Biological Fidelity Analysis of Stream Classes - UPDATE

Funded by: *Environmental Defense Fund*

Conducted by: *RTI International*

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Project Objectives:

- To adopt a stream classification system that represents the distribution of aquatic biota in North Carolina

    – Compare fidelities of aquatic biota to different stream classification systems

        ▪ Environmental Flow Specialists (EFS)

        ▪ McManamay et al., 2011 (McManamay)

    – Adopt the most suitable classification system and/or modify a system to better reflect biological assemblages

Project 7 Steps

1. Determine catchments to include in analysis:
   - minimally altered water quality and flow condition
   - 1,094 NHD+ catchments

2. Link catchments with biological data:
   - benthos – 1,094
   - fish – 416

3. Conduct preliminary statistical analysis of biological fidelity to test analysis framework:
   - 106 catchments
   - individual species and community analyses

Project 7 Steps

4. Compare stream classification systems:
    – EFS and McManamay

Stream Classification Systems

- **EFS:**
  - Developed for NC
  - Developed using USGS gage data restricted to locations with "stable flow conditions" for 18+ years (185 gages)
  - Based on 22 ecologically-relevant flow metrics
  - 7 classes:

B - Small Stable Streams	A - Coastal Streams
F - Medium Stable Streams	E - Large Piedmont Rivers
C - Large Stable Streams	D - Small Flashy
	G - Small Seasonal

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Stream Classification Systems

- ## McManamay:

  – Developed for Southeastern U.S. (8 states)

  – Developed using USGS gage data restricted to catchments with minimally disturbed, "unregulated" stream condition (292 gages)

  – Based on 9 ecologically-relevant flow metrics in hydrologic classification tree

  – 8 classes (6 main classes):

IF - Intermediate Flashy	SBF1 - Stable High Baseflow 1
CSI - Coastal Swamp/Intermittent	SBF2 - Stable High Baseflow 2
BKR - Black River	PR1 - Perennial Runoff 1
UPR - Unpredictable Perennial Runoff	PR1 - Perennial Runoff 2

Project 7 Steps

4. Compare stream classification systems:

   – EFS and McManamay

   – classifications determined using USGS gage data

   – 147 catchments (restricted to catchments with 15+ years of USGS records between 1960 – 2006)

Comparison of Stream Classification Systems

Classes	A	B	C	D	E	F	G	McMan Sum
CSI	12	1	2	0	0	0	0	15
IF	0	0	0	18	0	0	1	19
PR1	3	2	0	3	0	0	1	9
PR2	5	12	0	18	1	1	0	37
SBF1	0	10	1	1	0	2	0	14
SBF2	1	33	12	2	0	5	0	53
EFS Sum	21	58	15	42	1	8	2	147

- Kappa statistic = -0.145

- <u>Conclusion</u>: classifications are dissimilar enough that biological fidelity analyses should be conducted on both systems

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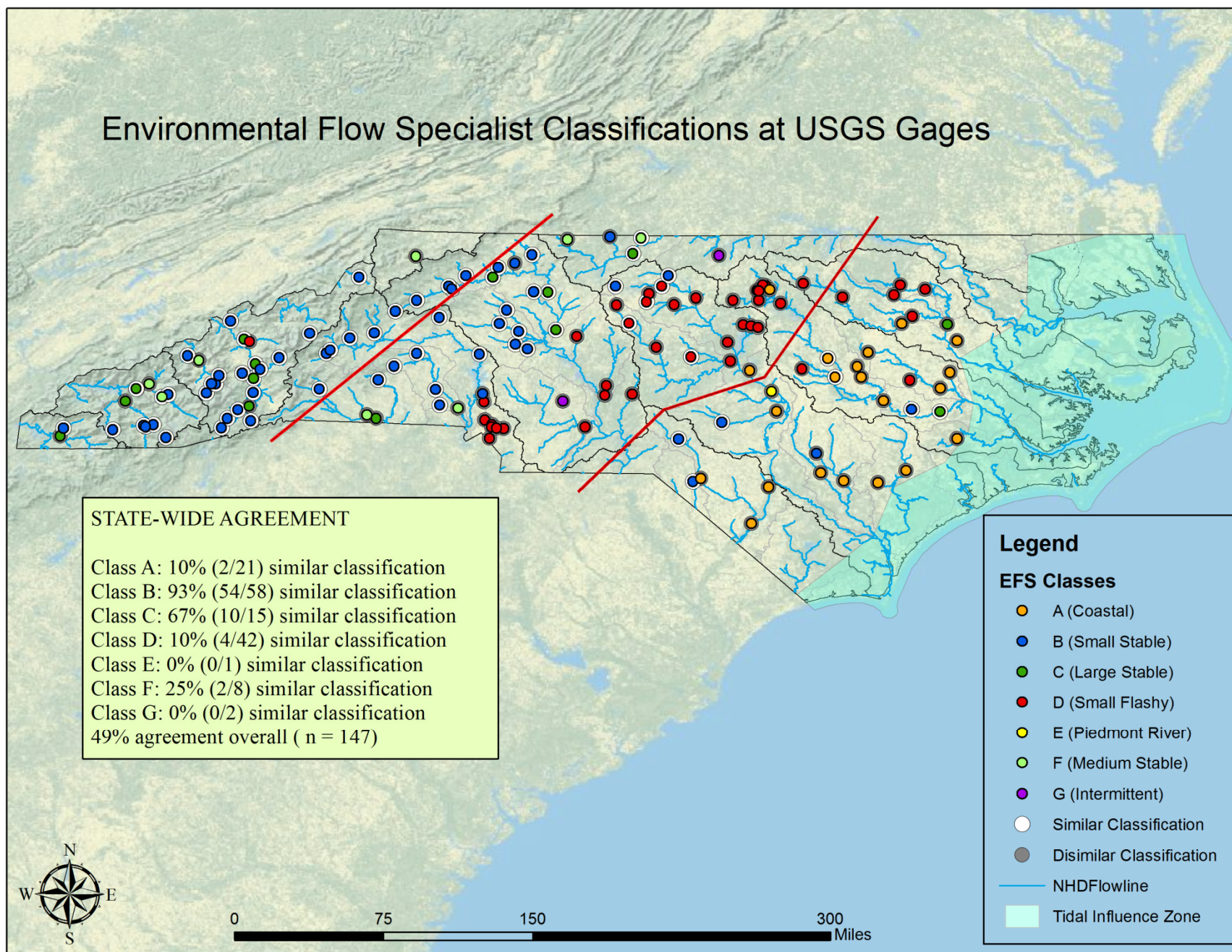
4. Compare stream classification systems:
   – EFS and McManamay
   – classifications determined using USGS gage data
   – 147 catchments (restricted to catchments with 15+ years of records between 1960 – 2006)
   – CONCLUSION = classifications are not the same

