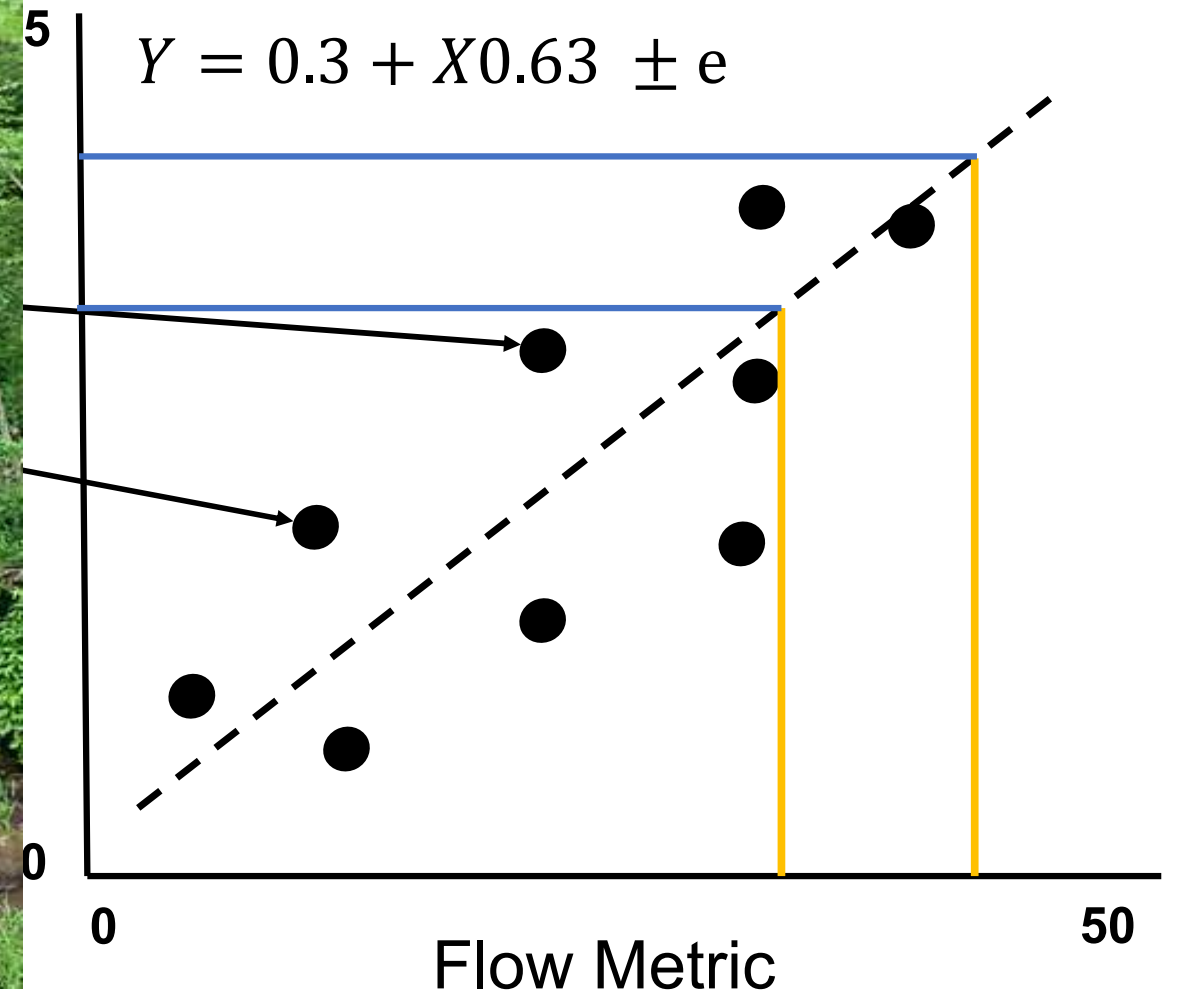
Le



Southeastern Plain

Middle Atlantic Coastal Plain

Piedmont



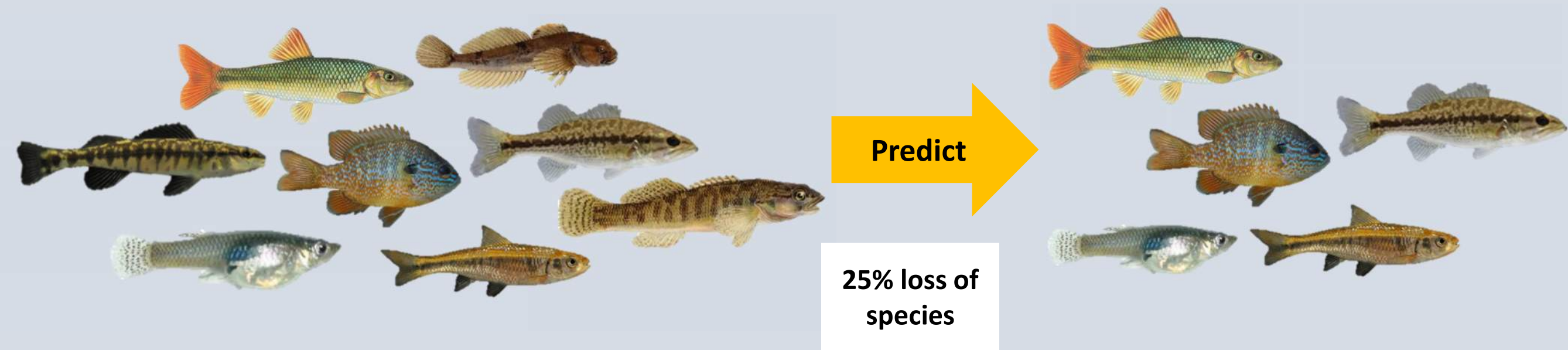
Future Planning

- Model future flow under 4 demand scenarios using SWAM
 - Unimpaired flow
 - Medium Development 2070
 - High Development 2070
 - Permitted and Registered (“Full”) Demand 2070
- Predict changes to biotic indices based on SWAM results.

