BIOLOGICAL - ENVIRONMENTAL CLASSIFICATION (BEC) SYSTEM AND SUPPORTING FLOW – BIOLOGY RELATIONSHIPS IN NORTH CAROLINA – PROJECT UPDATE

Conducted by: RTI and USGS

Funded by: Environmental Defense Fund, NC DENR, and NC WRC

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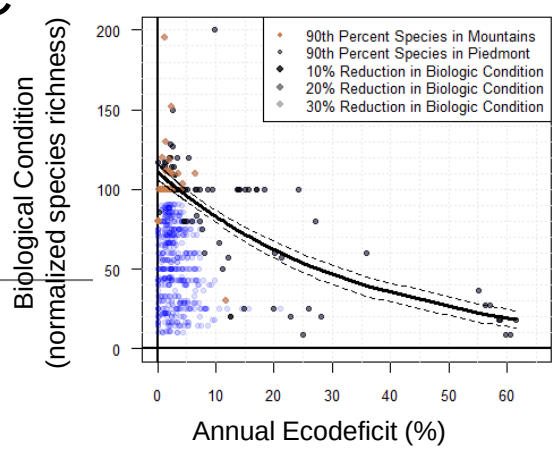
LAST MEETING……

BEC stream classification system:

- Do multifactor response models offer better predictions of biological response?
- Do *a priori* regional classifications improve strength of flow-biology relationships?

RTI IR&D flow-biology relationships:

- Riffle-run fish guild (normalized by basin)
- Wadeable streams in NC



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BEC STREAM CLASSIFICATION

- Multifactor response models?
  - NC fish (species richness of riffle-run guild)
  - Flow metrics:
    - Summer Ecodeficit
    - decreases in Annual 30-day Minimum Flow
  - Best model fit:
    - Flow metric
    - Ecological Drainage Unit (EDU) regions
    - Slope
    - % Forest Cover (correlated with flow metric)
    - Average Temperature

NOTE: Results are similar for invertebrates

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BEC STREAM CLASSIFICATION

- *A priori* regional classification improve strength of flow-biology relationship?
  - NC fish (species richness of riffle-run guild; RTI flow-biology methodology – normalized by basin; response of 90th percentile data)
  - Flow-biology relationships by EDU
  - Results:
    - Flow-biology relationships were not consistently strengthened by splitting up by EDU
      - only 4 of 10 EDUs had significant flow-biology relationships
      - only 1 EDU had a better model fit than the state-wide model (Albemarle Pamlico Piedmont EDU)

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RECOMMENDATION

- Use state-wide flow-biology relationships for fish and benthos (based on RTI flow-biology methodology) to support determination of ecological flows
  - Biological response:
    - Fish
      - Species richness of Riffle-run guild
      - Normalized by basin
    - Benthos
      - EPT Richness
      - Normalized by Omernik Level III
  - Flow metric:
    - Ecodeficit