5. Compare stream classes determined using USGS gage and WaterFALL hydrology data:
   – EFS and McManamay
   – 147 catchments

EFS classification – comparison of USGS and WaterFALL data sources

- Only 49% match
- Stable streams (B, F and C) are sensitive to the median base flow metric
- Flashy streams (D and A) are sensitive to the Very High Flows (>90th percentile) metric

EFS Class	% USGS – WaterFALL Match
B - Small Stable	93% (54/58)
C - Large Stable	67% (10/15)
F - Medium Stable	25% (2/8)
D - Small Flashy	10% (4/42)
A - Coastal	10% (2/21)
G - Intermittent	0% (0/2)
E - Piedmont River	0% (0/1)
Total	**49% (72/147)**

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Environmental Flow Specialist Classifications at USGS Gages

STATE-WIDE AGREEMENT

Class A: 10% (2/21) similar classification
Class B: 93% (54/58) similar classification
Class C: 67% (10/15) similar classification
Class D: 10% (4/42) similar classification
Class E: 0% (0/1) similar classification
Class F: 25% (2/8) similar classification
Class G: 0% (0/2) similar classification
49% agreement overall (n = 147)

Legend

EFS Classes

- A (Coastal)
- B (Small Stable)
- C (Large Stable)
- D (Small Flashy)
- E (Piedmont River)
- F (Medium Stable)
- G (Intermittent)
- Similar Classification
- Disimilar Classification
- NHDFlowline
- Tidal Influence Zone
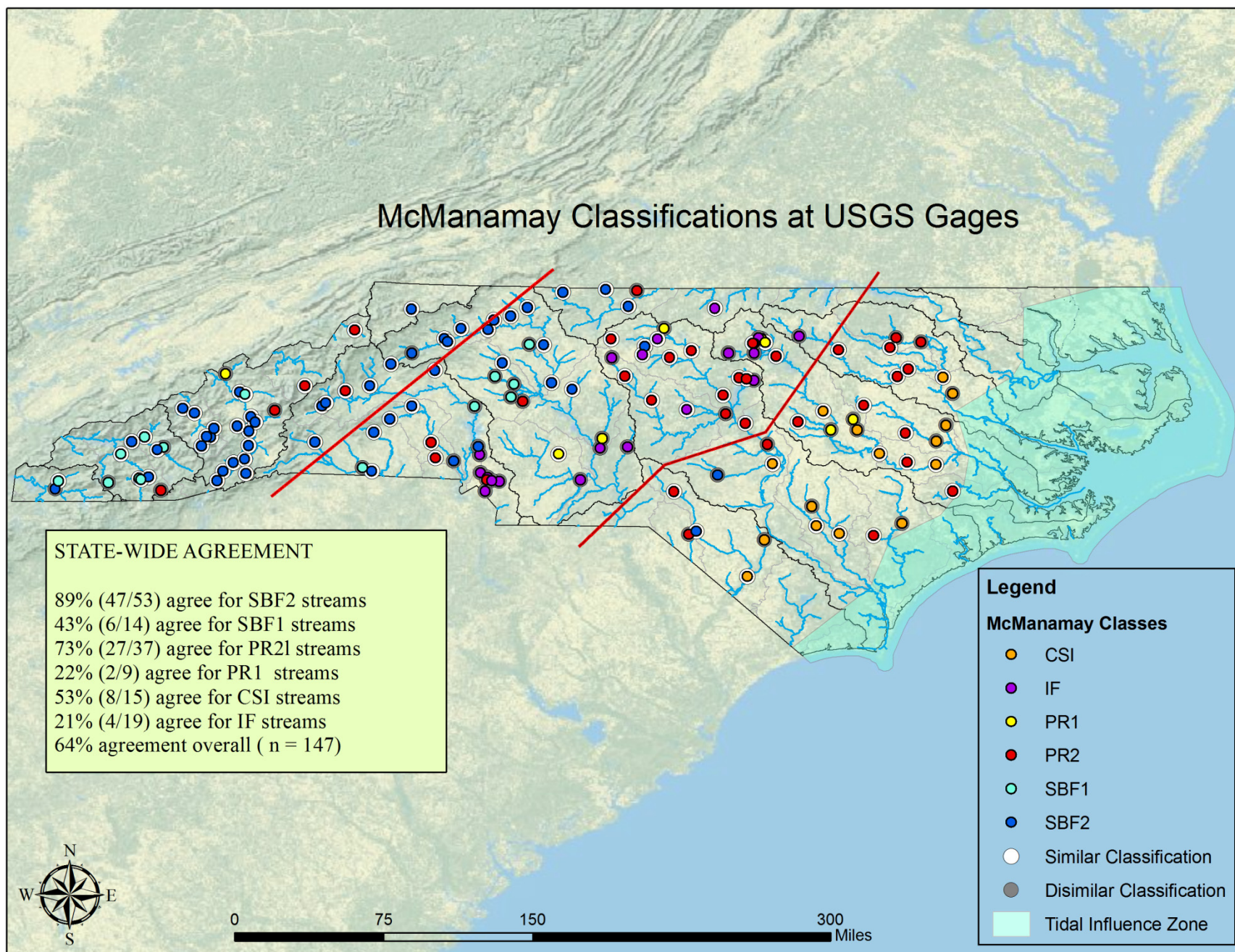
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Miles

McManamay classification – comparison of USGS and WaterFALL data sources

- Only 64% match
- Thresholds of classes sensitive
- McManamay found classification tree resulted in 66-80% accuracy in assigning USGS gages to classes

McManamay Class	% USGS – WaterFALL Match
SBF2	89% (47/53)
PR2	73% (27/37)
CSI	53% (8/15)
SBF1	43% (6/14)
PR1	22% (2/9)
IF	21% (4/19)
Total	**64% (94/147)**

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McManamay Classifications at USGS Gages

