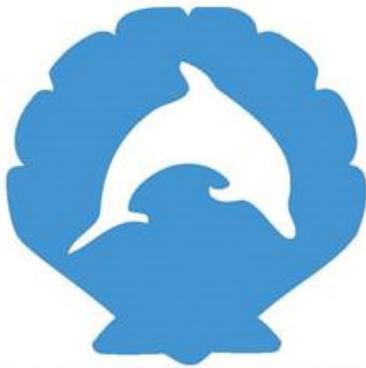


# Developing Management Level Nutrient Targets and Thresholds for Southwest Florida Tidal Creeks

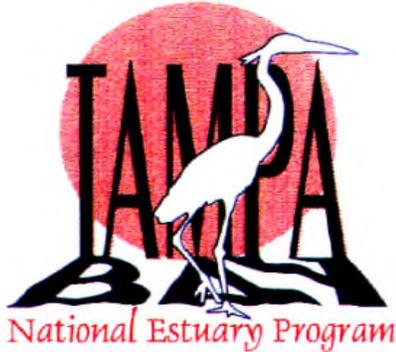
Presentation to the  
National Water Quality Monitoring  
Conference

Mike Wessel, Jay Leverone, Tony Janicki, Kellie Dixon, Ed Sherwood, Judy Ott

May 4, 2016



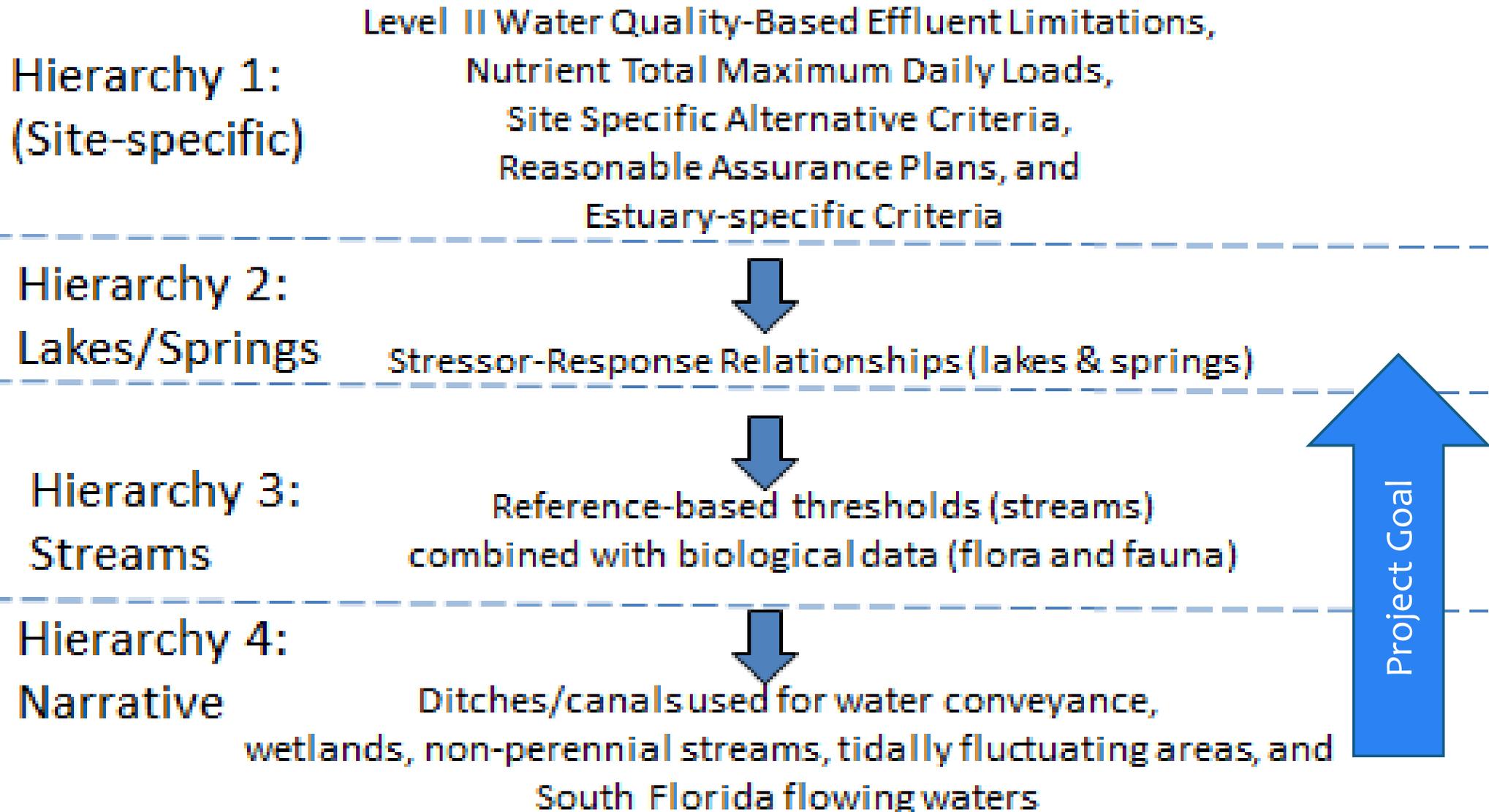
SARASOTA BAY  
ESTUARY PROGRAM  
*Restoring Our Bays*



# Multiple Project Goals

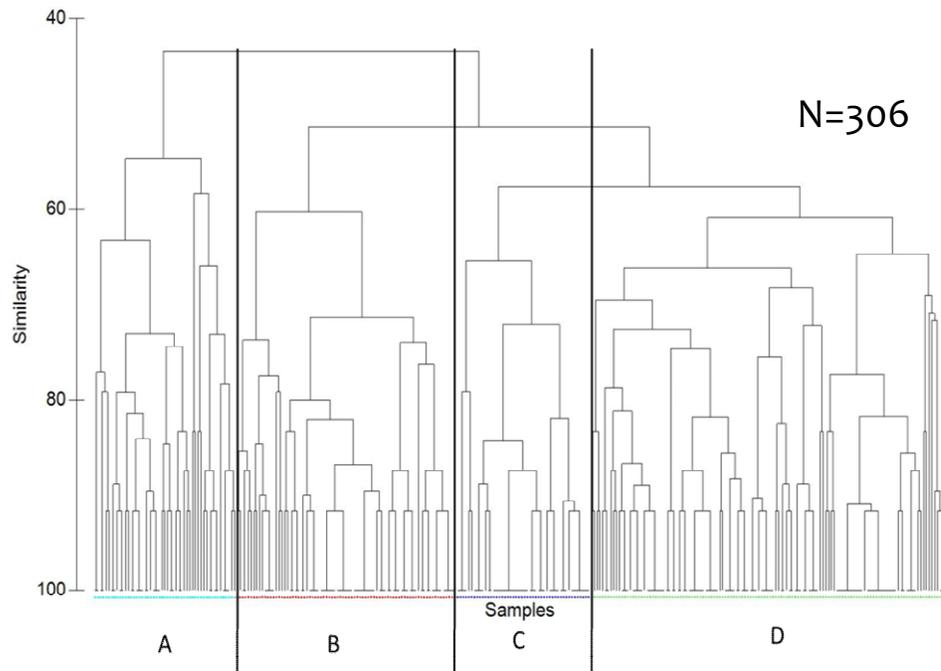
- Grantor (EPA Wetlands Program Development Grant)  
**Accelerate research on wetlands**
- National Estuary Programs/Stakeholders  
**Develop management level nutrient targets and thresholds for tidal creeks**
- FDEP/ EPA Standards  
**Inform regulatory criteria for tidal creeks**

