SARP: River Classification Framework

NC Environmental Flow Science Advisory Board

April 16, 2013

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Southern Instream Flow Network

SOUTHEAST AQUATIC RESOURCES PARTNERSHIP
SARP

Southern Instream Flow Network

Purpose - To facilitate protective instream flow policies and practices in 15 southern states by providing science-based resources and opening lines of communication.

More information at:
www.southeastaquatics.net/programs/sifn/

Presentation Overview

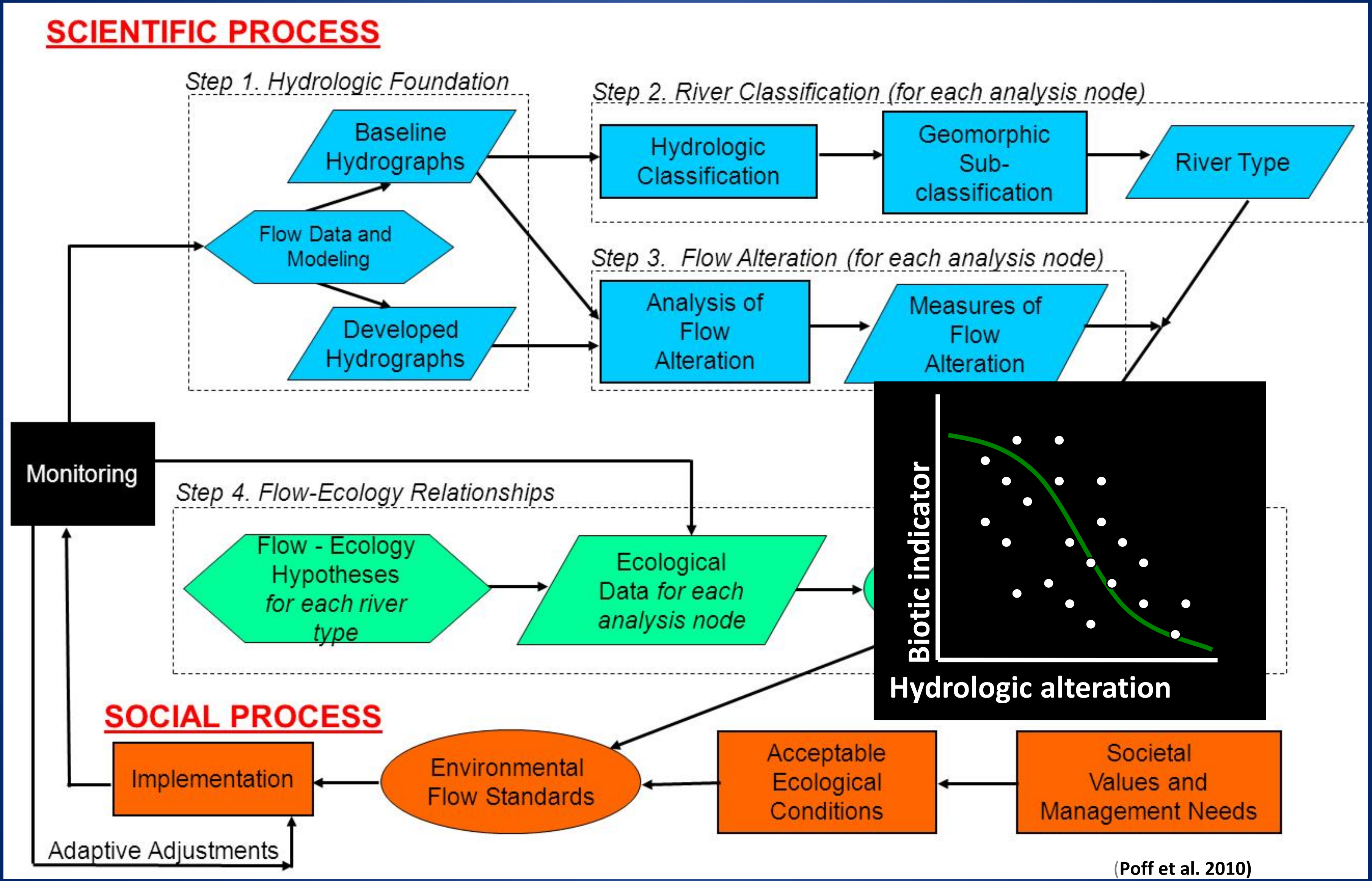
1. Present SARP River Classification Framework for the South Atlantic Landscape Conservation Cooperative (SALCC) region

2. Review uses of classification

SARP River Classification Framework
Objectives

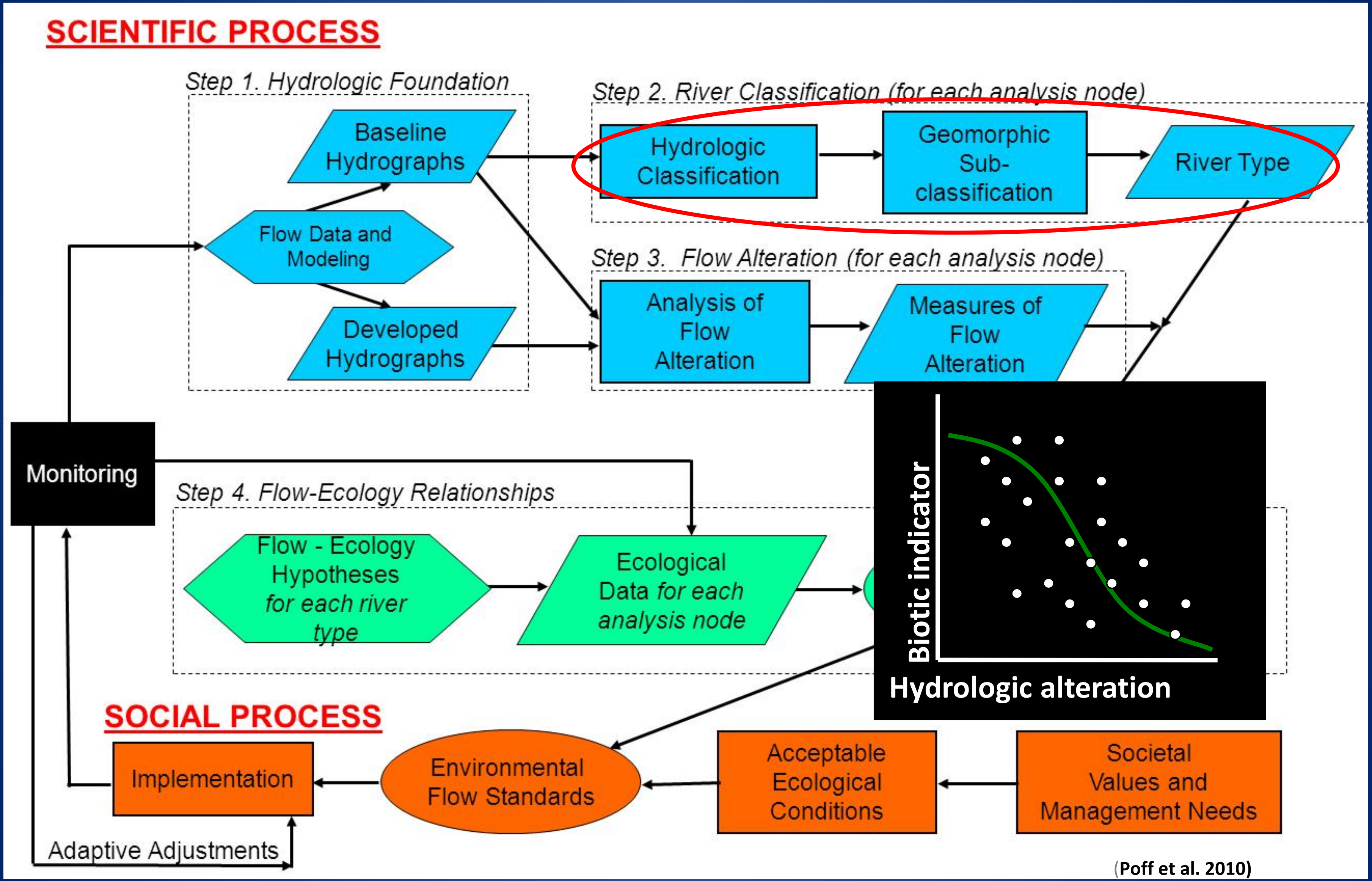
- Characterize streams by ecologically relevant characteristics
- Provide common terms for describing rivers across the region
- Support development of flow-ecology relationships

Ecological Limits of Hydrologic Alteration (ELOHA)



http://conserveonline.org/workspaces/eloha

Ecological Limits of Hydrologic Alteration (ELOHA)