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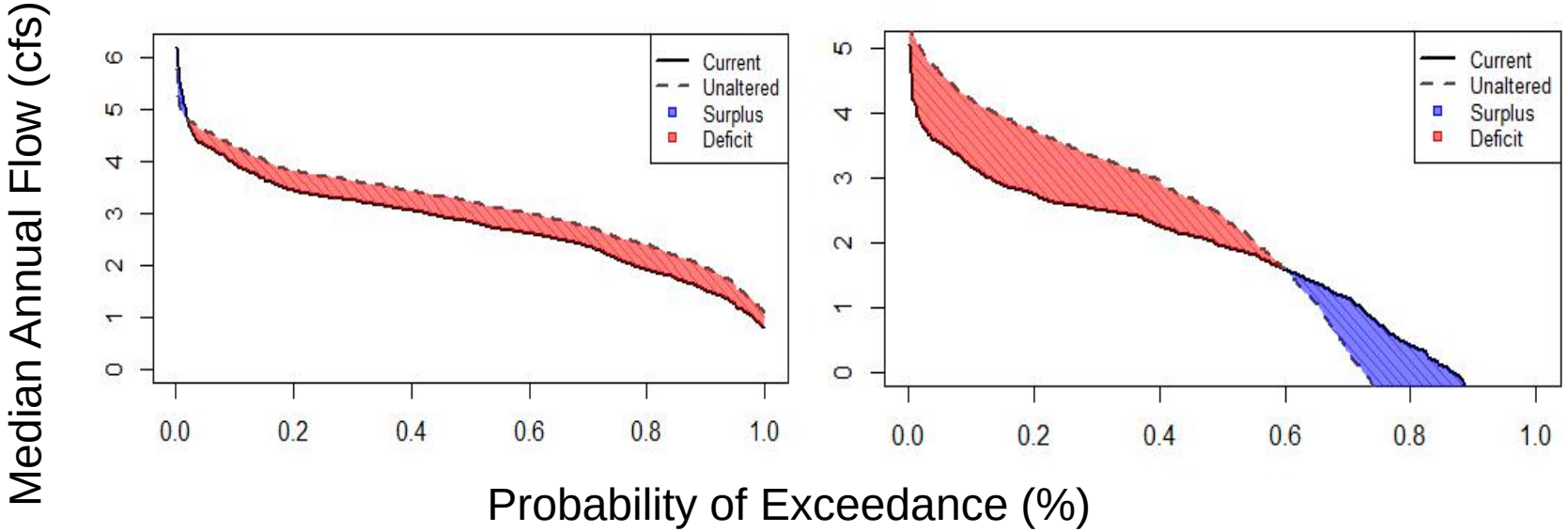
ECODEFICIT

NHD+ Catchments in Roanoke Basin



- Ecodeficit is a measure of the reduction in volumetric water availability
- 20% ecodeficit = 20% reduction in volumetric water availability (over a defined period of time)

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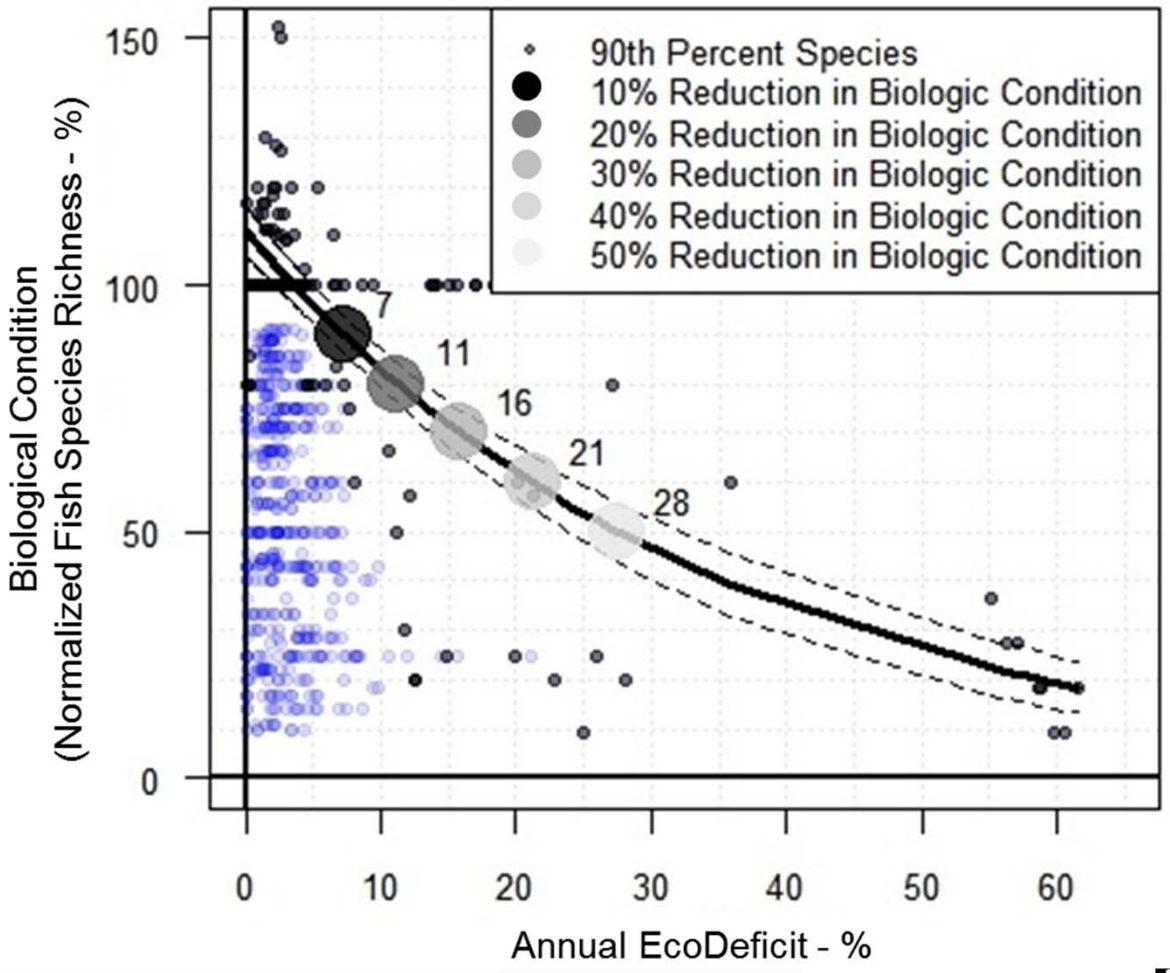
ANNUAL ECODEFICIT - FISH