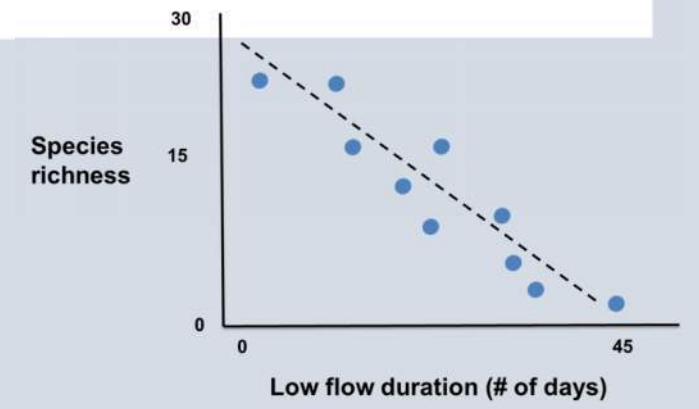
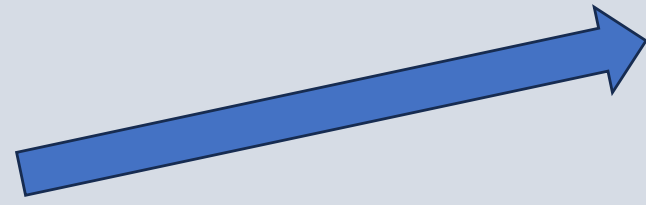
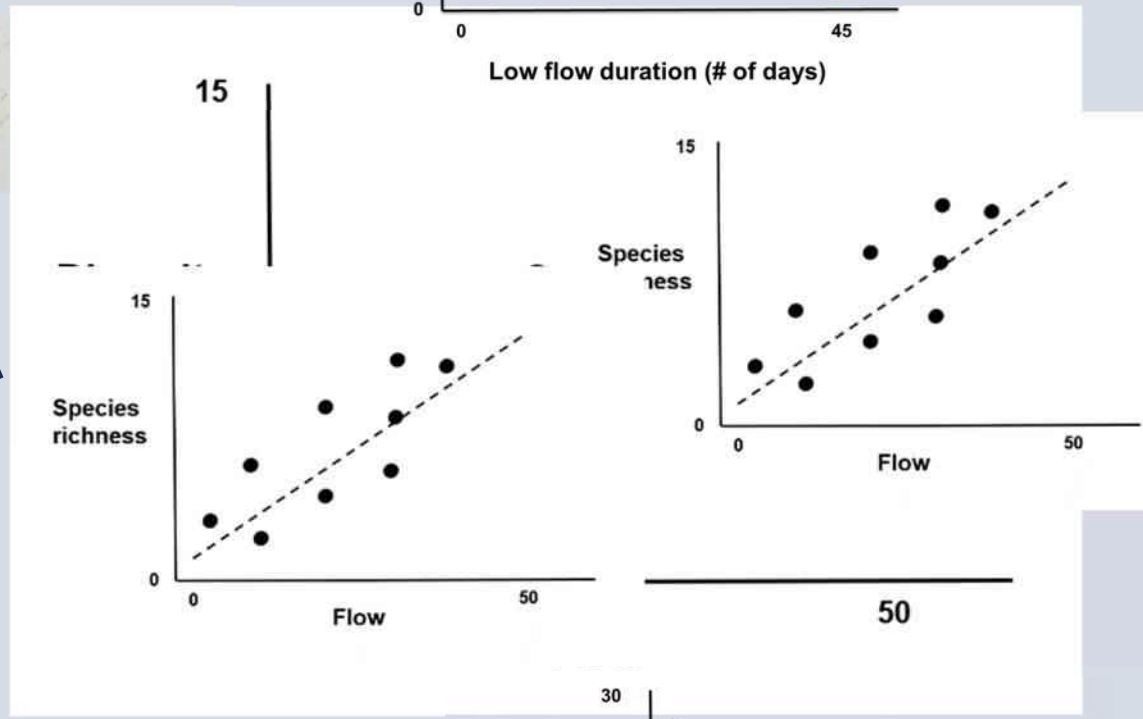
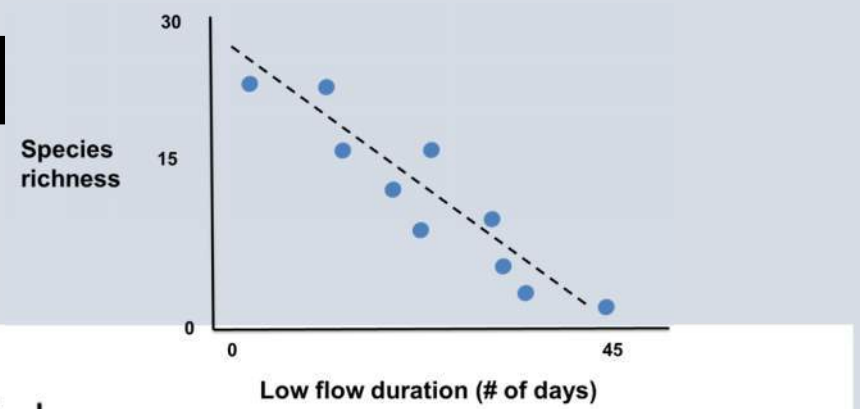