# Florida Nutrient Criteria Development

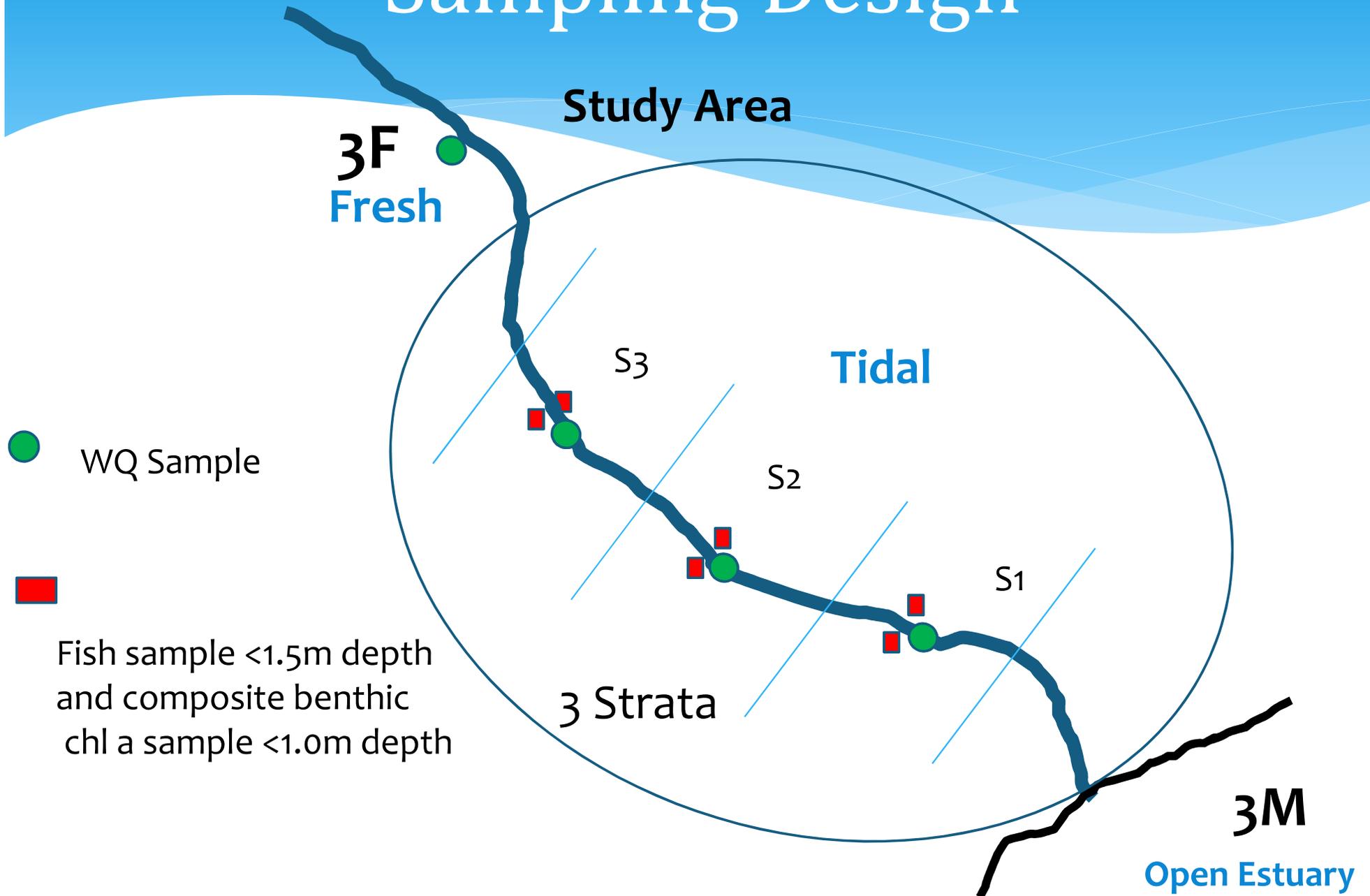


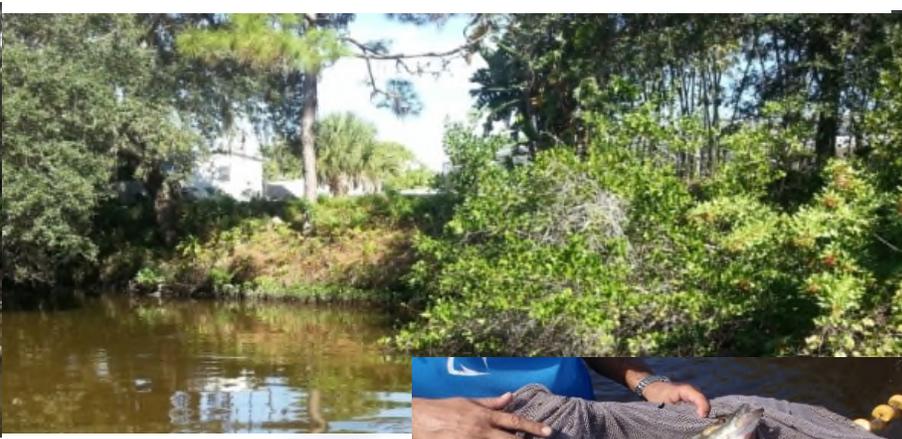
# Classification and Selection (16 creeks sampled)

## Creek Classification and Selection

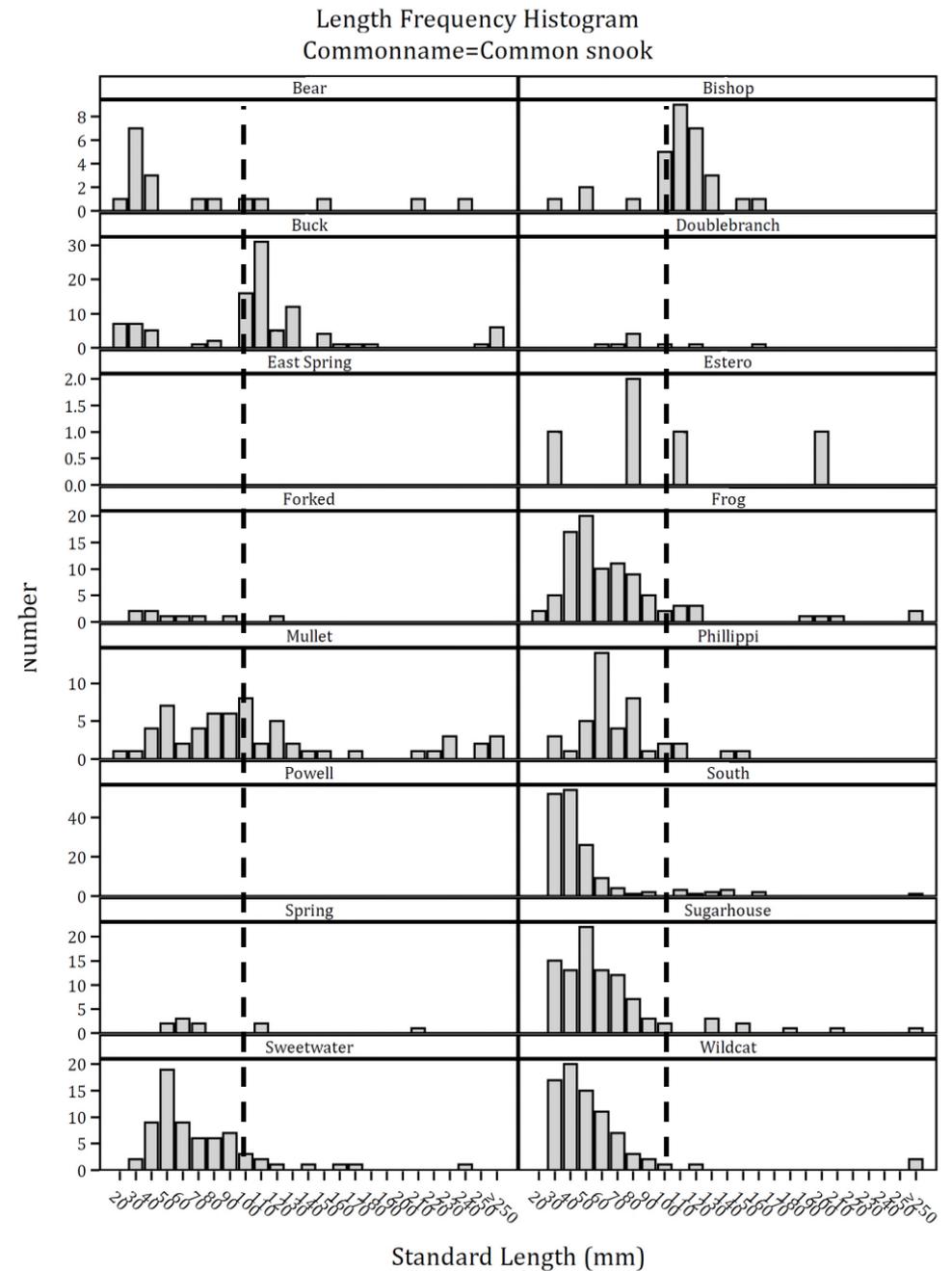
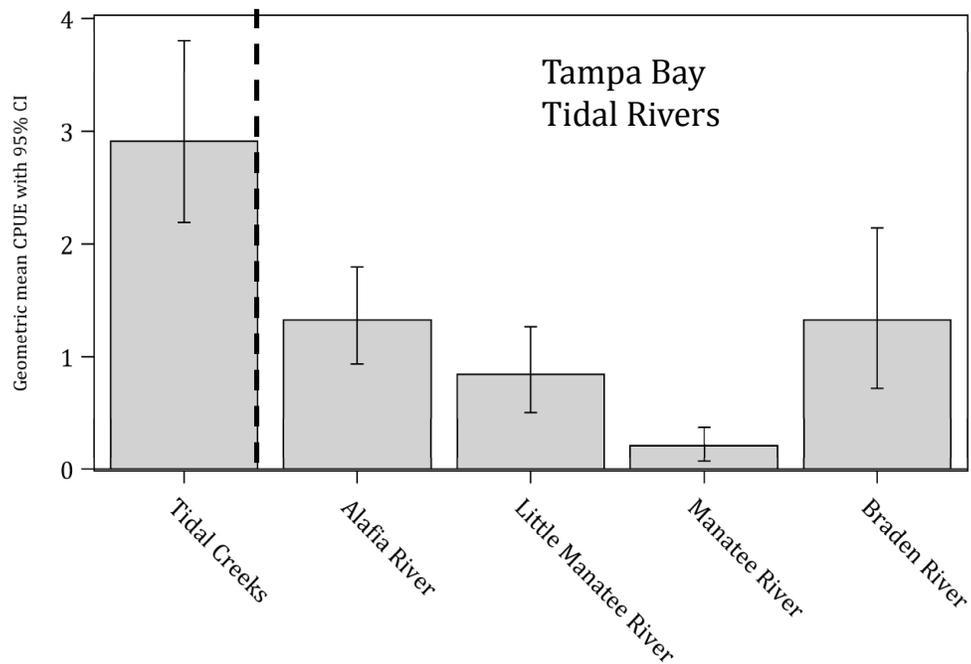
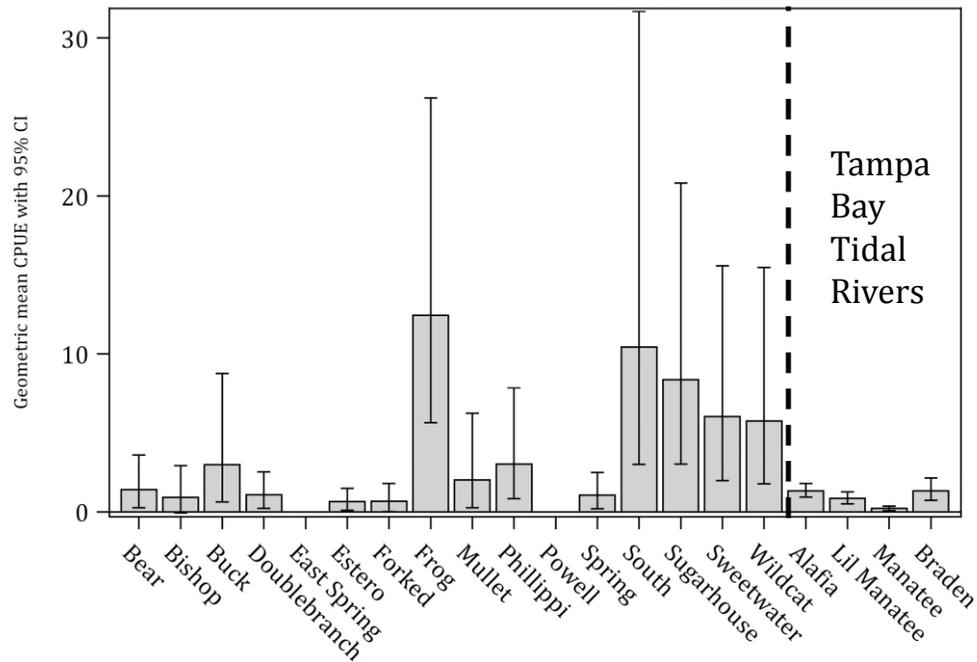