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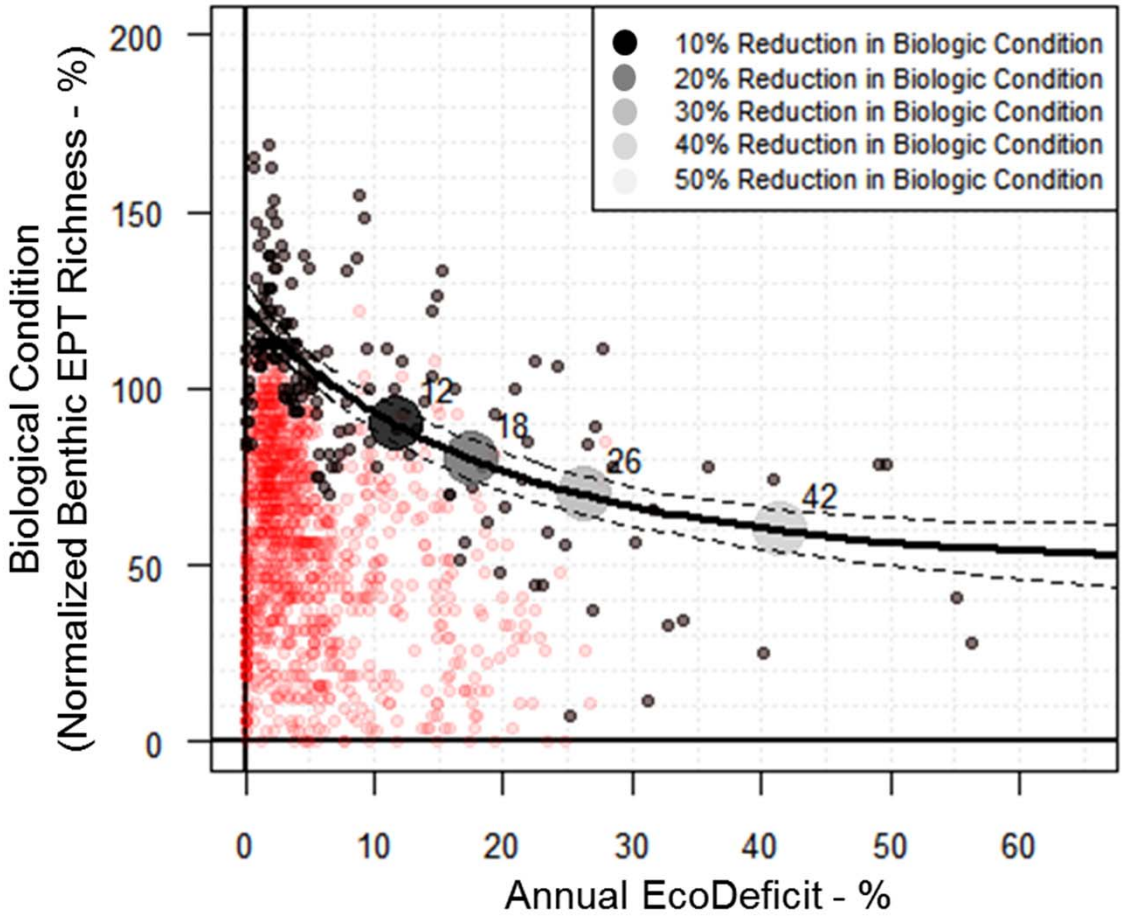
ANNUAL ECODEFICIT - BENTHOS