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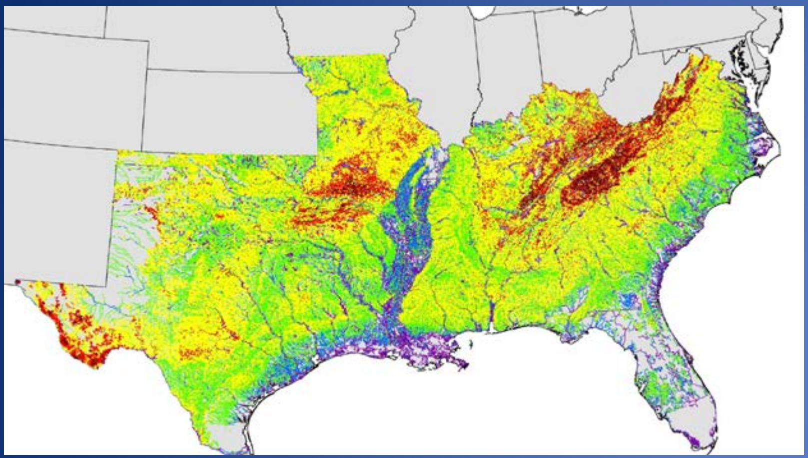
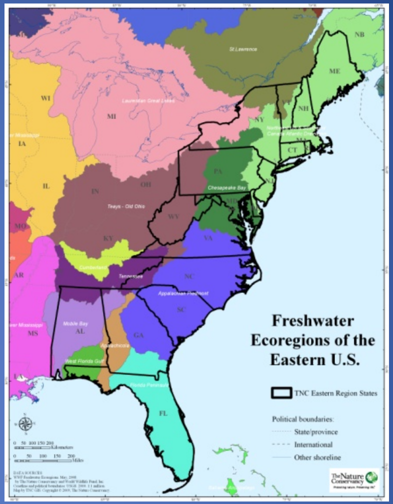
SARP River Classification Framework
Geomorphic Sub-Classifications

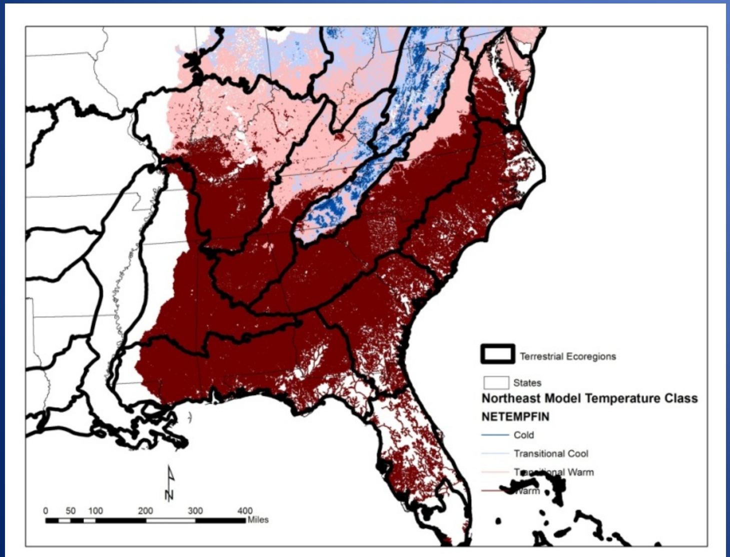
Stream Gradient



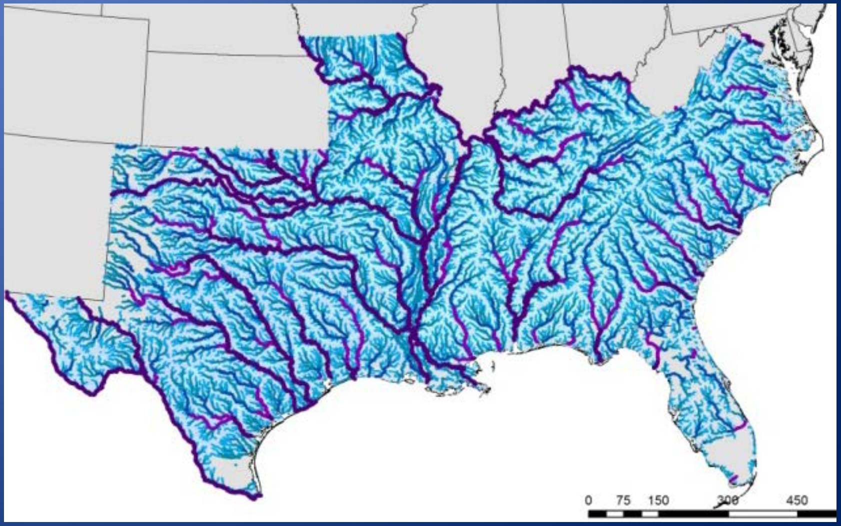


Ecoregions
- EPA Level III
- Freshwater
- EDU

Stream Temperature

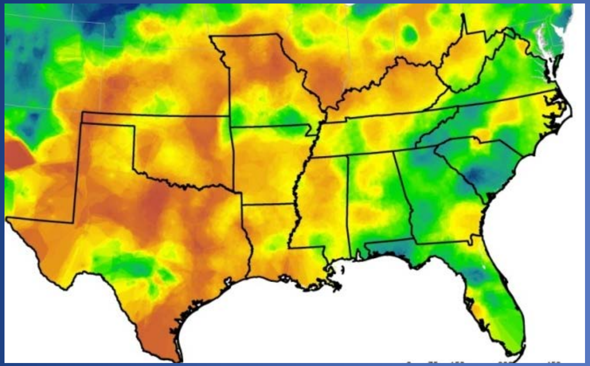


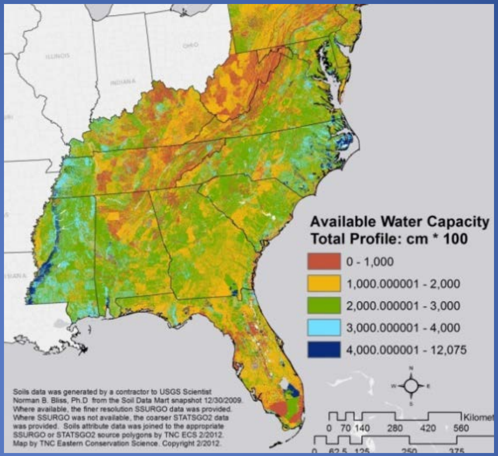
Size (basin area and MAF)



SARP River Classification Framework
Geomorphic Sub-Classifications (cont.)