# Sampling Design





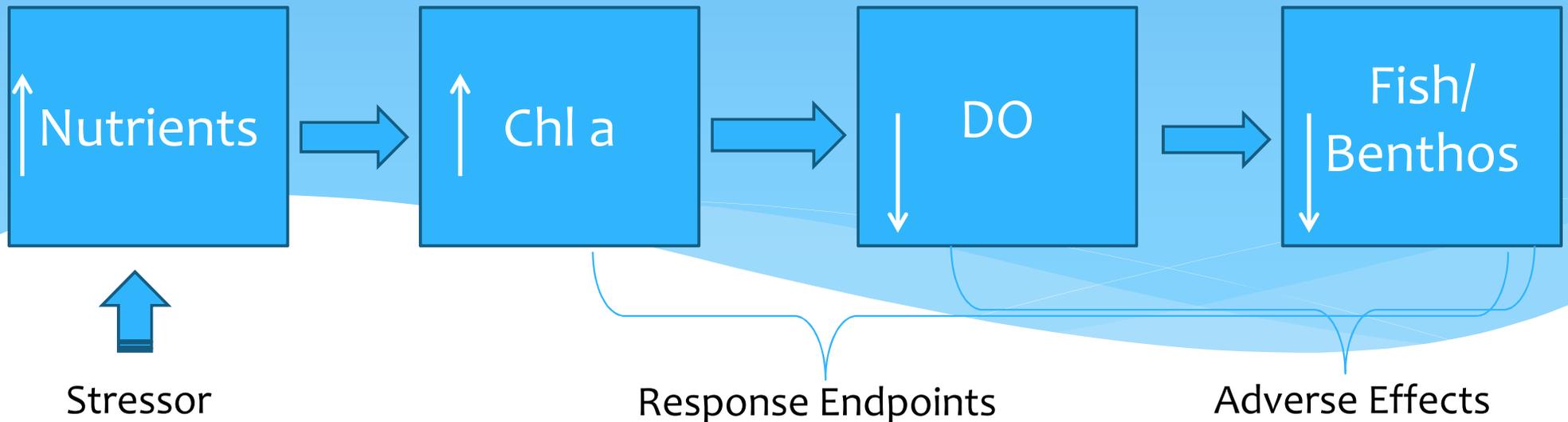
# Snook Statistics



# Current Narrative Thresholds

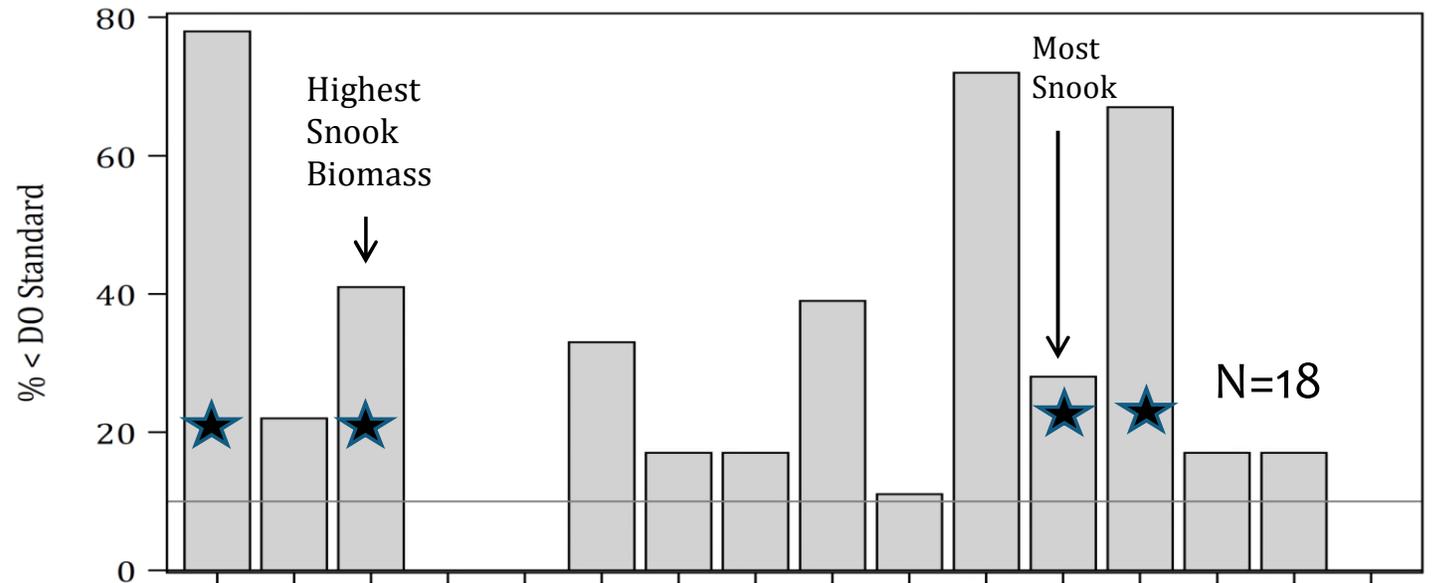
## Dissolved Oxygen and Chlorophyll *a*