Note: 50% reduction in biological condition is beyond the range of the data

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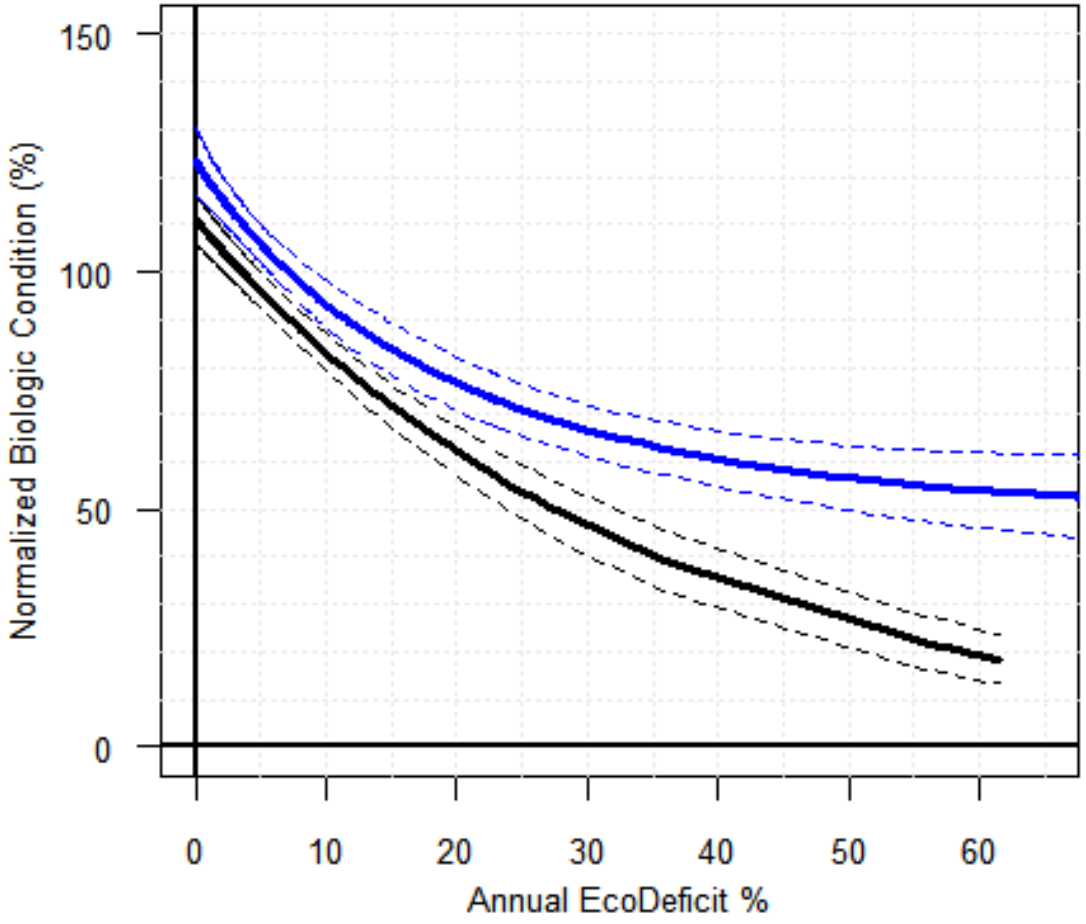
ANNUAL ECODEFICIT - COMBINED