Base Flow Index

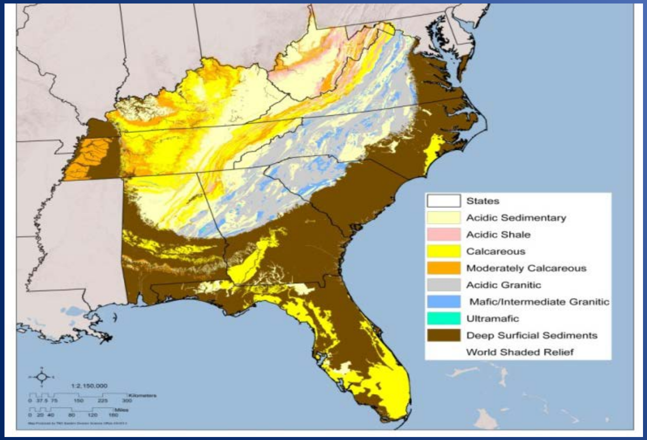




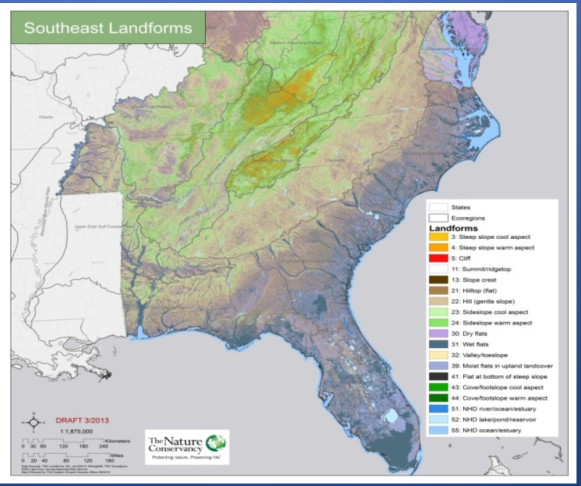
Soils

- Available water capacity
- Soil organic carbon
- % Sand, Silt, and Clay

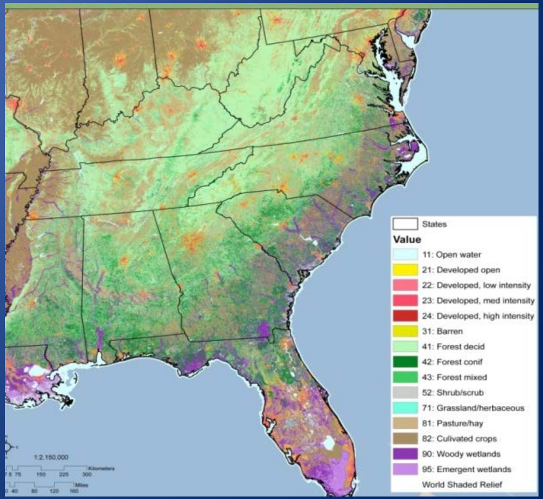
Bedrock Geology



Landforms



Land Uses



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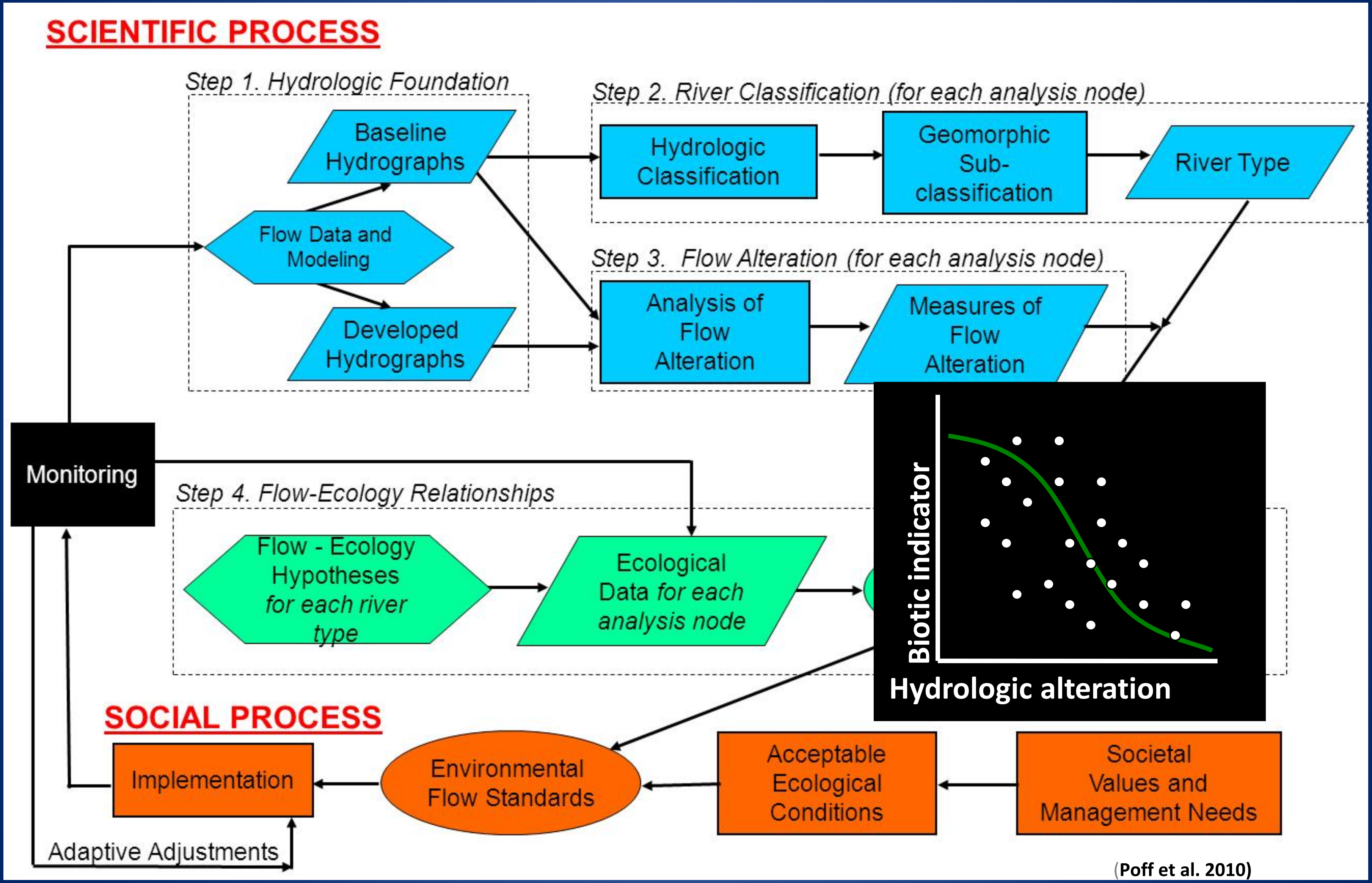

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SARP Hydrologic Classification Framework
for SALCC region

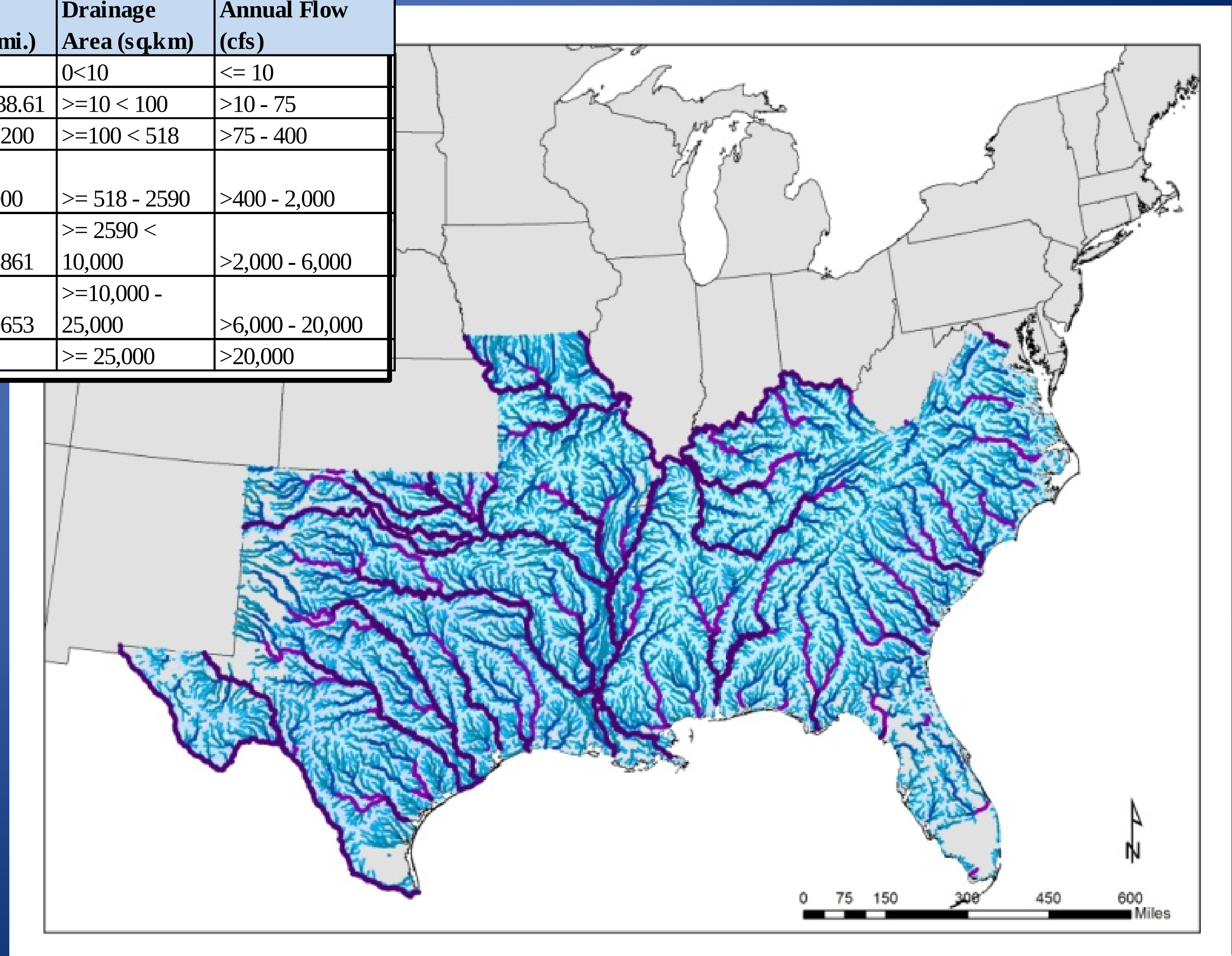
1. **Size** –
    - Headwater,
    - Creek,
    - Small R.,
    - Medium R.,
    - Large R.,
    - Great R.