### Surrogate Endpoints

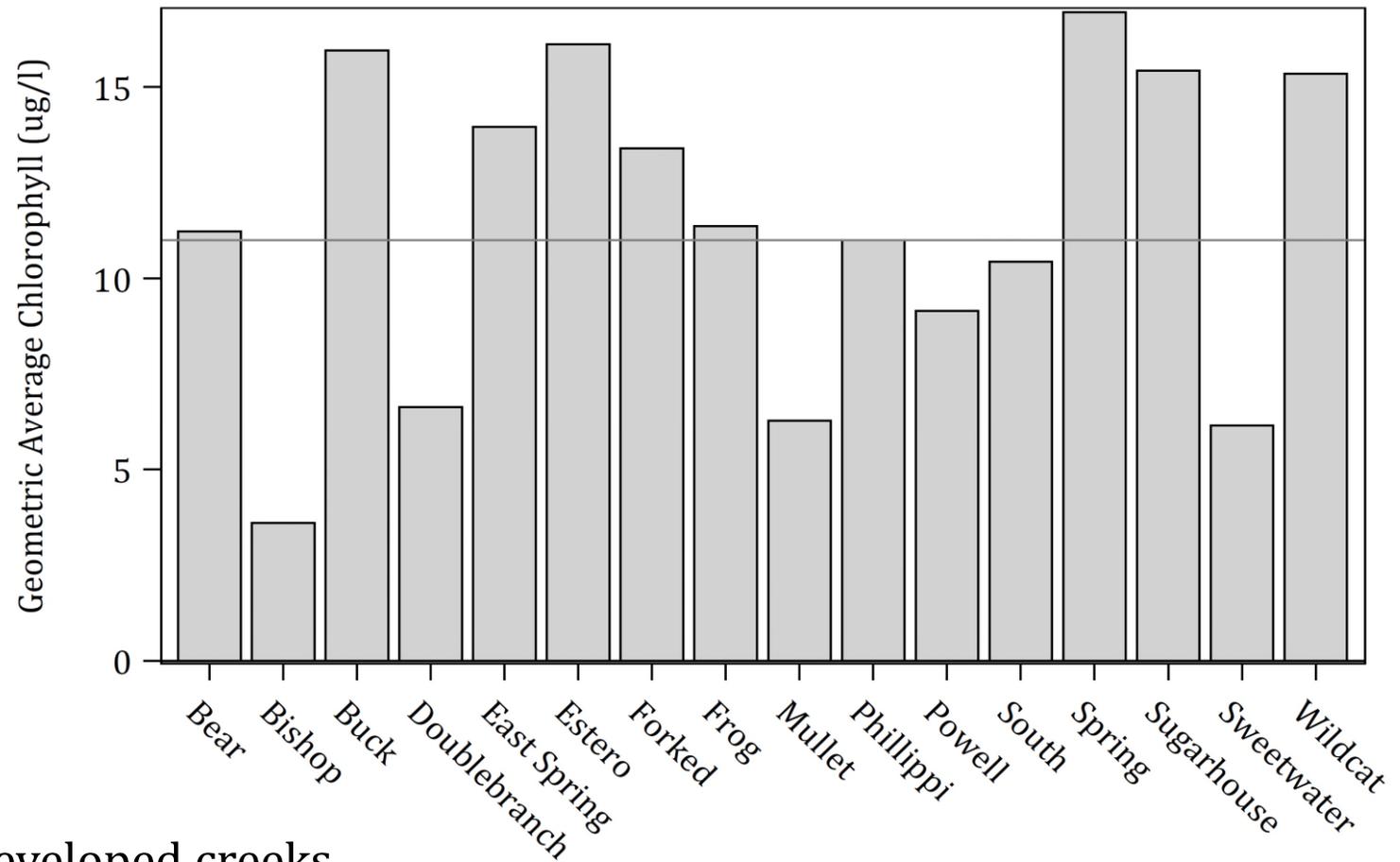


# Narrative Standards

## Estuarine DO Evaluation

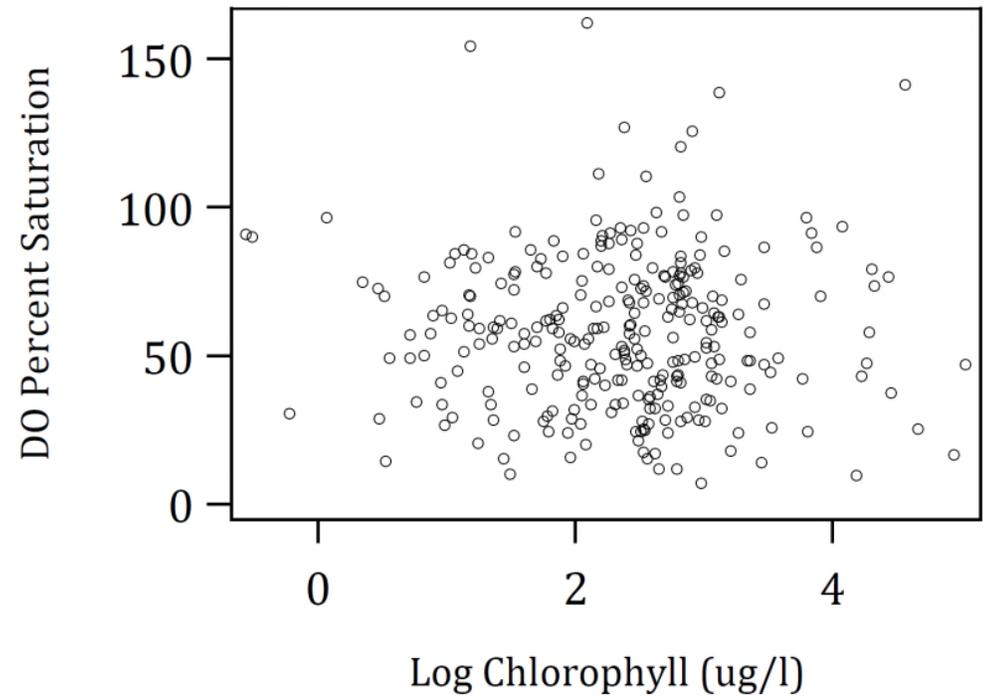
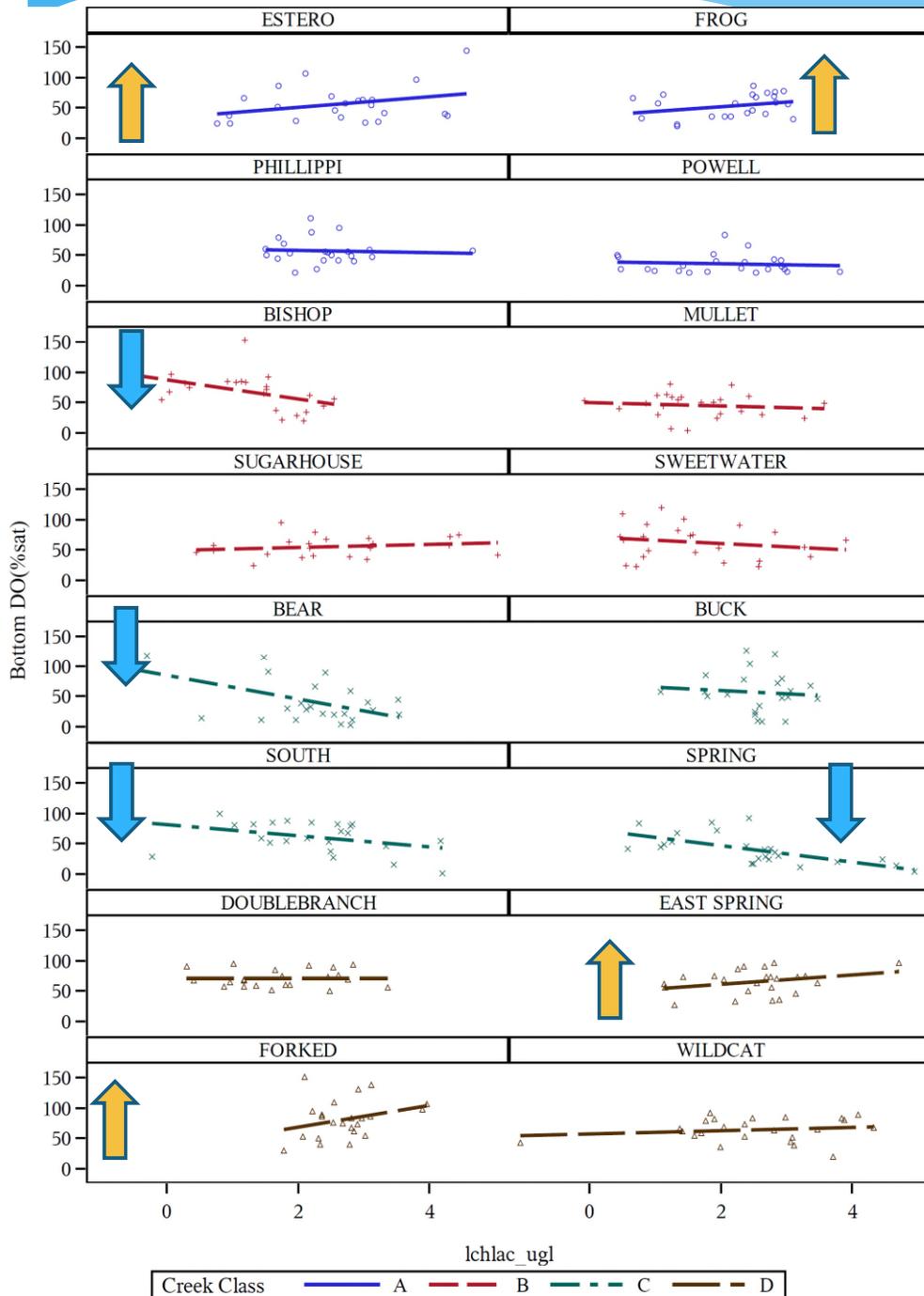