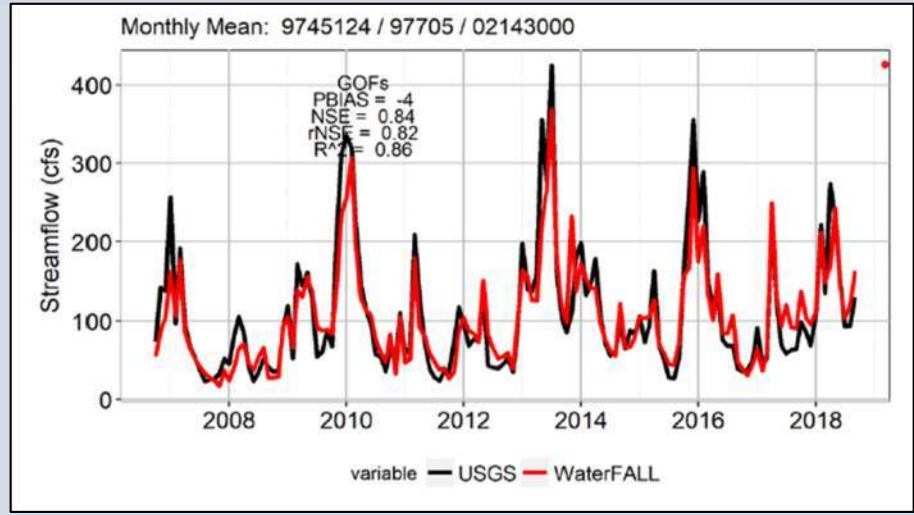
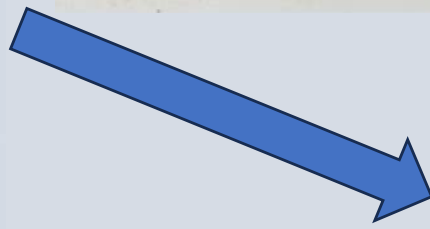
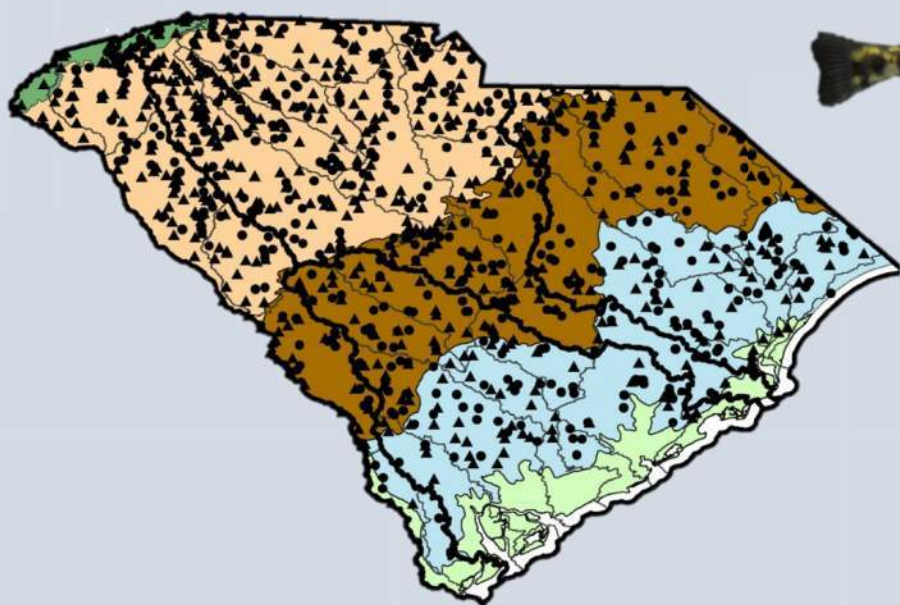