2. **Variability** – (median annual std deviation/mean flow)
    - Very low,
    - Low,
    - Medium-High

SARP River Classification Framework

Stream Size Class(by basin area)

Size Class	Description	Definition: Upstream Drainage Area (sq.mi.)	Definition: Upstream Drainage Area (sq.km)	Definition: Mean Annual Flow (cfs)
1a	Headwaters	0<3.861	0<10	<= 10
1b	Creeks	>=3.861<38.61	>=10 < 100	>10 - 75
2	Small Rivers	>= 38.61<200	>=100 < 518	>75 - 400
3a	Medium Tributary Rivers	>=200<1000	>= 518 - 2590	>400 - 2,000
3b	Medium Mainstem Rivers	>=1000<3861	>= 2590 < 10,000	>2,000 - 6,000
4	Large Rivers	>=3861<9653	>=10,000 - 25,000	>6,000 - 20,000
5	Great Rivers	>=9653	>= 25,000	>20,000



SARP River Classification Framework
Flow Variability Class (Median daily variability)

Predict Flow Variability Class for Ungaged Locations

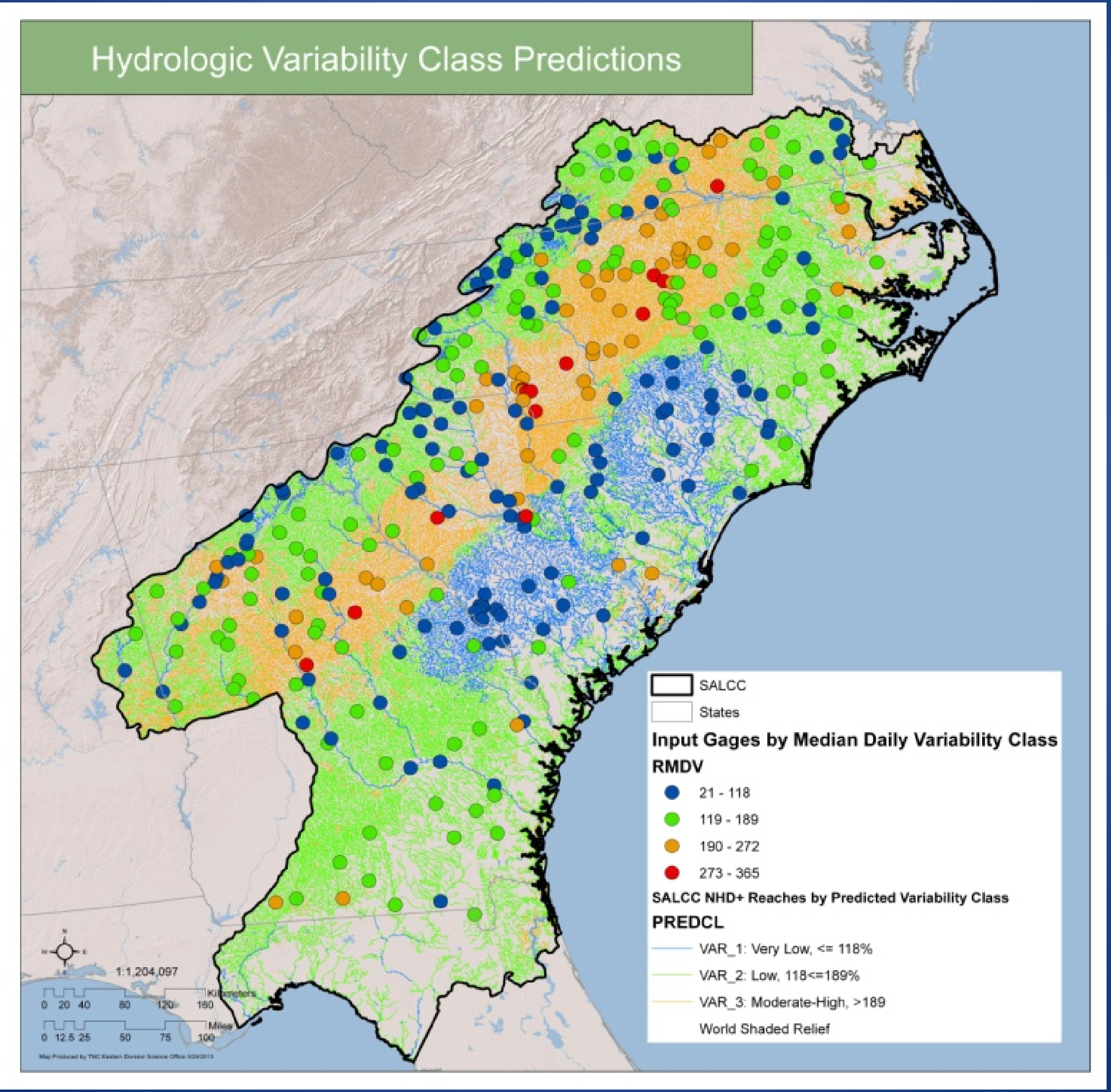
The modeling work consisted of four major steps.

1. Compile set of gages, assign hydrologic class, and link them to the appropriate NHDPlusreach
2. Attribute each stream reach and gage with GIS predictor variables
3. Build random forest (RF) classification models using the *randomForest* package in in R
4. Apply the best RF model to each stream reach and map each stream reach according to the “highest probability” class.

Of 75 predictor variables, the most important variables were:

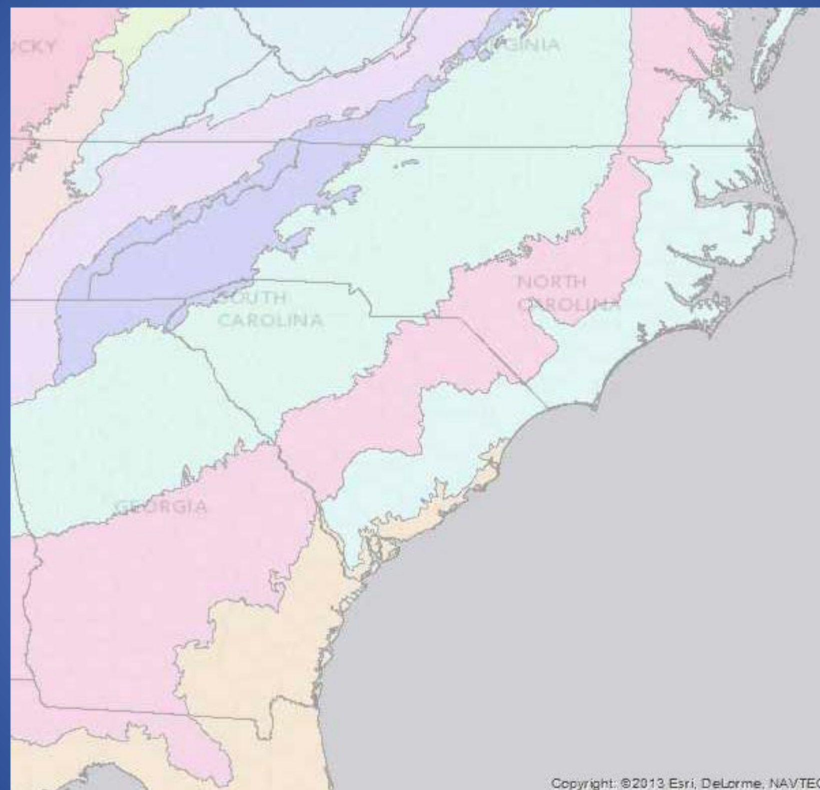
- mean baseflow index
- stream size
- cumulative drainage area and
- run-off coefficient.

SARP River Classification Framework
Flow Variability Class (Median % variability)



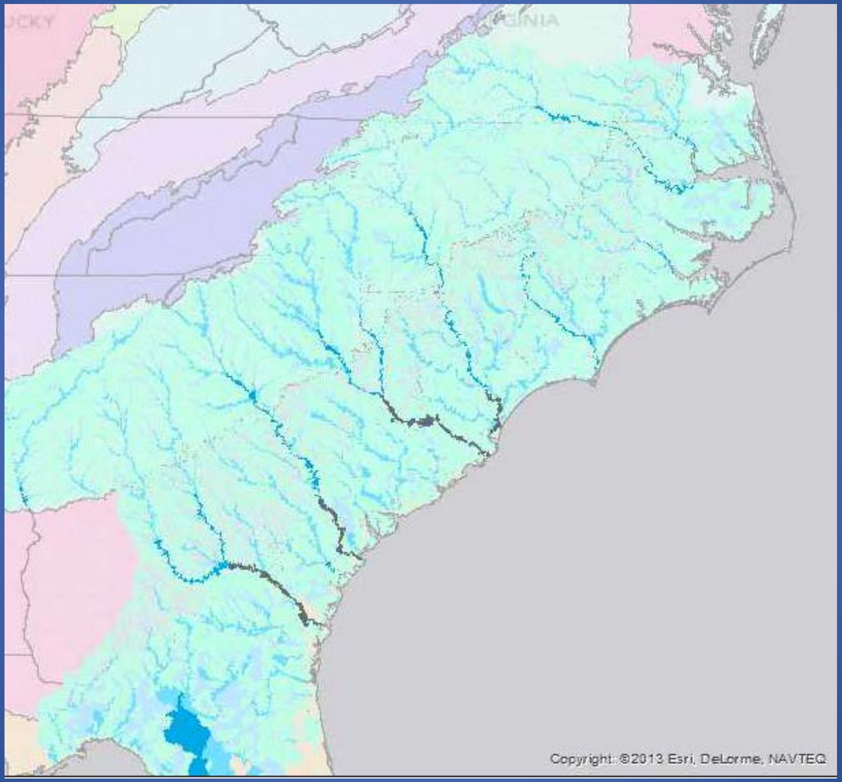
Use of the SARP River Classification Framework