## Estuarine Chl a Evaluation

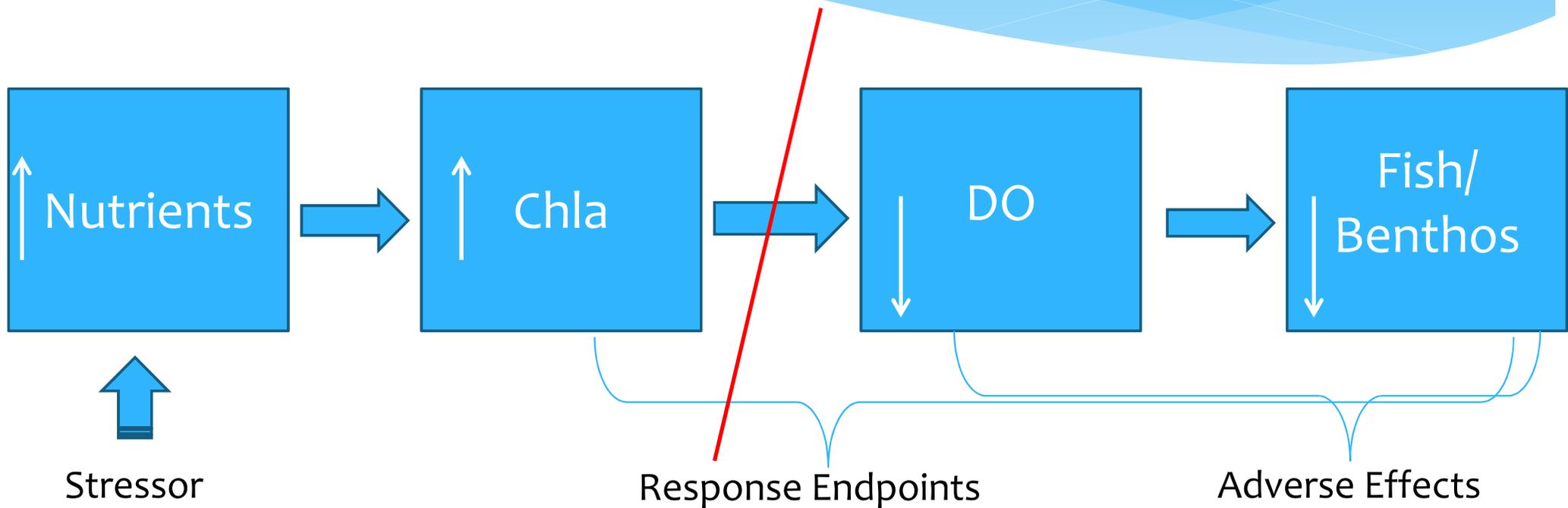


 = Class C : most undeveloped creeks

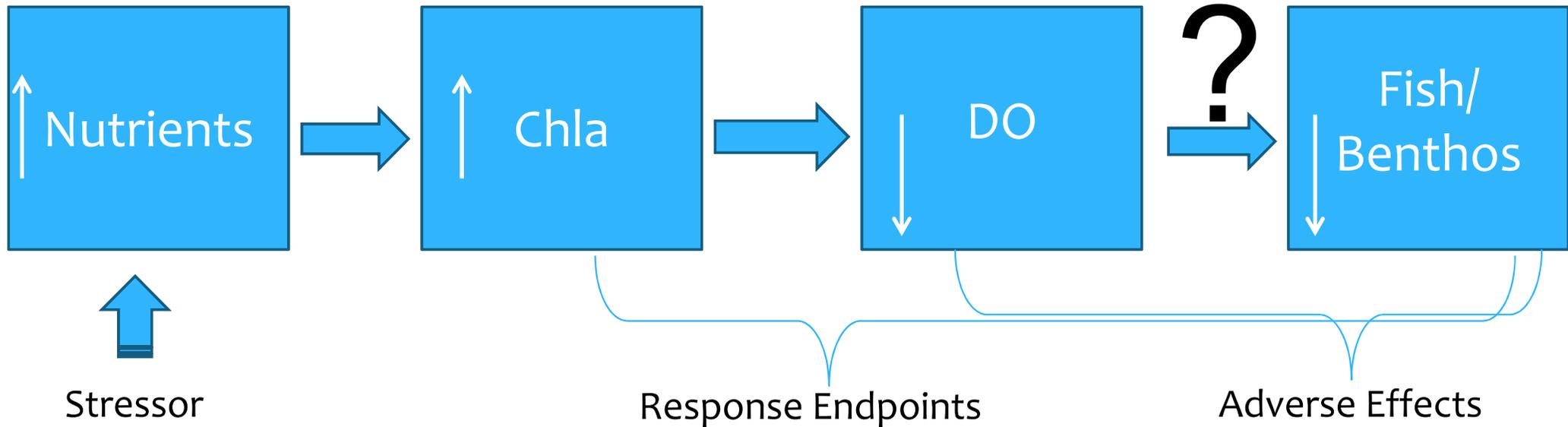
# Dissolved Oxygen and Chlorophyll a



# General Nutrient Management Model



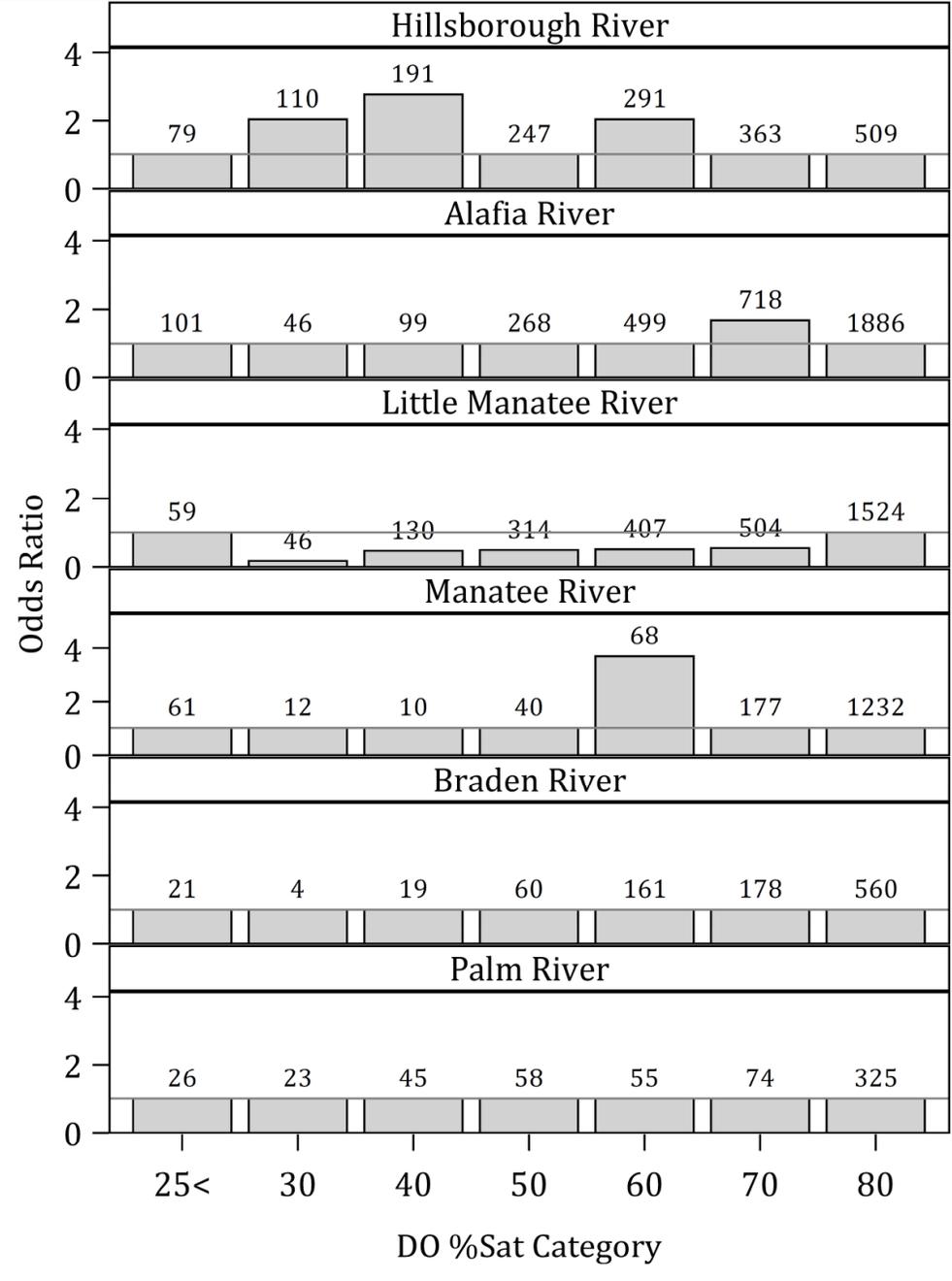
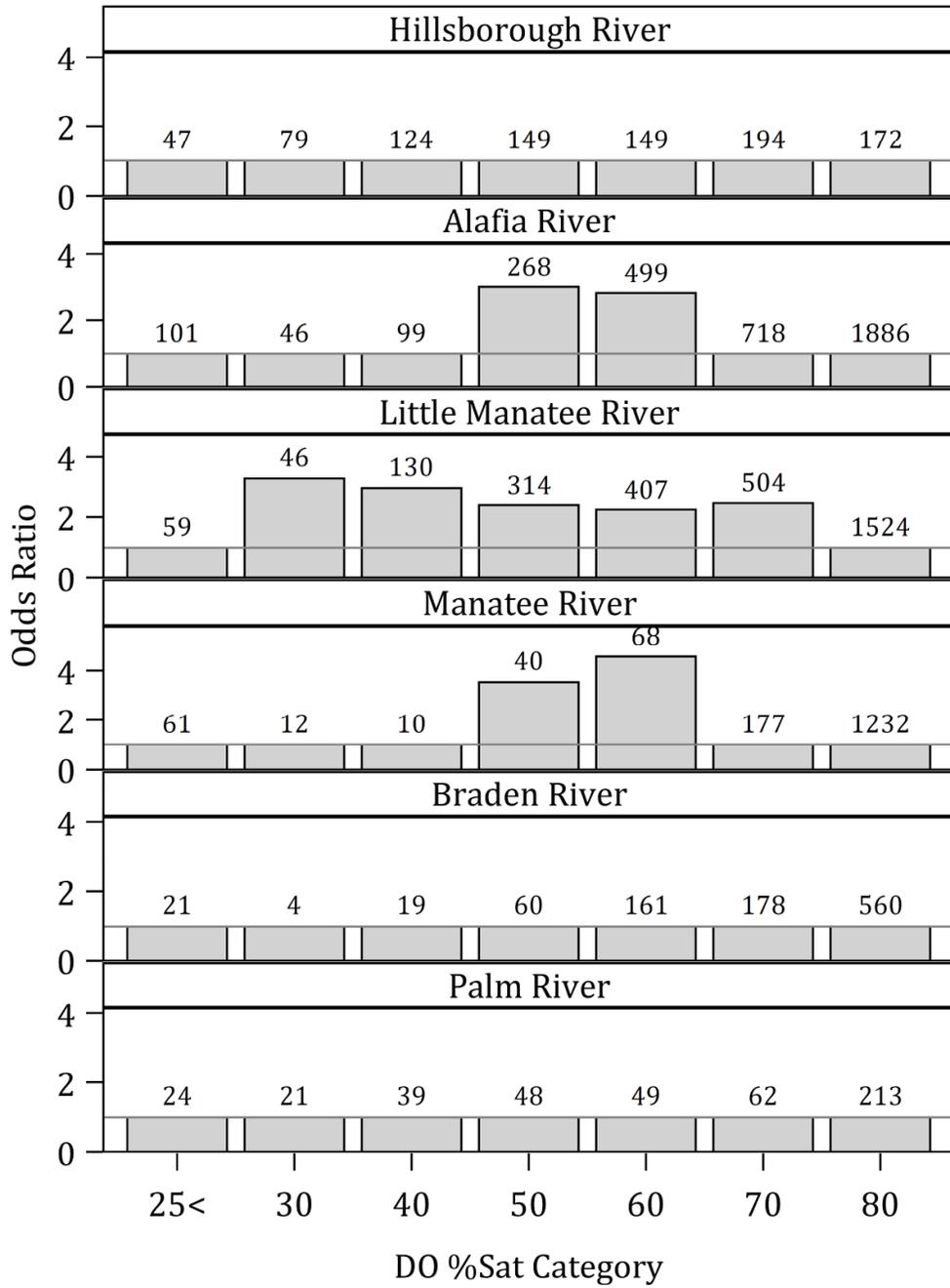
# General Nutrient Management Model