Benthic EPT Richness

Fish Species Richness

ANNUAL ECODEFICIT - COMBINED

- Annual versus seasonal ecodeficit – biological responses relationships and associated “biological condition” thresholds

	Fish: Species Richness			Benthos: EPTR		
Metric	**10%**	**20%**	**30%**	**10%**	**20%**	**30%**
Annual EcoDeficit	7	11	16	12	18	26
Winter Deficit	7	11	16	11	16	24
Spring Deficit	7	11	15	11	17	25
Summer Deficit	9	13	18	13	20	31
Fall Deficit	10	15	20	14	21	30
Average	**8**	**12**	**17**	**12**	**18**	**27**
Standard Deviation	**1**	**2**	**2**	**1**	**2**	**3**

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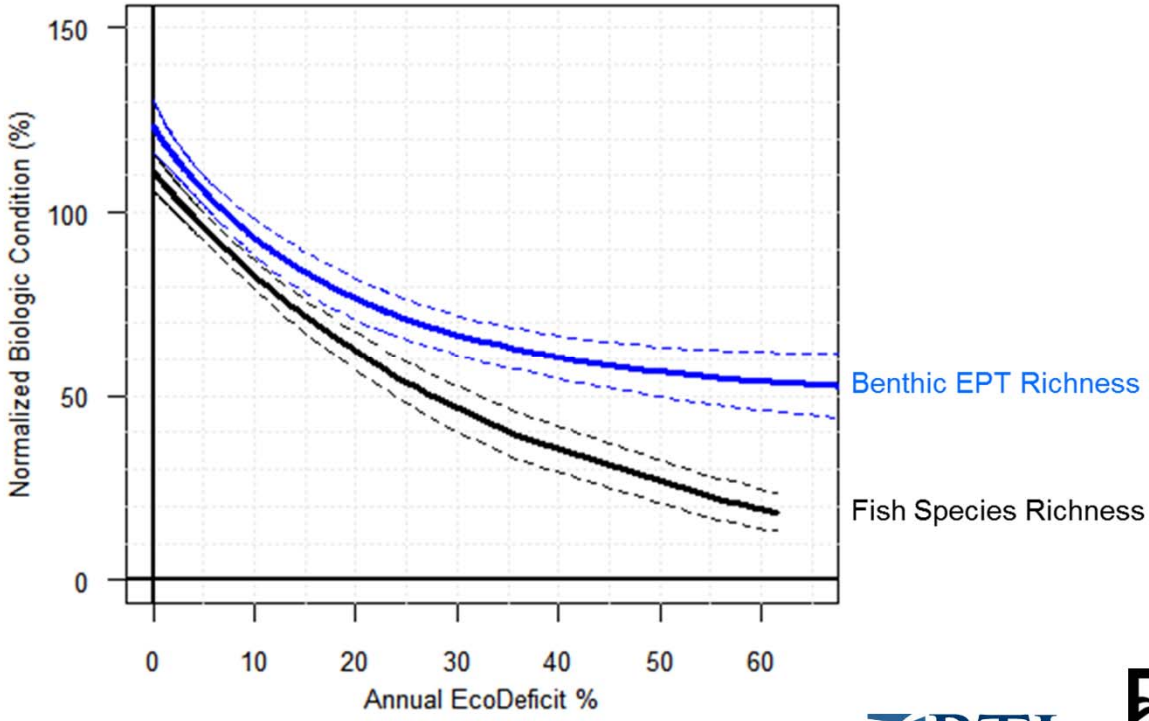
WHAT'S NEXT?

- Depending on the current condition of a stream, how much degradation in the biological condition is EF-SAB (NCDENR) willing to tolerate?