River Class: EPA Level III Ecoregion



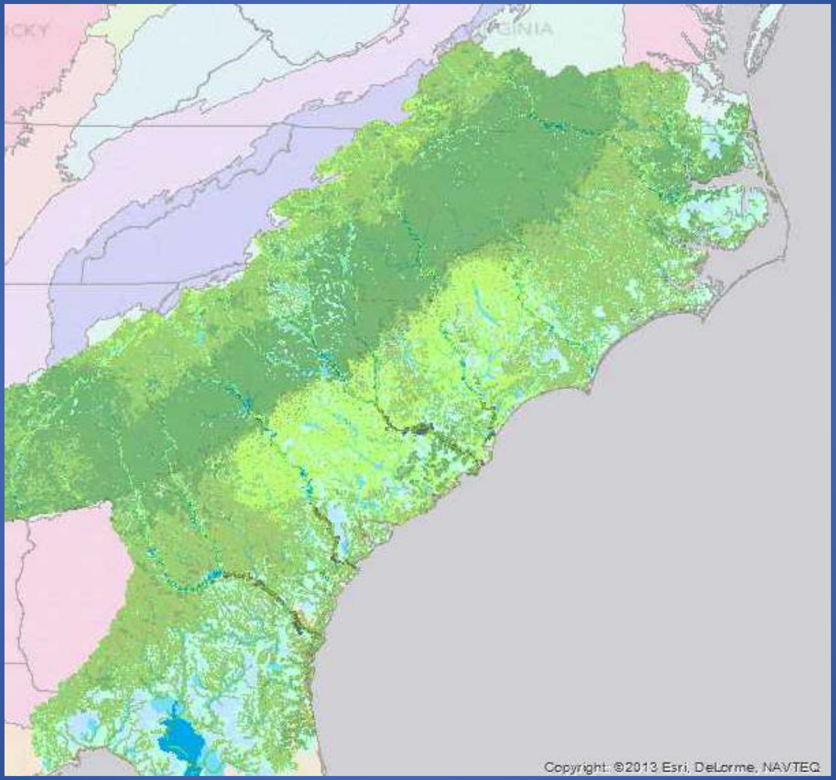
Use of the SARP River Classification Framework

River Class: Size within EPA Level III Ecoregion



Use of the SARP River Classification Framework

River Class: Flow Variability by Size within EPA Level III Ecoregion



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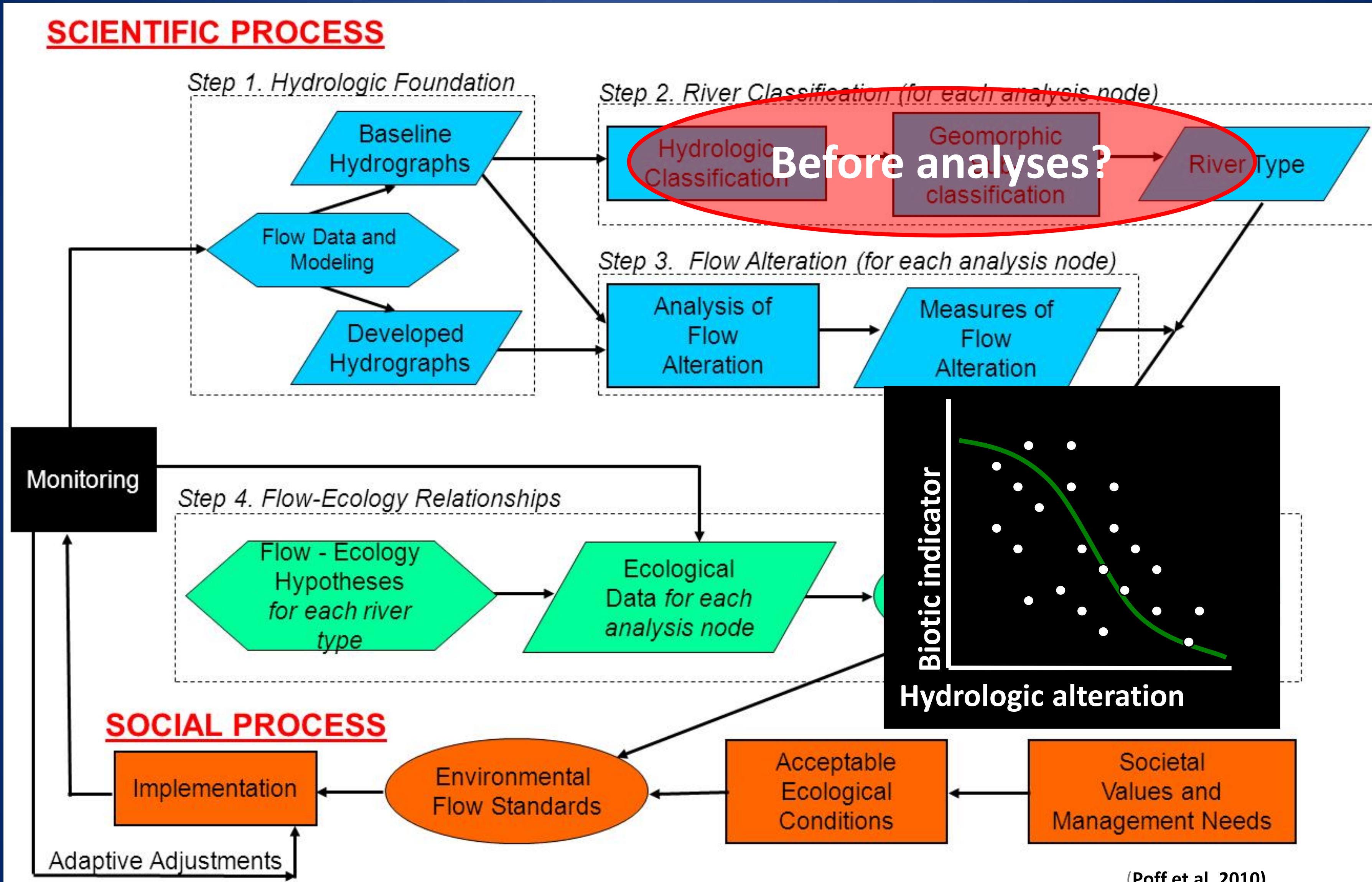
1. Present SARP River Classification Framework for the South Atlantic Landscape Conservation Cooperative region

2. Review uses of classification –

When do you classify?

– Michigan
– Potomac River Commission

Ecological Limits of Hydrologic Alteration (ELOHA)



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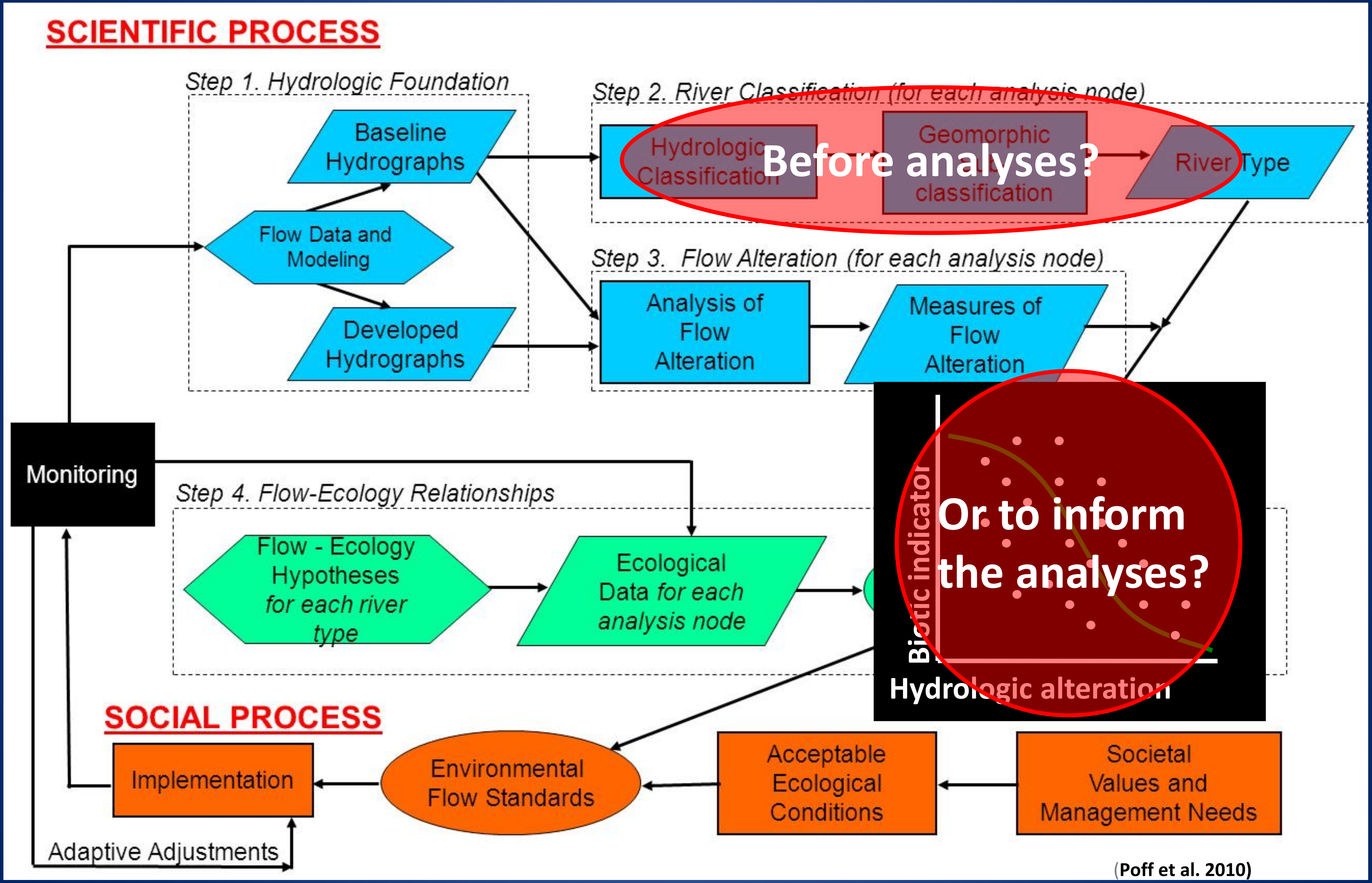