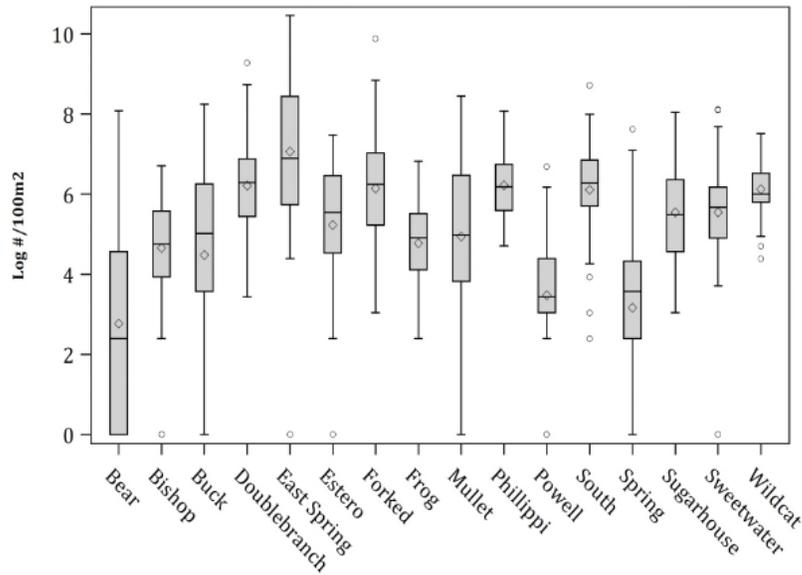
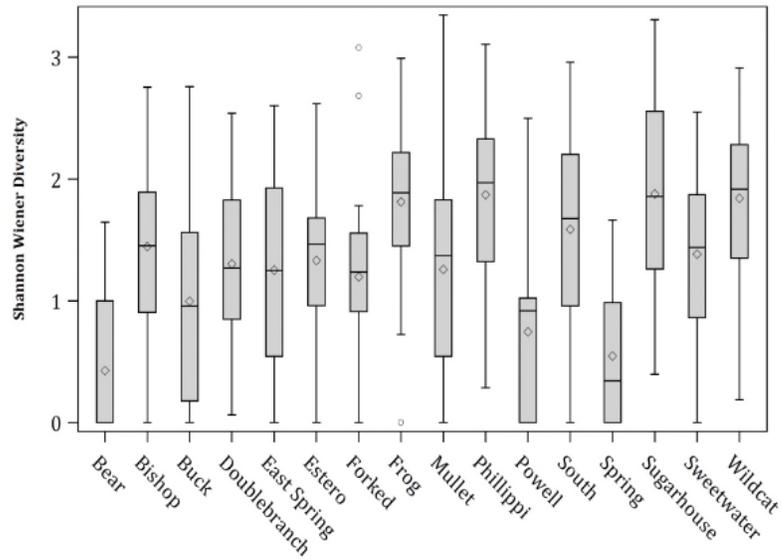
# DO Logistic Regression

Snook (*Centropomus undecimalis*)

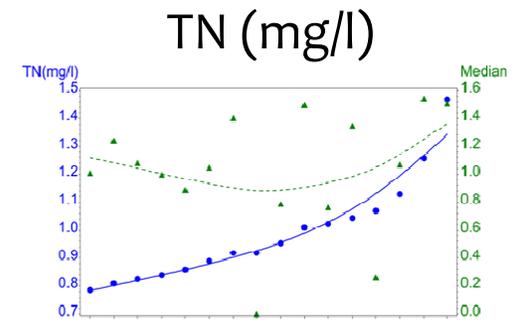
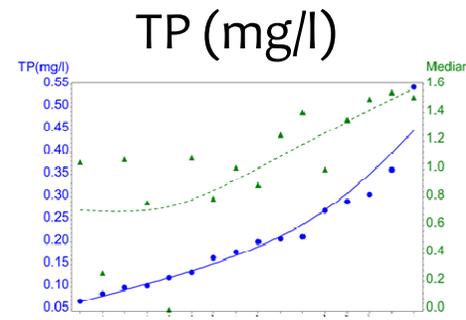
Naked Goby (*Gobiosoma bosc*)



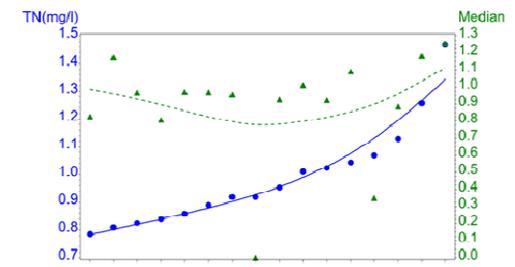
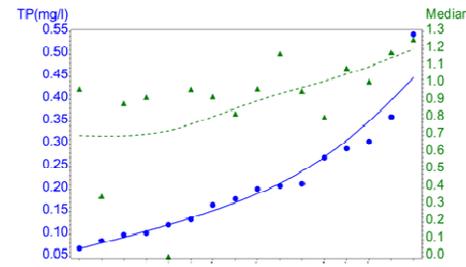
# Nutrients and Fish Diversity Indices



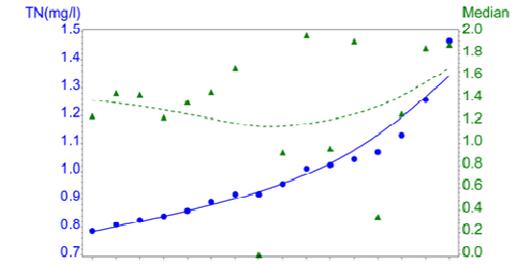
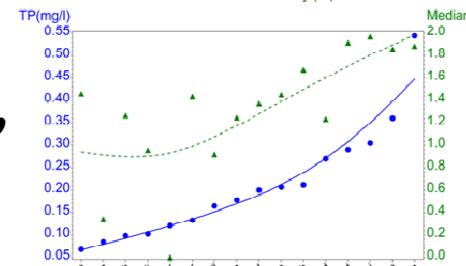
D



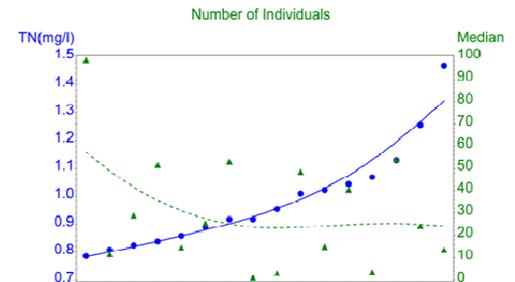
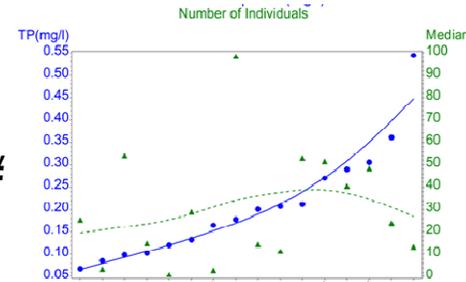
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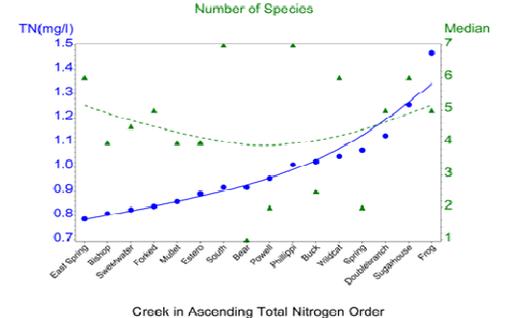
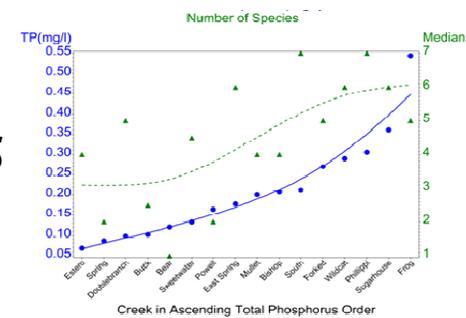
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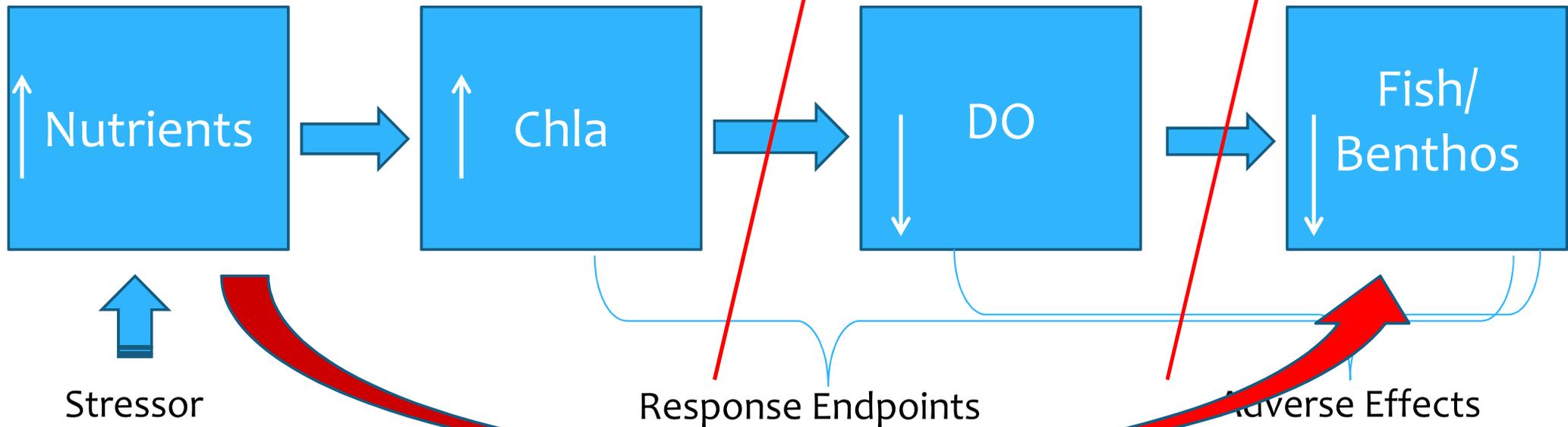
#



S



# General Nutrient Management Model



Dulce Vida

ORGANIC

TEQUILA

AUSTIN, TEXAS ★ GUADALAJARA, JA

IS EVERYTHING  
OK?