RELEVANCE:
NEED TO LINK ECOLOGICAL RESPONSES (E.G., EPT RICHNESS) AND FLOW DEFICITS (I.E., QUANTILE REGRESSIONS) TO ECOLOGICAL CONDITION

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DWQ HAS ESTABLISHED INVERTEBRATE CONDITION CLASSES BASED ON EPT TAXA RICHNESS

- DWQ uses EPT richness as one means of establishing condition classes:

	Mountain	Piedmont	Coastal Plain
Excellent	>35	>27	>23
Good	28-35	21-27	18-23
Good-Fair	19-27	14-20	12-17
Fair	11-18	7-13	6-11
Poor	0-10	0-6	0-5

- DWQ has condition rankings for most sites and dates used in EF-SAB analyses

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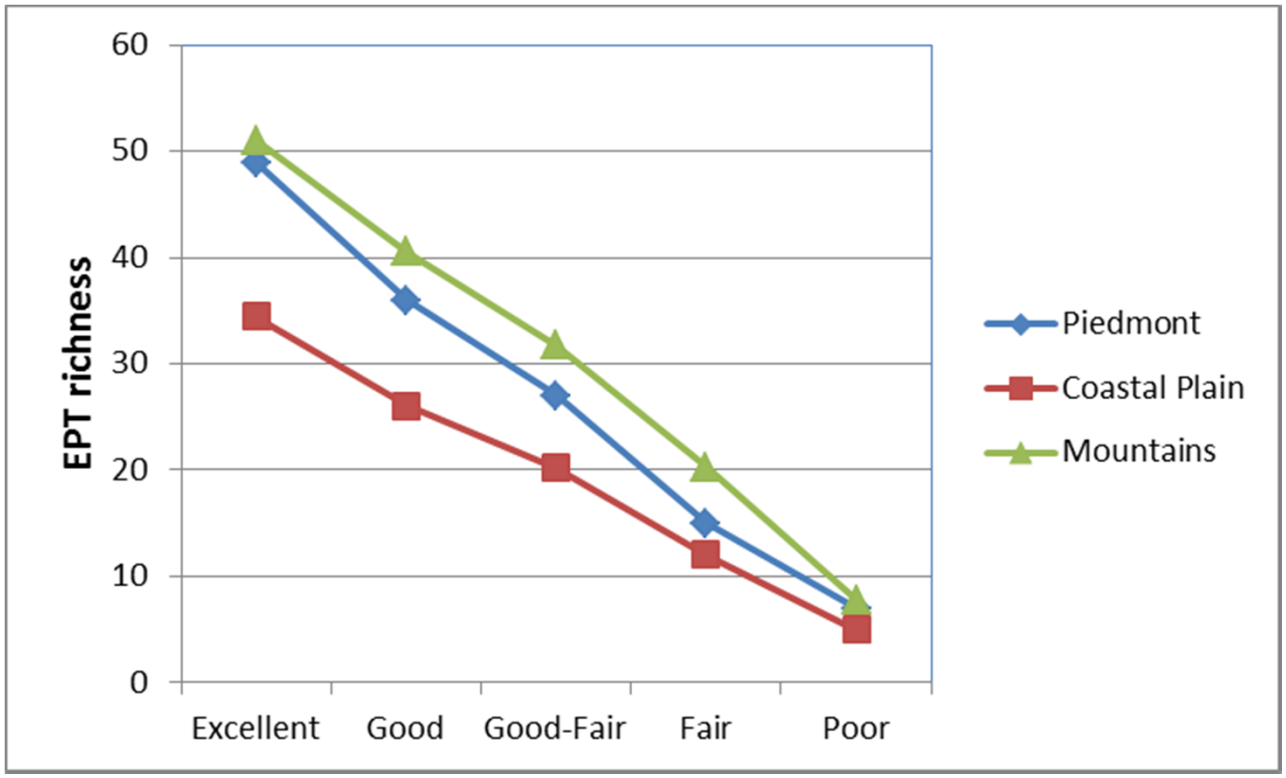
THEREFORE, WE CAN CALCULATE 90TH PERCENTILE FOR CONDITION CLASSES IN EACH ECOREGION



Mountains: 66 (Blue Ridge), Piedmont: 45, Coastal Plain: 63 (Mid Atlantic Coastal Plain) + 65 (Southern Plain)