Future Planning

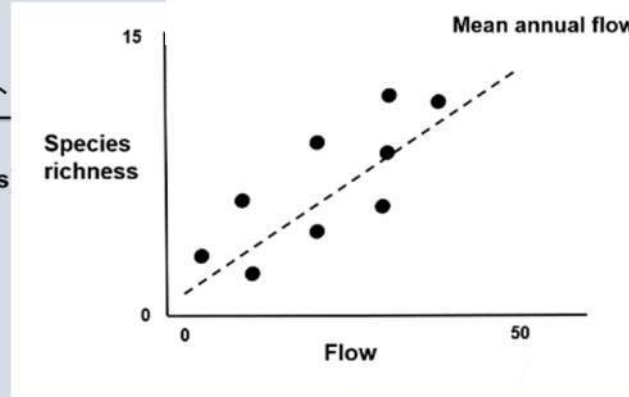
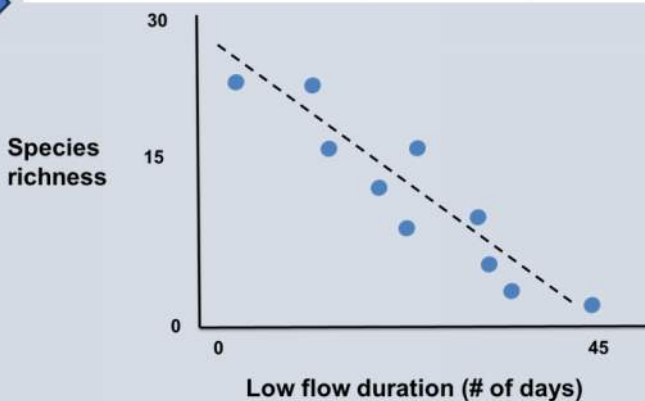
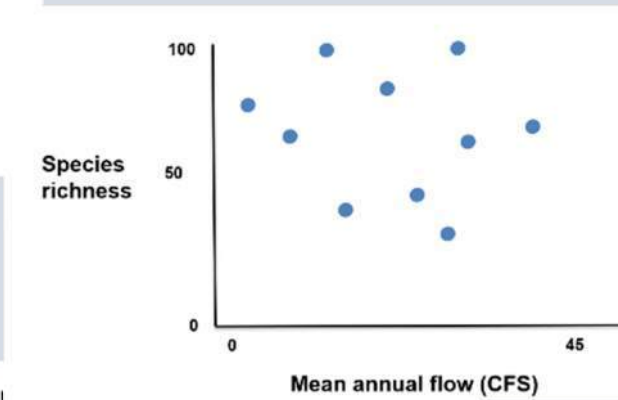
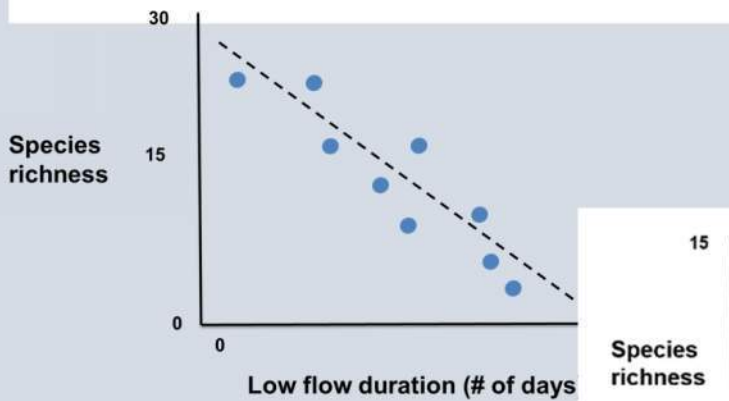
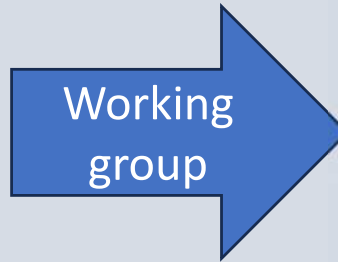
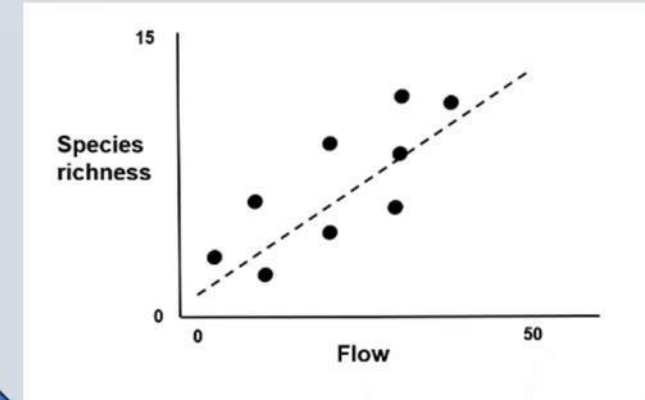
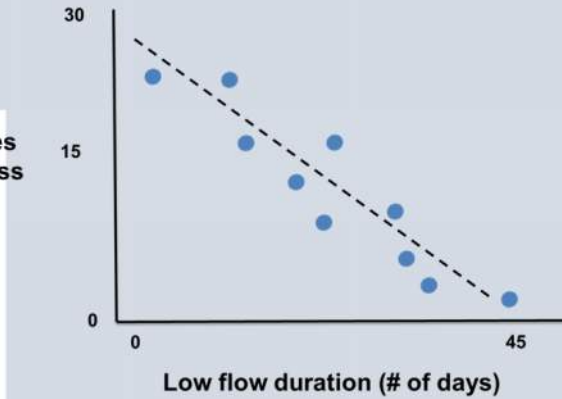
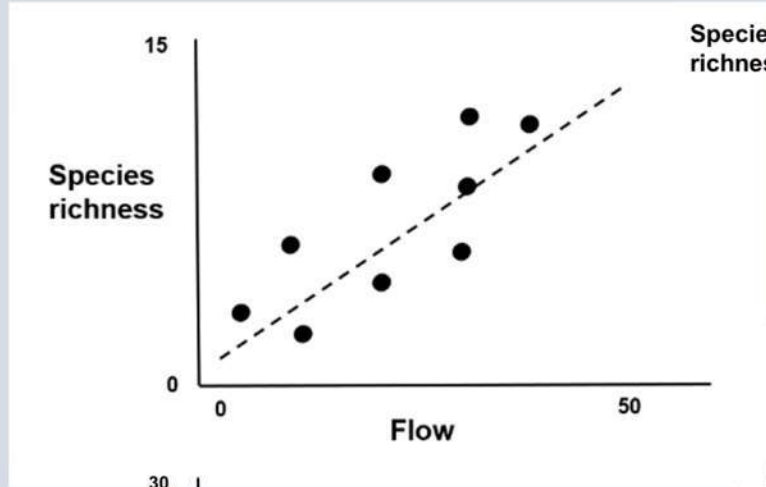
- Consider a water use scenario with a 40% reduction in flow