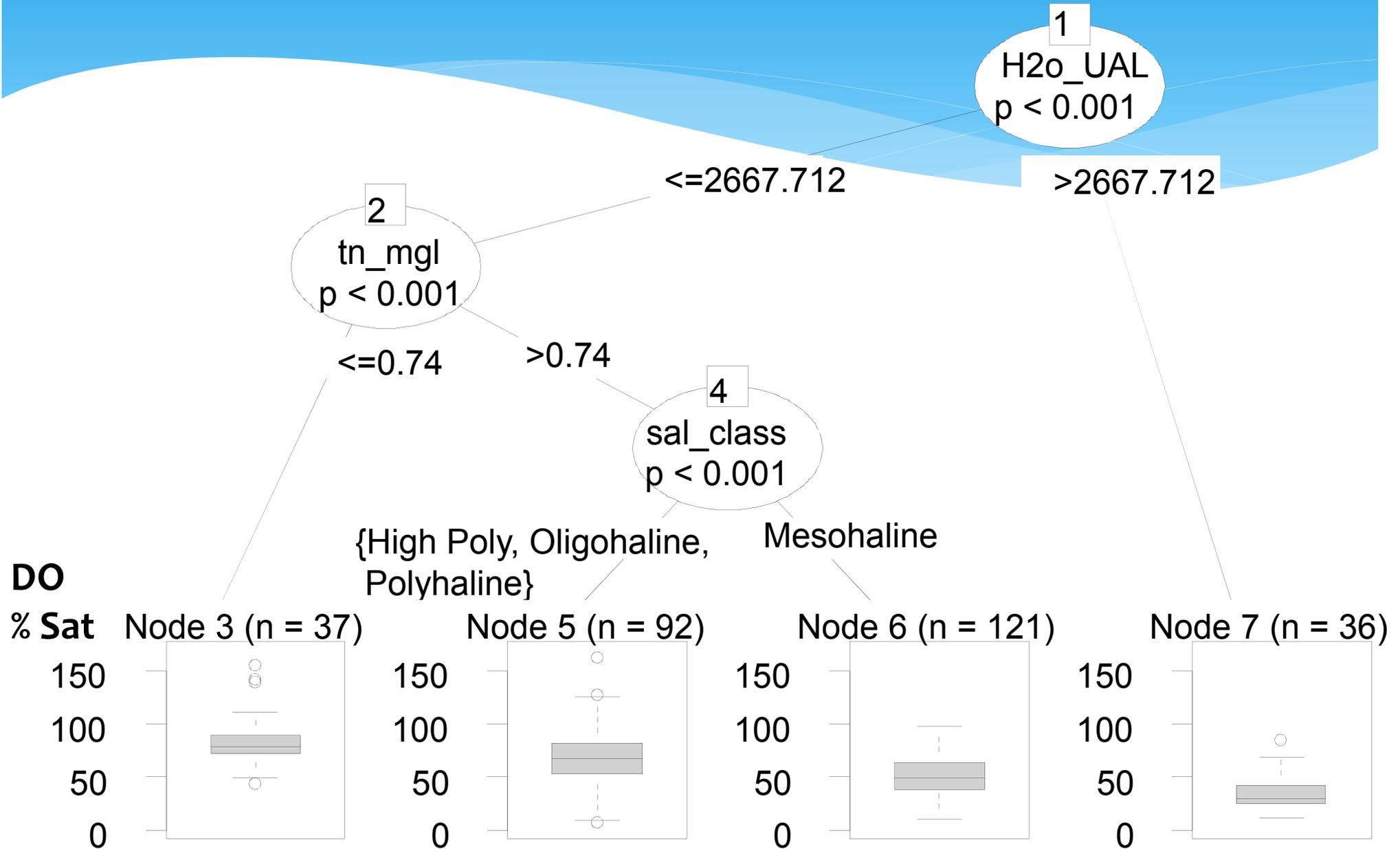
NO

YES

Have a  
margarita!

Dulce Vida  
ORGANIC  
TEQUILA

# Conditional Inference



# Habitat Interactions

## 50m Buffer Attributes

- LDI
- % Urban / % Natural
- USF Canopy Cover
- Number of veg species

## Watershed Attributes

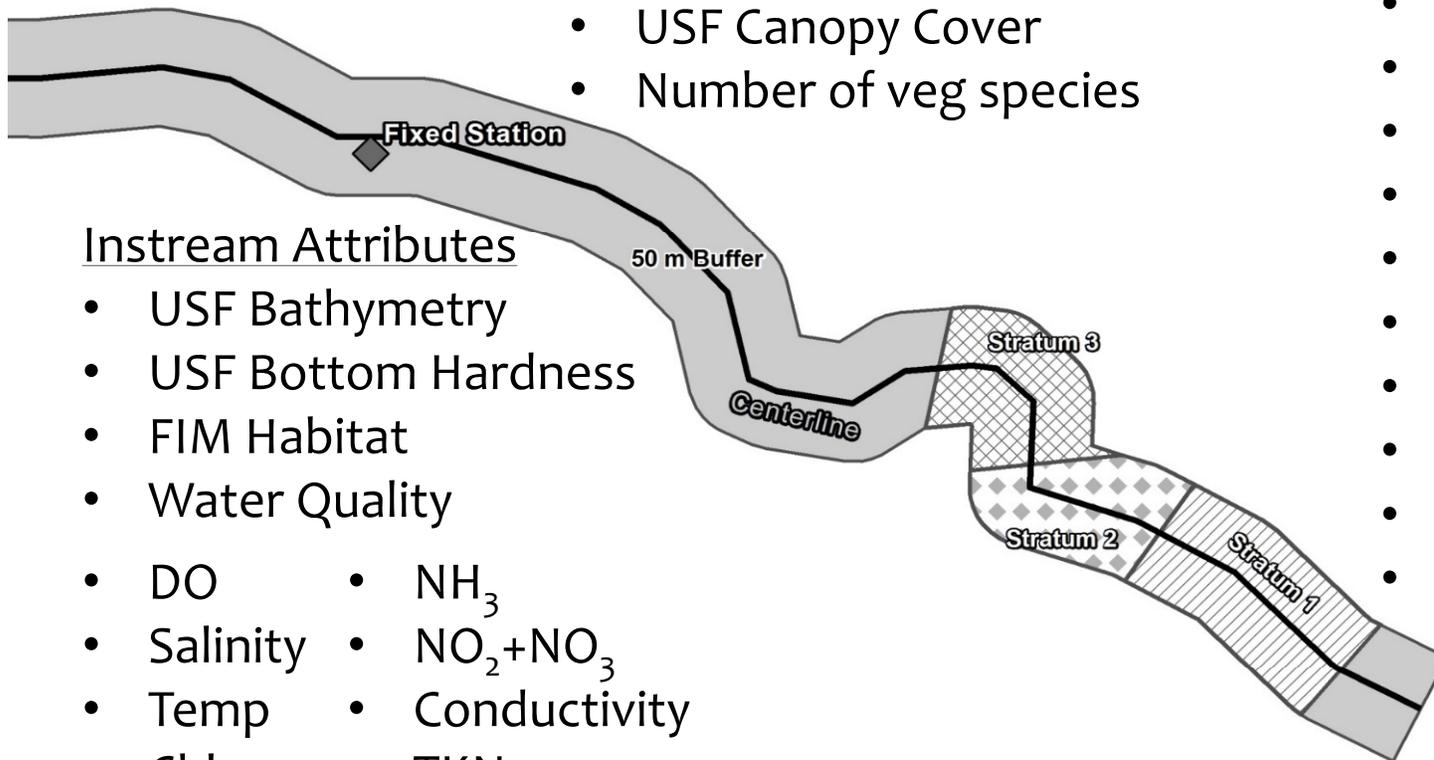
- Nutrient/Hyd Loads
- Soils
- Elevation
- LDI
- Acres of Ag -Golf
- Impervious Area
- Stormwater Treatment
- Road Density
- Distance to Nearest Pass
- Bed Sediment Phosphorus
- USF- # Observed Outfalls

## Instream Attributes

- USF Bathymetry
- USF Bottom Hardness
- FIM Habitat
- Water Quality
- DO
- Salinity
- Temp
- Chl *a*
- Turbidity
- TN
- NH<sub>3</sub>
- NO<sub>2</sub>+NO<sub>3</sub>
- Conductivity
- TKN
- Orthophosphate
- TP

## Instream Biological Responses

- Dissolved Oxygen
- Nutrients
- Water Column and Benthic Chlorophyll
- Ratio of Water Column/Benthic Chlorophyll



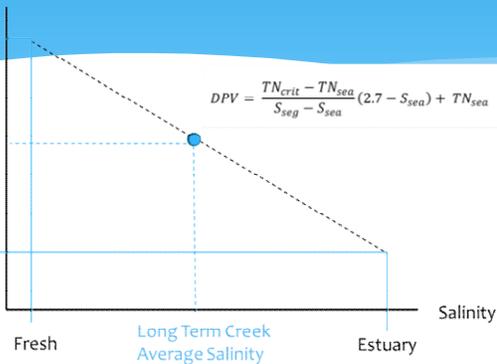
Response Variable	Predictor	Percent of Variance explained
Water column average (DO % sat)	CDOM 345, TN , OPO4, H2O_UAL, Natural Buffer Proportion, Salinity Class	42.03%
Water Column Chlorophyll	TKN, TN, NH3, OrgP, Turbidity, Natural Buffer Proportion	46.84%
Total Nitrogen	TP, CDOM, Turbidity, OPO4, OrgP, Proportion of agriculture in the buffer, Acreage of golf course in the watershed, Natural buffer proportion, and the number of outfalls in the surveyed portion of the creek	69.97%
Total Phosphorus	Creek Length, TN, Proportion of agriculture in the buffer, TKN, Acreage of golf course in the watershed, Natural buffer proportion, and the number of outfalls in the surveyed portion of the creek	84.24%
Benthic Chlorophyll (BMAC)	Salinity, OPO4, CDOM, Natural buffer proportion, Creek length, TP, and Nh3	20.27%
Chlorophyll Ratio	TKN, TN, Nh3, NO23, Turbidity, Natural buffer proportion, OPO4, TP, and CDOM	34.05%