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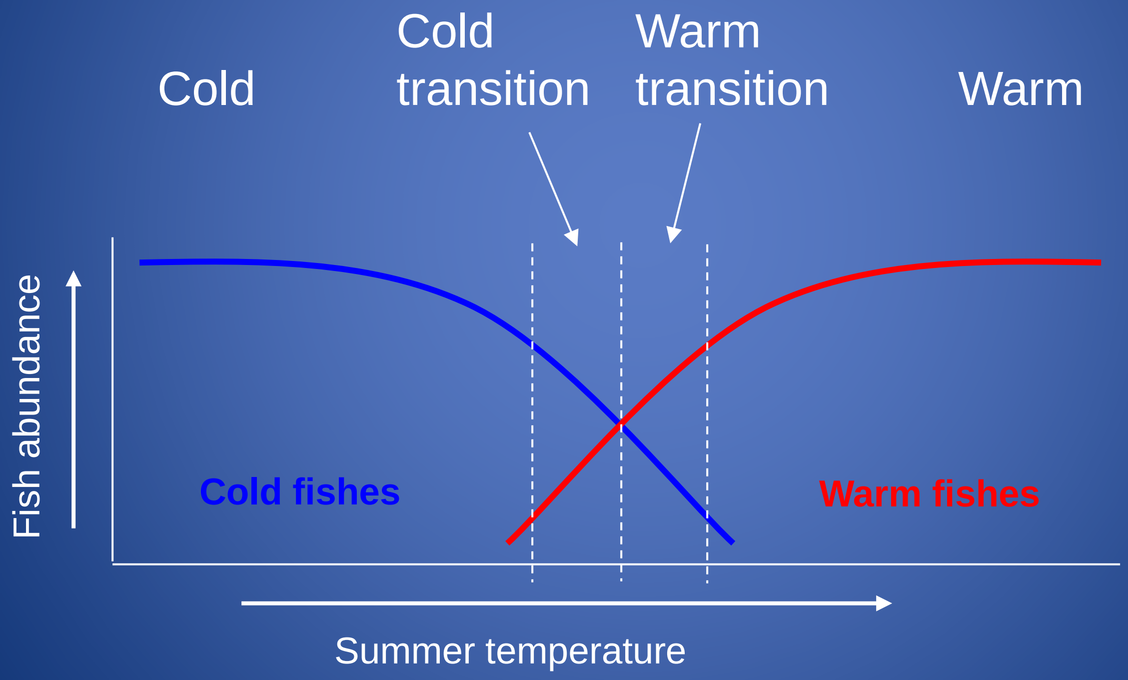
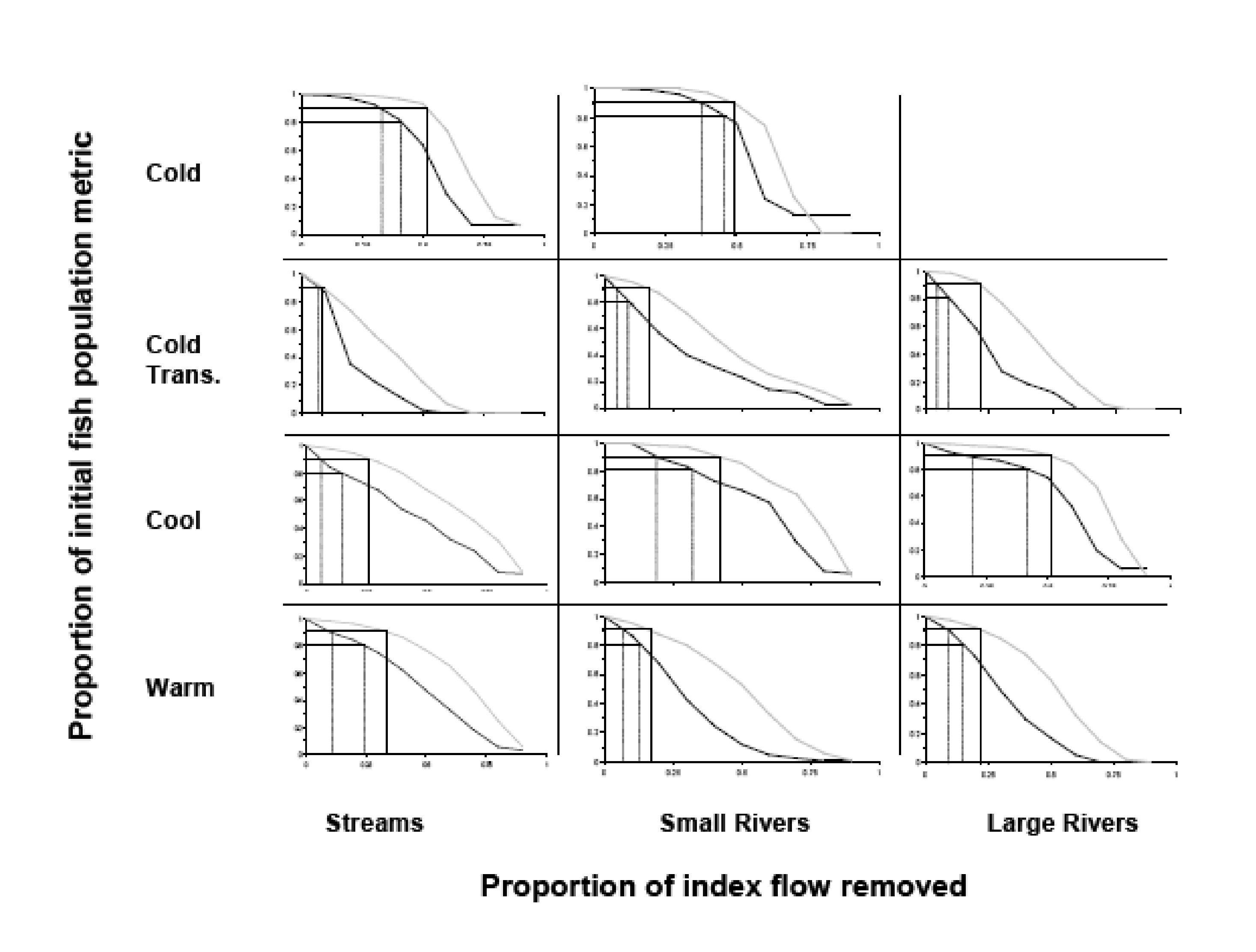
Michigan Instream Flow Standard Setting Process

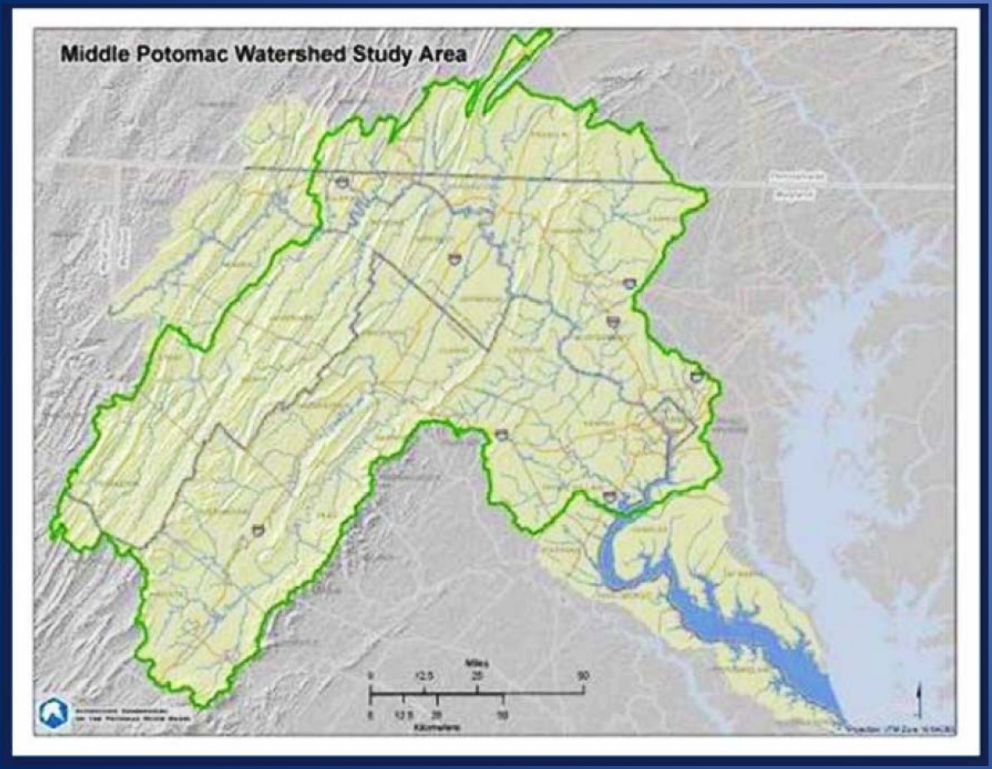
- Used fish assemblage temperature preferences to classify