How will this work? Step 1



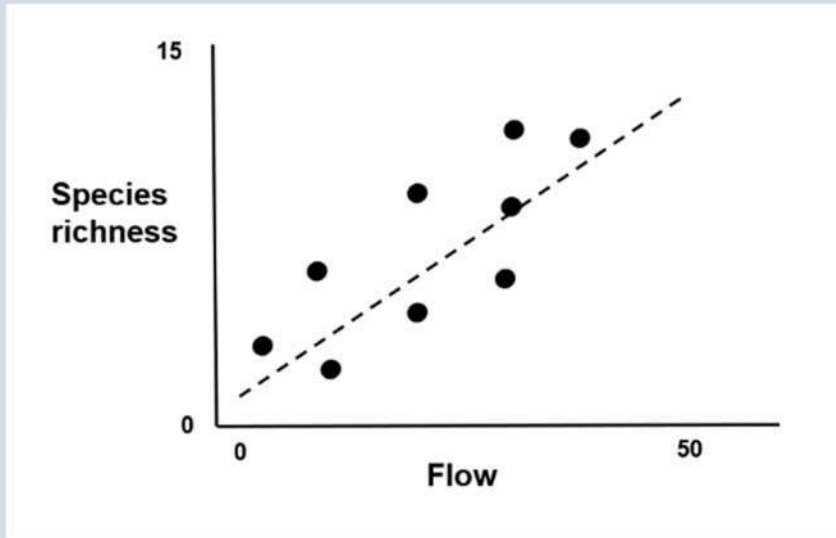
How will this work? Step 2



Ask RBC for a vote

How will this work? Step 3

Selected relationships



View SWAM results in a biological context

Scenario	Loss of species	Risk
MD	15%	Med
HD	25%	High

SWAM results

Scenario	Current	Predicted	% Change
MD	100	80	20%
HD	100	60	40%

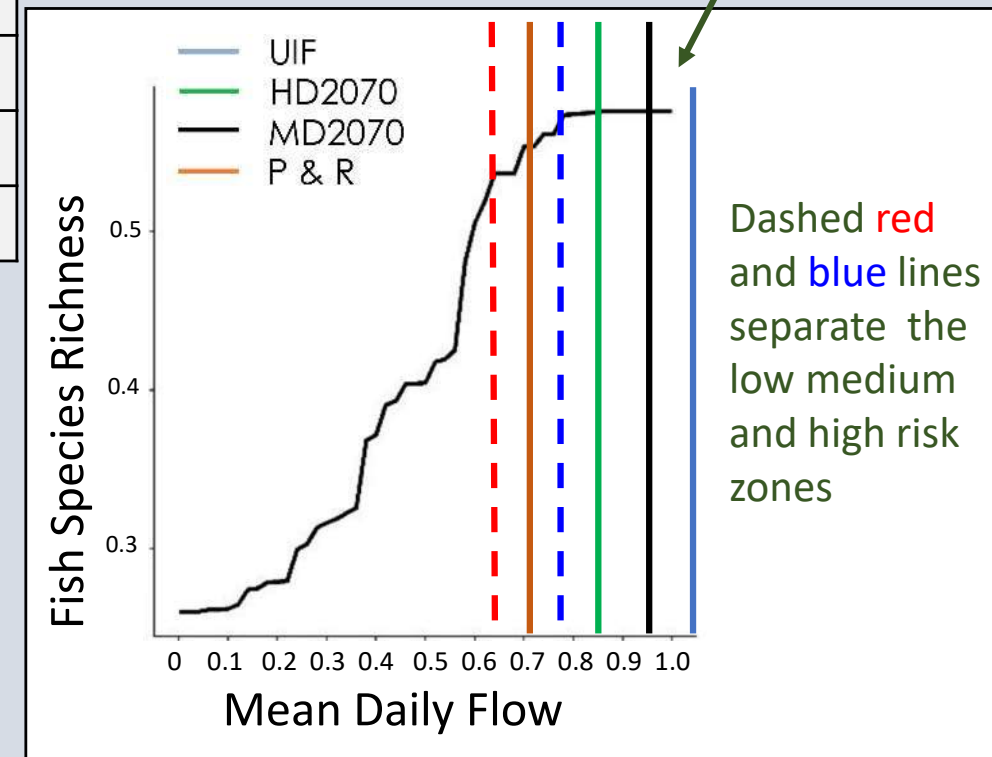
Key to Understanding the Results of the Surface Water Modeling Scenarios:

Mean daily flow (MA1): N. Pacolet near Fingerville

Scenario	Current	Predicted	% change	Bio Metric	Change in Bio	95ci
UIF	320	368.91	15.4%	Richness	12.7%	7
MD 2070	320	283.39	-11.3%	Richness	-9.3%	7
HD 2070	320	257.78	-19.4%	Richness	-15.9%	7
P&R	320	227.65	-28.8%	Richness	-23.6%	7