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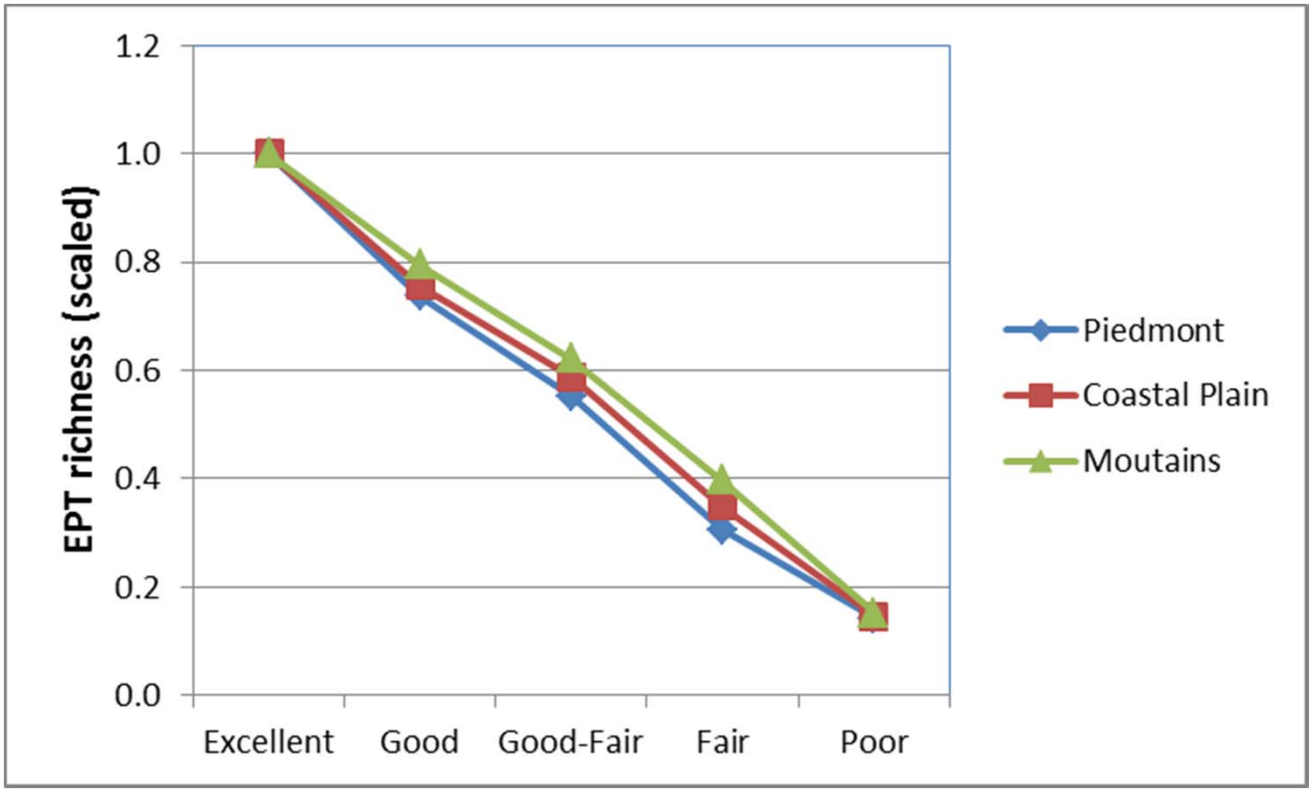
STANDARDIZE FOR 90TH PERCENTILE CONDITION IN EACH CONDITION CLASS WITHIN EACH ECOREGION



DERIVE STATE-WIDE CONDITION CLASSES BASED ON AVERAGE STANDARDIZED VALUES

STATE-WIDE CONDITION CLASSES BASED ON 90TH PERCENTILE

	EPT richness[1]
Excellent	≥ 0.868
Good	0.868 - 0.675
Good-Fair	0.675 - 0.469
Fair	0.469 - 0.249
Poor	< 0.249

[1]EPT taxa richness scaled by 90th percentile in mountains, Piedmont, and Coastal Plain

Screening criteria: if a planned water withdrawal results in a flow deficit (annual, summer, winter, etc.) that pushes the site into a lower condition class then a site-specific flow-ecology study is warranted (e.g., PHABSim).