Michigan's Instream Flow Standards by Class



Middle Potomac Watershed Assessment: Environmental Flows



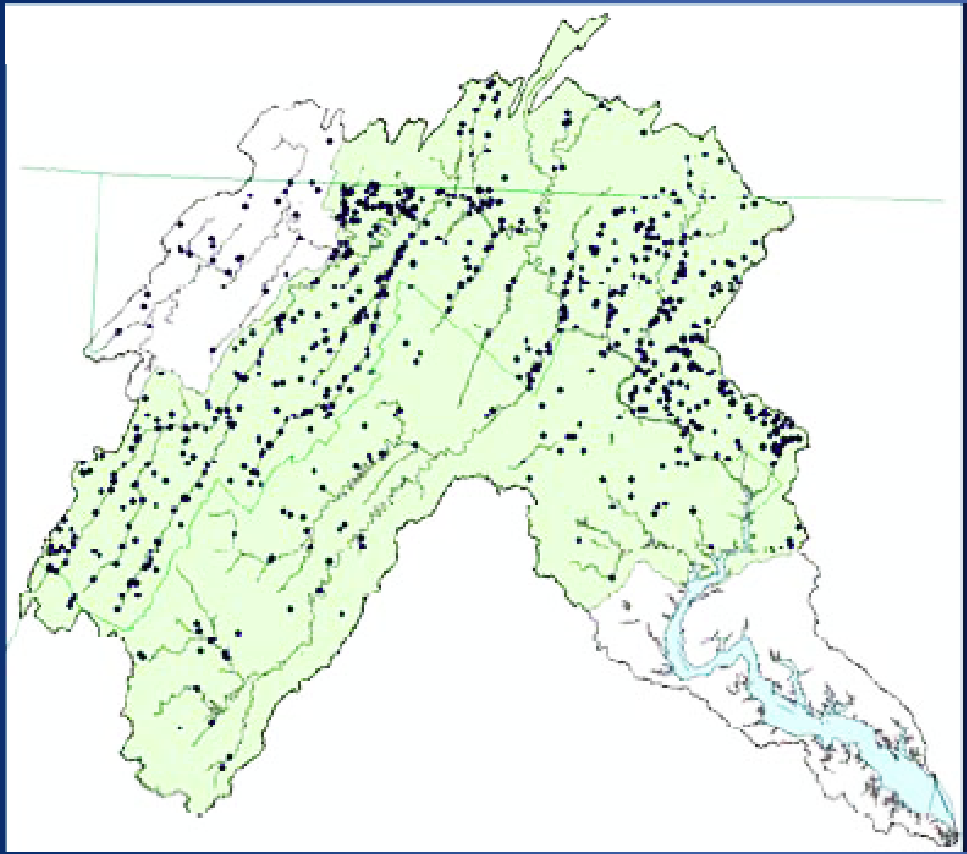
- Follows ELOHA framework
- Multistate watershed
- www.potomacriver.org

Slides courtesy of Carlton Haywood, PRC

Hydrologic Data

- Simulated daily flow time series for a current conditions scenario and for a baseline scenario
  - Current conditions:
    - 2000 land use
    - 2005 withdrawals, discharges, and impoundment volume
    - 1984-2005 hydrology
  - Baseline:
    - Land use modified to 78% forest, 0.35% impervious surface, other land uses adjusted proportionally,
    - Discharges and withdrawals set to zero.
    - No impoundments
- Flows simulated for 747 watersheds

Middle Potomac – Biological Data



1) Benthic macroinvertebrate data
   a) Only bio data set sufficiently rich for this basinwide, interstate, assessment
   b) Samples rarified to common basis and metrics calculated to family level for consistency

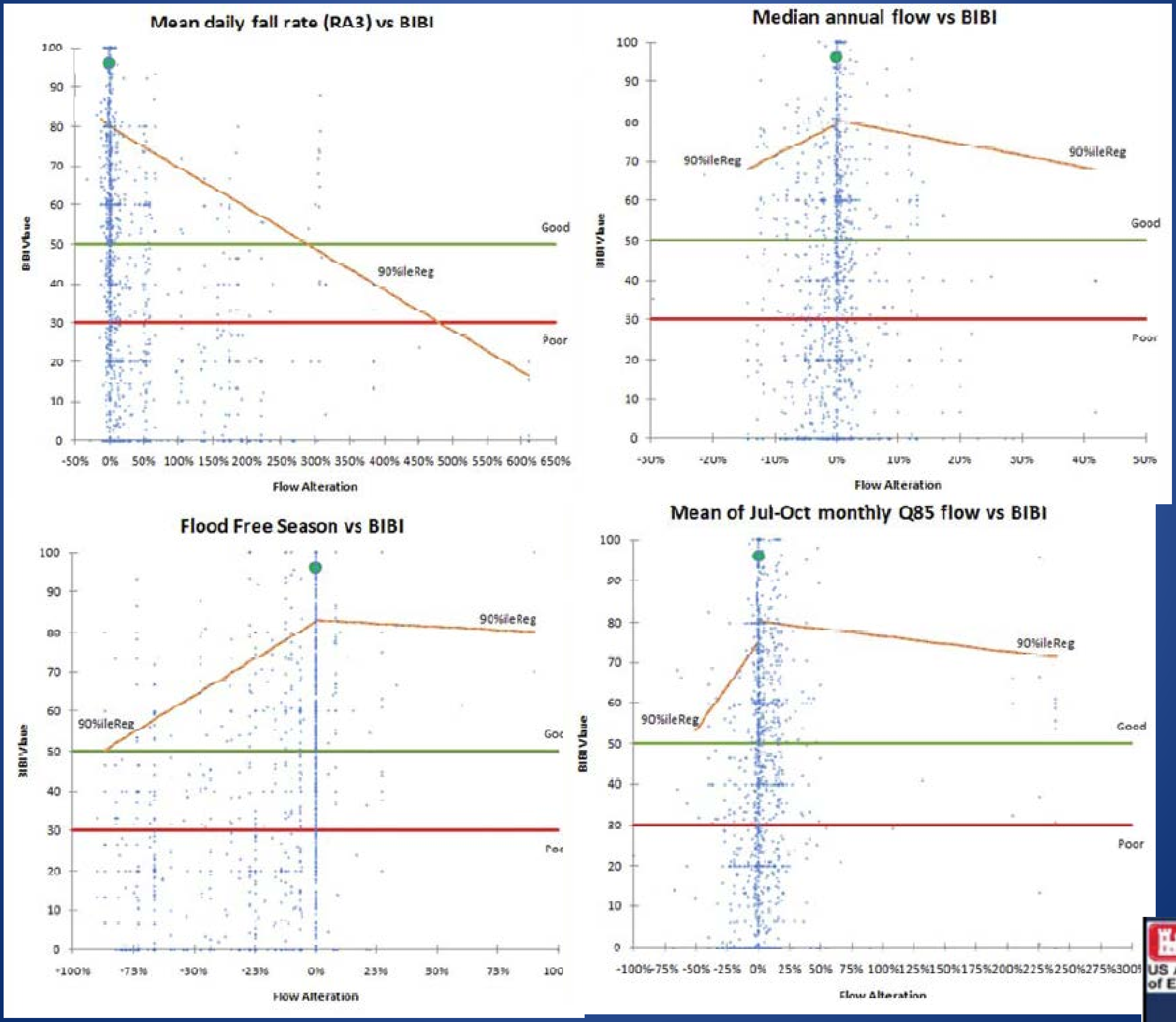
2) Collected in years 2000 – 2008

3) 1,313 samples at 869 locations for 747 watersheds

US Army Corps of Engineers

The Nature Conservancy
Protecting nature. Preserving life.