95% Confidence Interval

Colored lines correspond to scenario results shown in the table



Dashed red and blue lines separate the low medium and high risk zones

Current Use Scenario Mean Daily Flow

Scenario Mean Daily Flows

% Changes for each scenario are relative to the Current Use Scenario

Key to Understanding the Results of the Surface Water Modeling Scenarios:

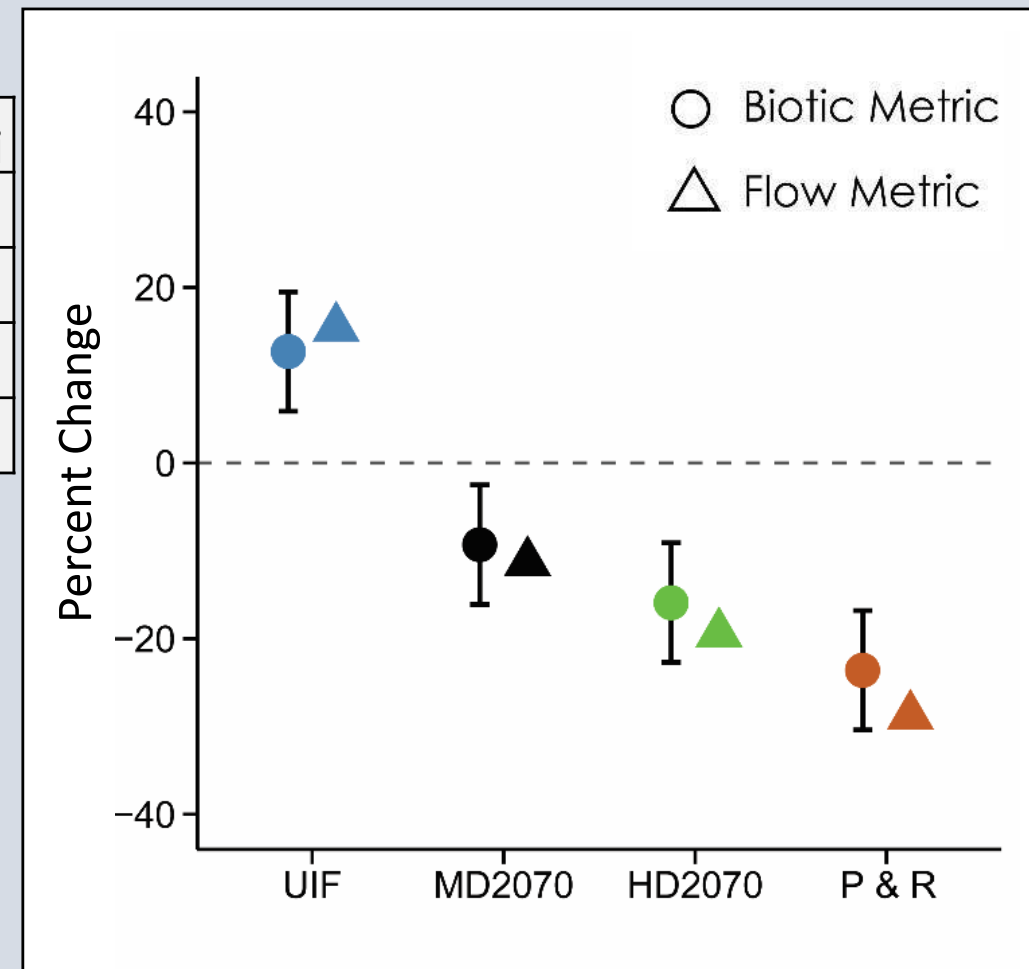
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Current Use Scenario
Mean Daily Flow

Scenario
Mean Daily Flows

% Changes for each
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Some implications of this work

Expected results: richness

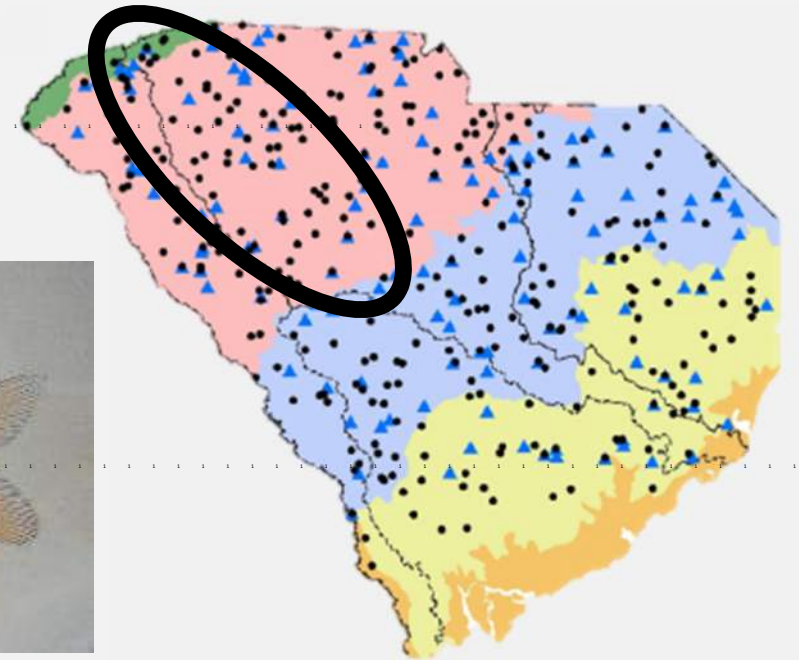
- 95 species collected at 29 sites in Saluda river basin
- Average 12 species per site
- Max 20 species per site