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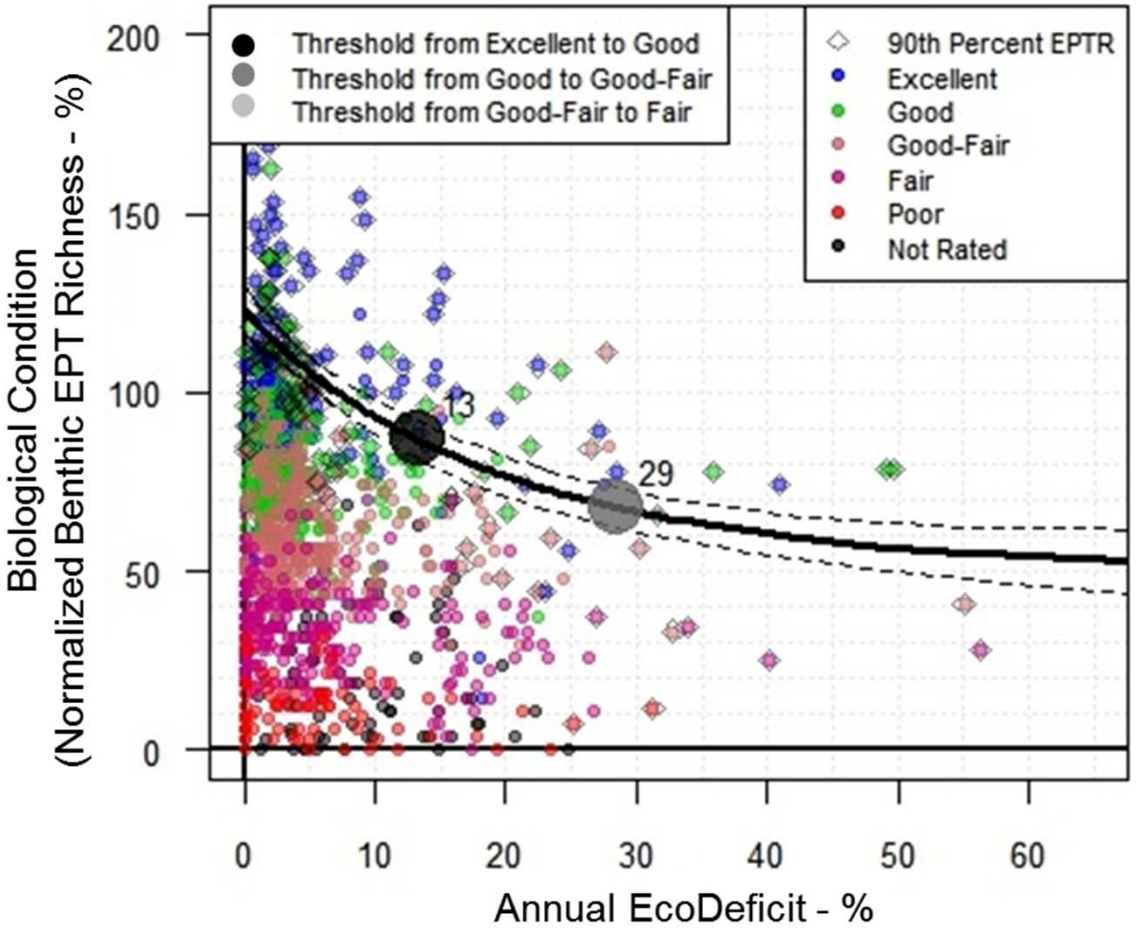
STATE-WIDE CONDITION CLASSES BASED ON 90TH PERCENTILE



Note: Thresholds for Good-Fair to Fair and Fair to Poor are not reached within 100% decrease in Annual EcoDeficit

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ADVANTAGES OF APPROACH

- Data-driven approach for establishing ecological flows
- Relates back to NC DWQ concept of biological condition classes
- Uses state-wide flow-biology relationships for fish and benthos (based on RTI flow-biology methodology) to support determination of ecological flows
- Guards against further degradation, while taking into account of current conditions
- On-going process (adaptive management)

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