Flow-Ecology Relationships



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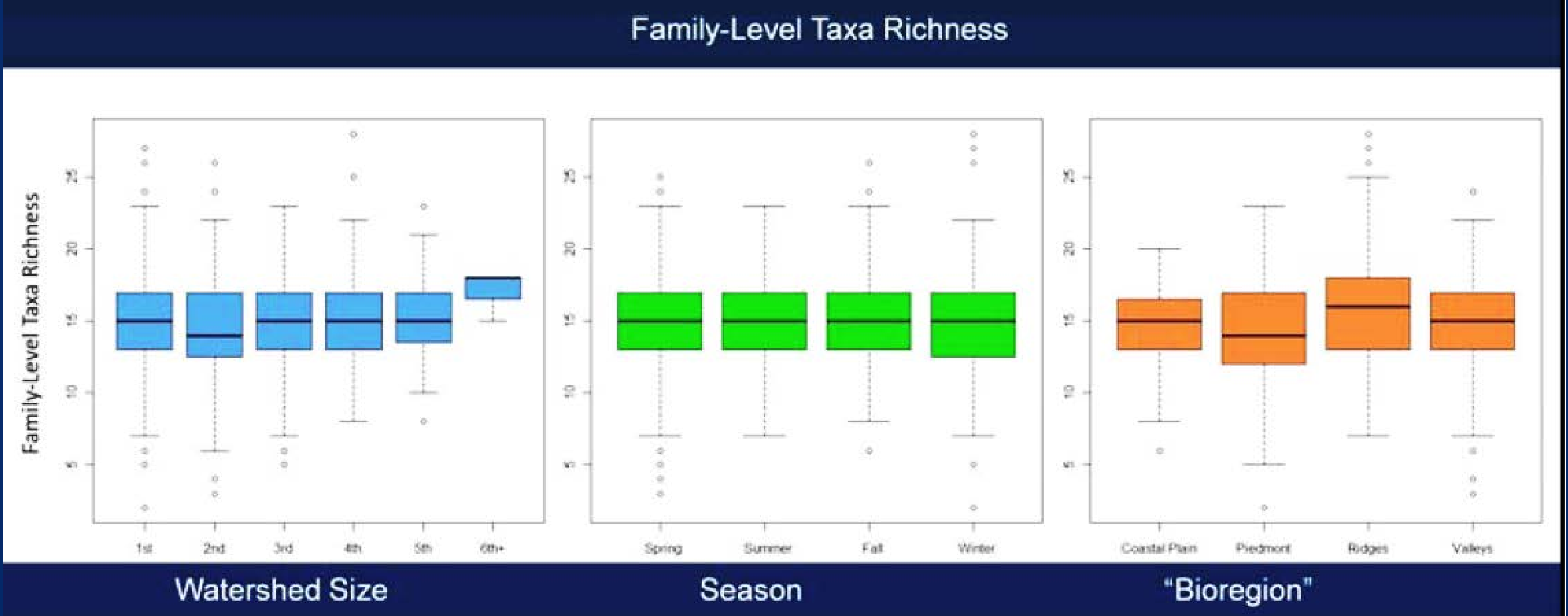
Classification

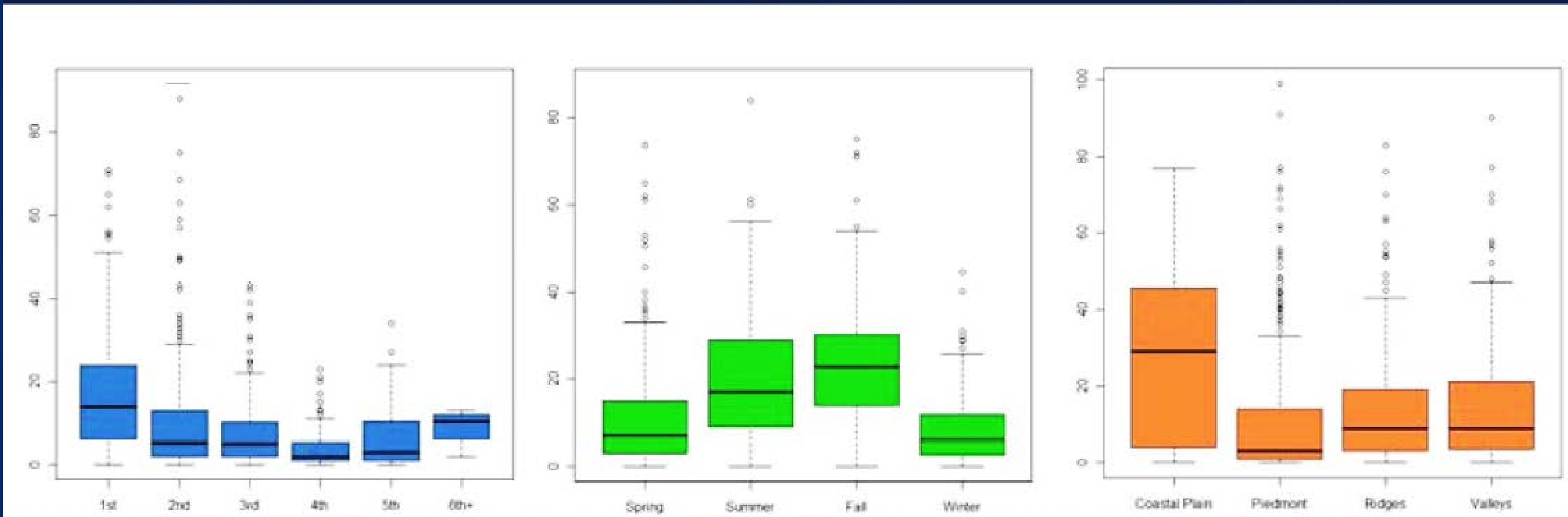
Some biological metrics appear not to need classification….



Classification

…while others may need classification

%Shredders | %Net Caddisfly | %Chironomidae



Watershed Size | Season | "Bioregion"

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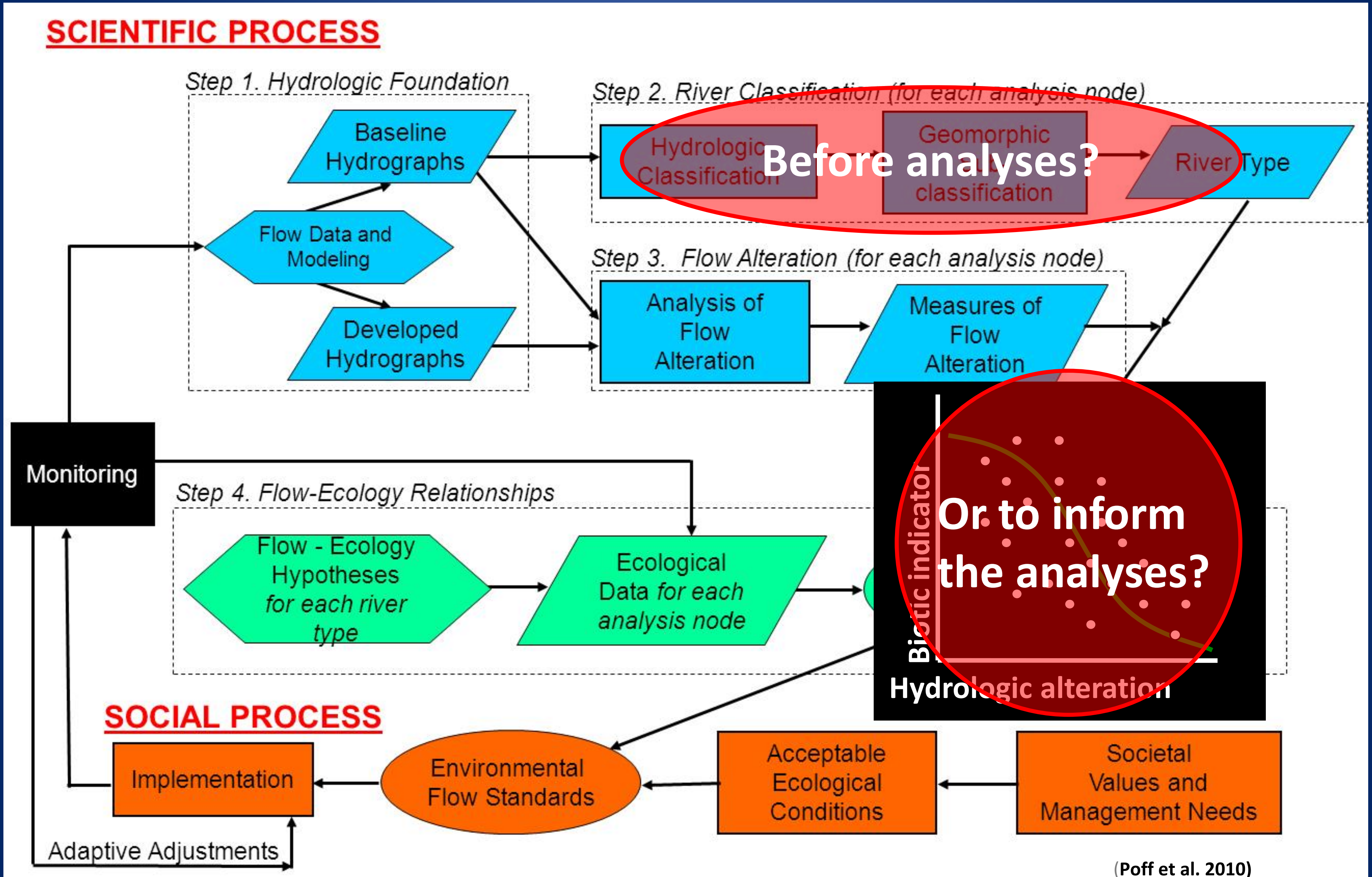

(Poff et al. 2010)

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When to classify for flow-ecology relationships?

The answer for when to classify seems to depend:

- Complexity of the system
- Parameters being analyses
- ???

Since the answer is not clear, a safe approach is to allow for exploration of both approaches and let the rivers direct the results.