Redbreast sunfish



Notchlip redhorse



Fieryblack Shiner



Margined Madtom



Rosyside Dace

Expected results: richness

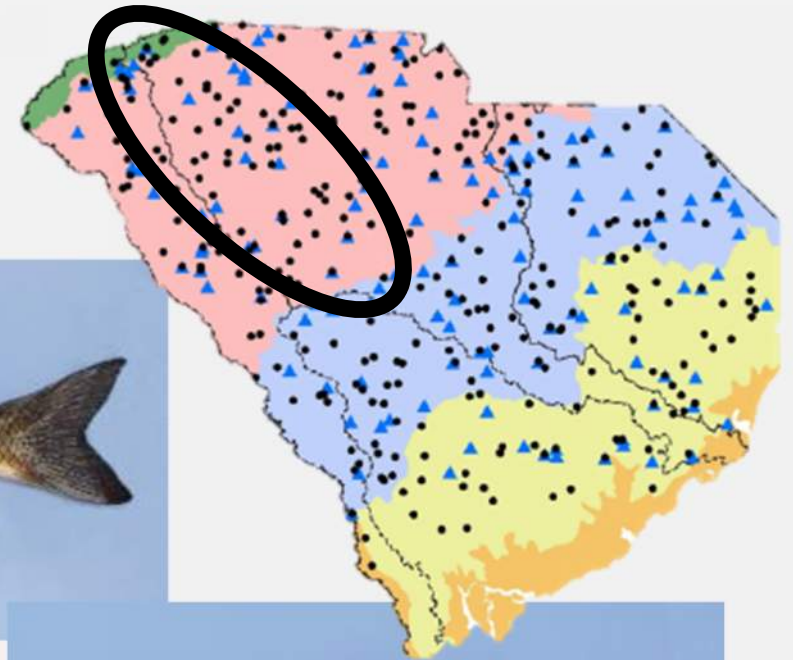
- Up to XX% biodiversity loss in some streams at full allocation
- Replacement by common generalists & invasives



Green sunfish



White sucker



Eastern mosquitofish



Yellow Bullhead



Golden Shiner

SWAP-listed fishes in Saluda River basin



Thinlip Chub



Santee Chub



Carolina Darter



Greenfin Shiner



Seagreen Darter



Fieryblack Shiner



Highback Chub



Carolina Fantail Darter



Eastern Brook Trout

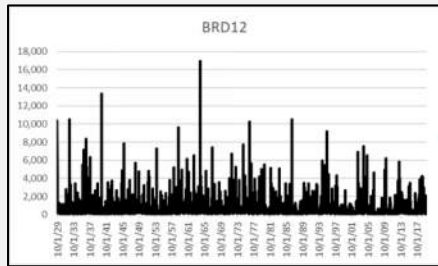
What this info is

- Guidances based on best available data and analysis tools
- Based on models with compounding statistical uncertainty

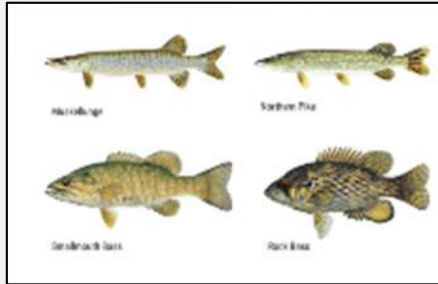
What this info is not

- Arbitrary recommendations from 'expert advice'
- Perfect.
- More data = less uncertainty
- Changing climate & land cover = more uncertainty

Flow Chart



Gauge Data



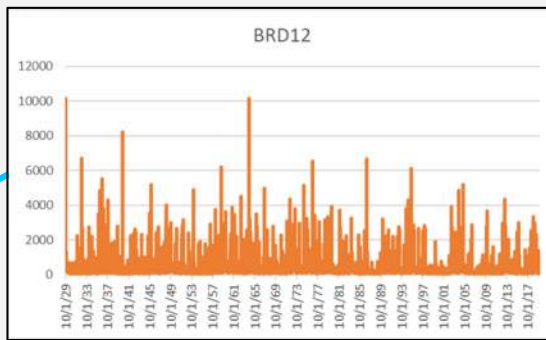
Community Data

Estimate Flow metrics

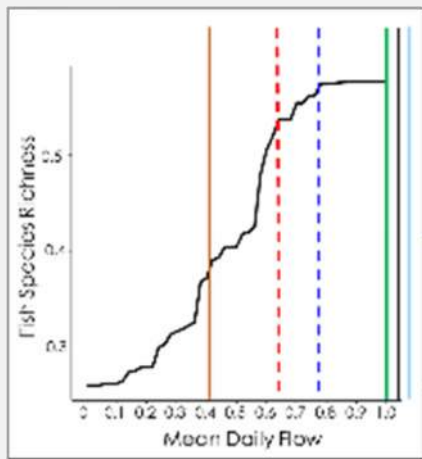
+ Uncertainty

Estimate Flow-Ecology Relationships

+ Uncertainty



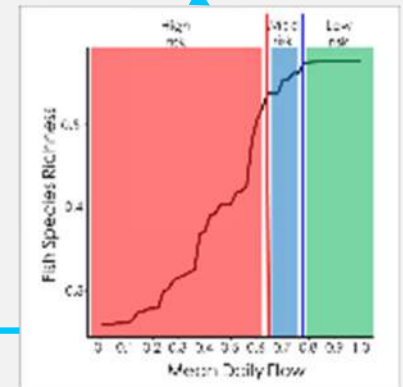
Forecast Future Flows



Forecast Changes in Biota

+ Uncertainty

+ Uncertainty



Identify Thresholds

What this info is

- Guidances based on best available data and analysis tools
- Based on models with compounding statistical uncertainty
- Representative of overall (30-year) flow regime characteristics