STATE-WIDE AGREEMENT

89% (47/53) agree for SBF2 streams
43% (6/14) agree for SBF1 streams
73% (27/37) agree for PR2l streams
22% (2/9) agree for PR1 streams
53% (8/15) agree for CSI streams
21% (4/19) agree for IF streams
64% agreement overall (n = 147)

Legend

McManamay Classes

- CSI
- IF
- PR1
- PR2
- SBF1
- SBF2
- Similar Classification
- Disimilar Classification
- Tidal Influence Zone

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W — E
S

McManamay classification – comparison of USGS and WaterFALL data sources

- Combined classes:
  - Stable Base Flow (SBF1 + SBF2)
  - Perennial Run Off (PR1 + PR2)
- Increased to 76% match

Grouped McManamay Class	% USGS – WaterFALL Match
SBF	99% (66/67)
PR	72% (33/46)
CSI	53% (8/15)
IF	21% (4/19)
Total	**76% (111/147)**

Project 7 Steps

4. ## Compare stream classification systems:

   - EFS and McManamay

   - Classifications determined using USGS gage data

   - 147 catchments (restricted to catchments with 15+ years of records between 1960 – 2006)

   - CONCLUSION = classifications are not the same

5. ## Compare stream classes determined using USGS and WaterFALL hydrology data:

   - EFS and McManamay

   - 147 catchments

   - CONCLUSION = can't extrapolate either classification beyond USGS gages

Project 7 Steps

6. Assign stream classes to all 1,094 catchments
7. Conduct biological fidelity analyses to determine fidelities of benthos and fish to the stream classes

What's Next?

- **Need a classification system that is:**
  - Not based on sensitive threshold values
  - Consistent and reproducible using USGS stream gage and modeled data
  - Easy to understand and implement
  - Can be applied throughout state
  - Captures the distribution of aquatic biota in North Carolina
- **NCDENR is in process of evaluating other potential approaches**
  - balance of Biological Fidelity project will be devoted to pursuing an alternative approach

Questions?