What this info is not

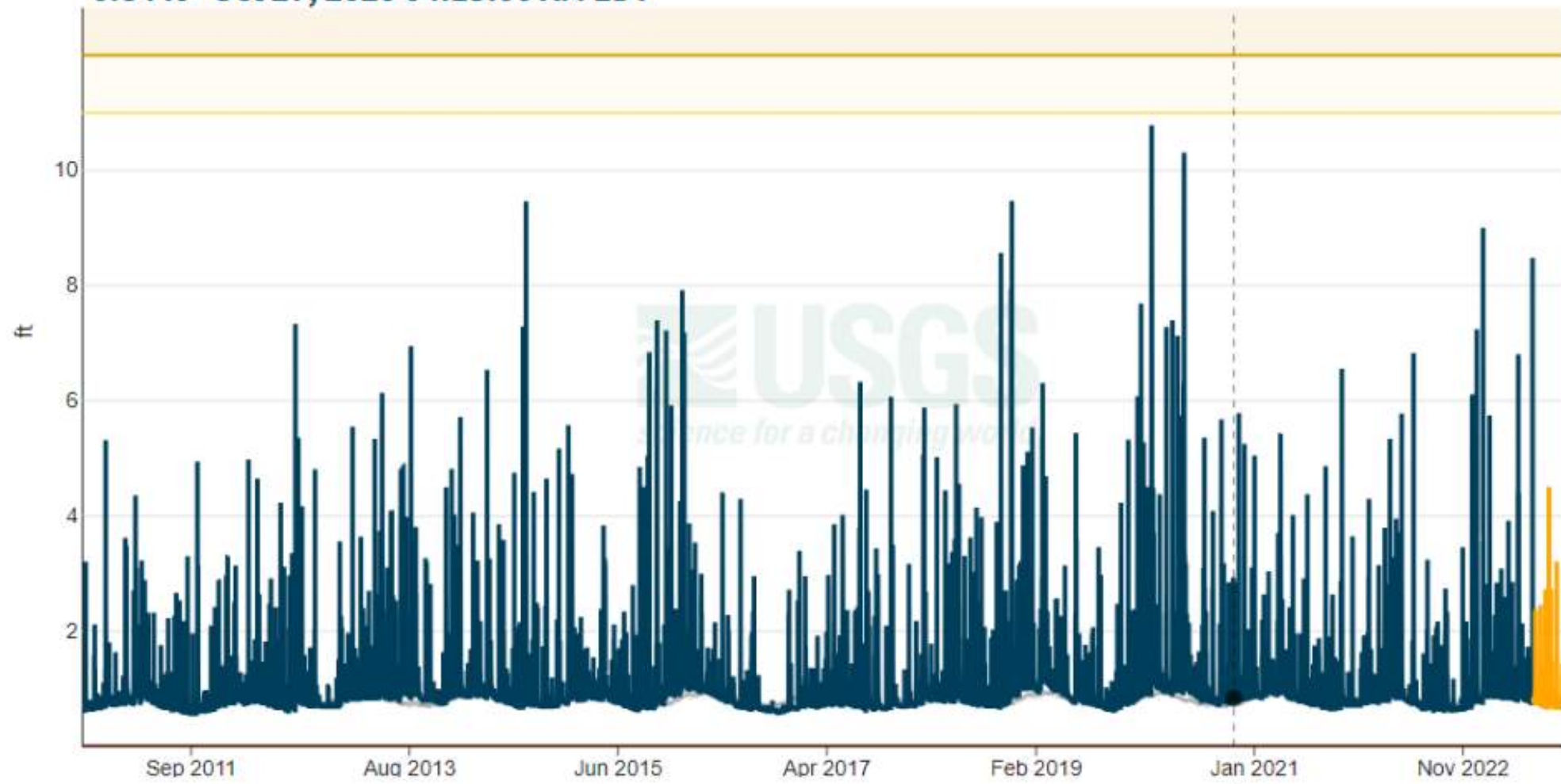
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- Perfect.
- More data = less uncertainty
- Changing climate & land cover = more uncertainty
- One-time withdrawal thresholds

Reedy River Near Greenville, SC - 02164000

September 18, 2010 - September 18, 2023

Gage height, feet

0.84 ft - Oct 27, 2020 04:15:00 AM EDT



What this info is

- Guidances based on best available data and analysis tools
- Based on models with compounding statistical uncertainty
- Representative of overall (30-year) flow regime characteristics
- Applicable to streams and small rivers (~86% of all SC waters)
- Relationships between organisms and flow

What this info is not

- Arbitrary recommendations from 'expert advice'
- Perfect.
- More data = less uncertainty
- Changing climate & land cover = more uncertainty
- One-time withdrawal thresholds
- Applicable to large rivers and reservoirs
- Parsing out other factors that affect organisms
- Land use affects flow, etc.

Questions

A scenic view of a river with many large, flat rocks protruding from the water, surrounded by a dense forest of green trees. The water is clear and flows over the rocks, creating small rapids and pools. The forest is lush and green, with many trees visible in the background.