# Mixing Curves/Nutrient Dynamics

Example TN  
Freshwater  
Criterion 1.65

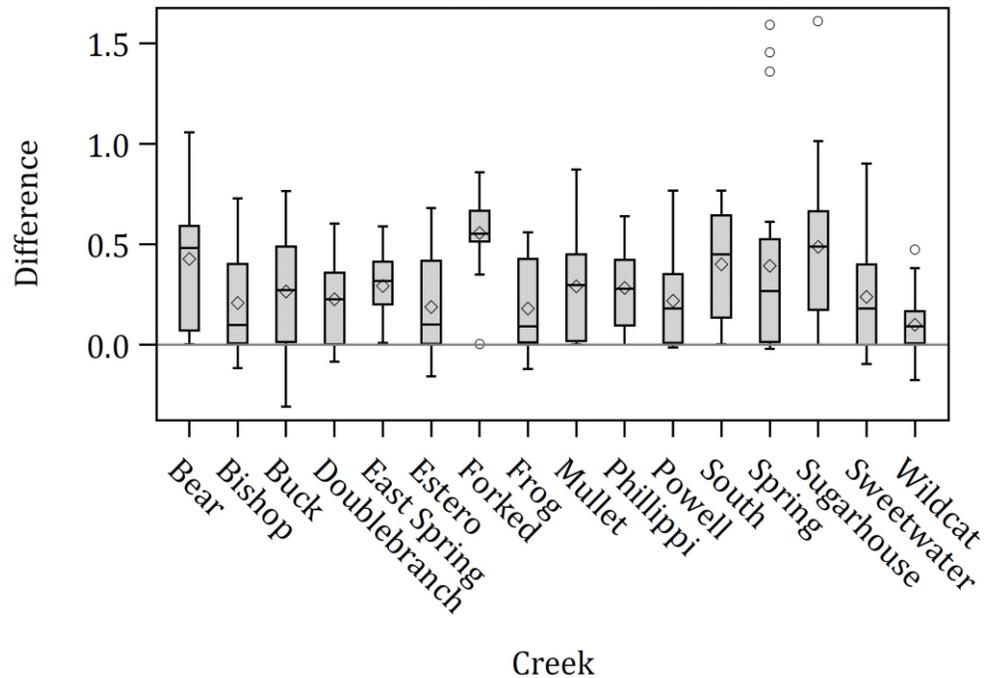
Proposed Creek  
Criterion

Example TN  
Estuary  
Criterion 0.50

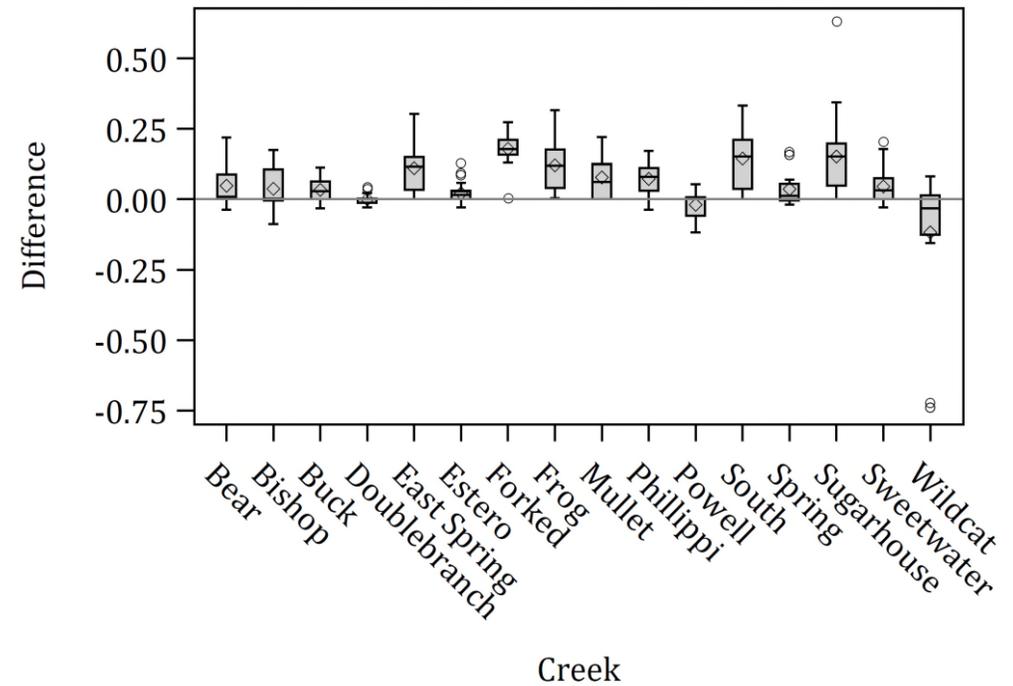


Based on EPA 2012

Parameter=Total Nitrogen (mg/l)



Parameter=Total Phosphorus (mg/l)



# Review of Findings

- \* Tidal creeks are critical habitat for estuarine dependent fish.
- \* The water quality was characteristic of wetland environments.
- \* Existing DO and Chlorophyll criteria not reliable indicator of nutrient impairment in southwest Florida tidal creeks.
- \* Tidal portion can contribute nutrients to the system.
- \* Unclear if addition is natural or anthropogenic.
- \* Observed nutrient levels have not yet resulted in highly eutrophic or dystrophic conditions in sampled creeks.

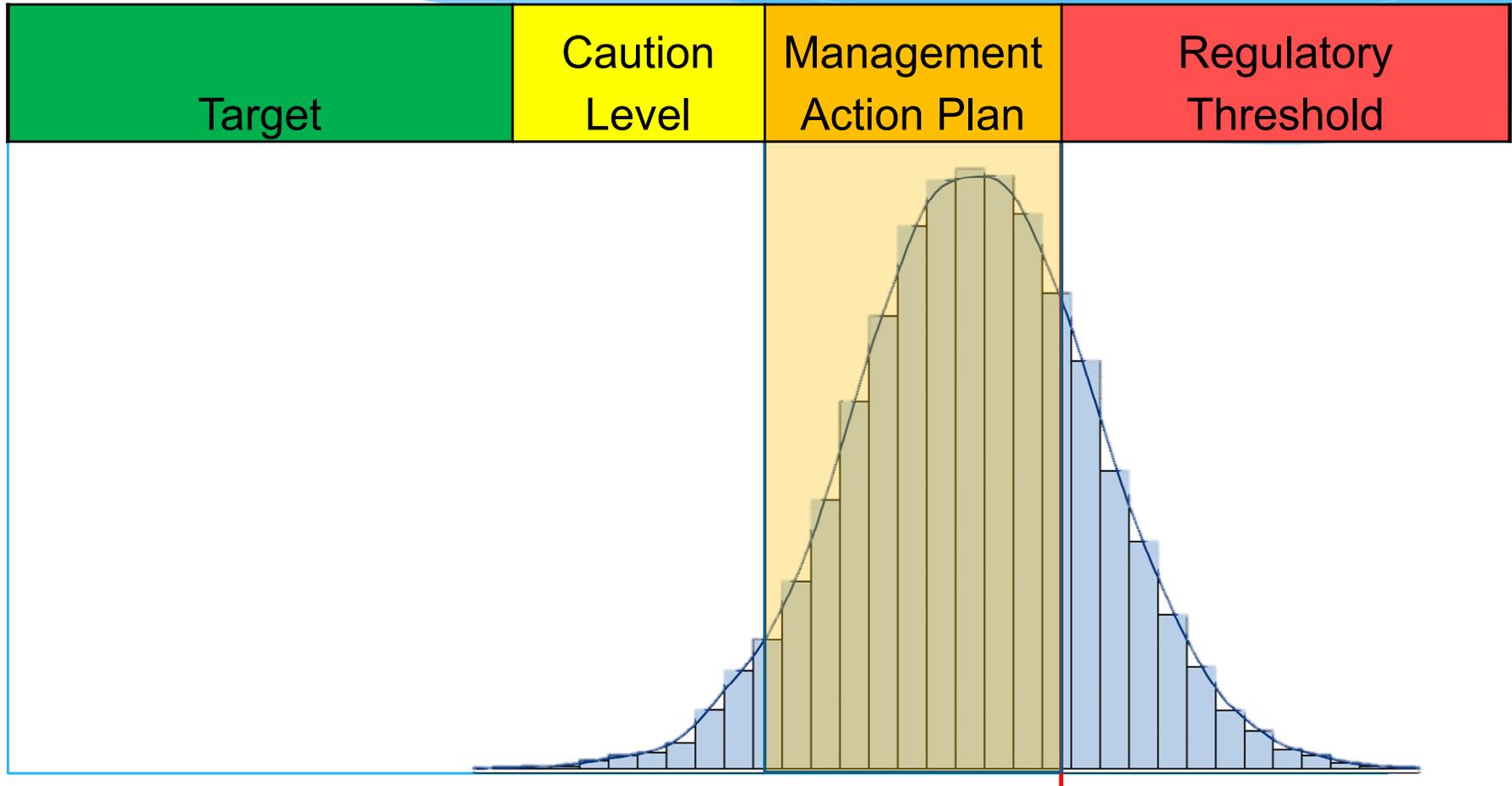
# The Reference-Based Approach

Setting Targets and Thresholds in the Absence of  
an Observed Adverse Effect

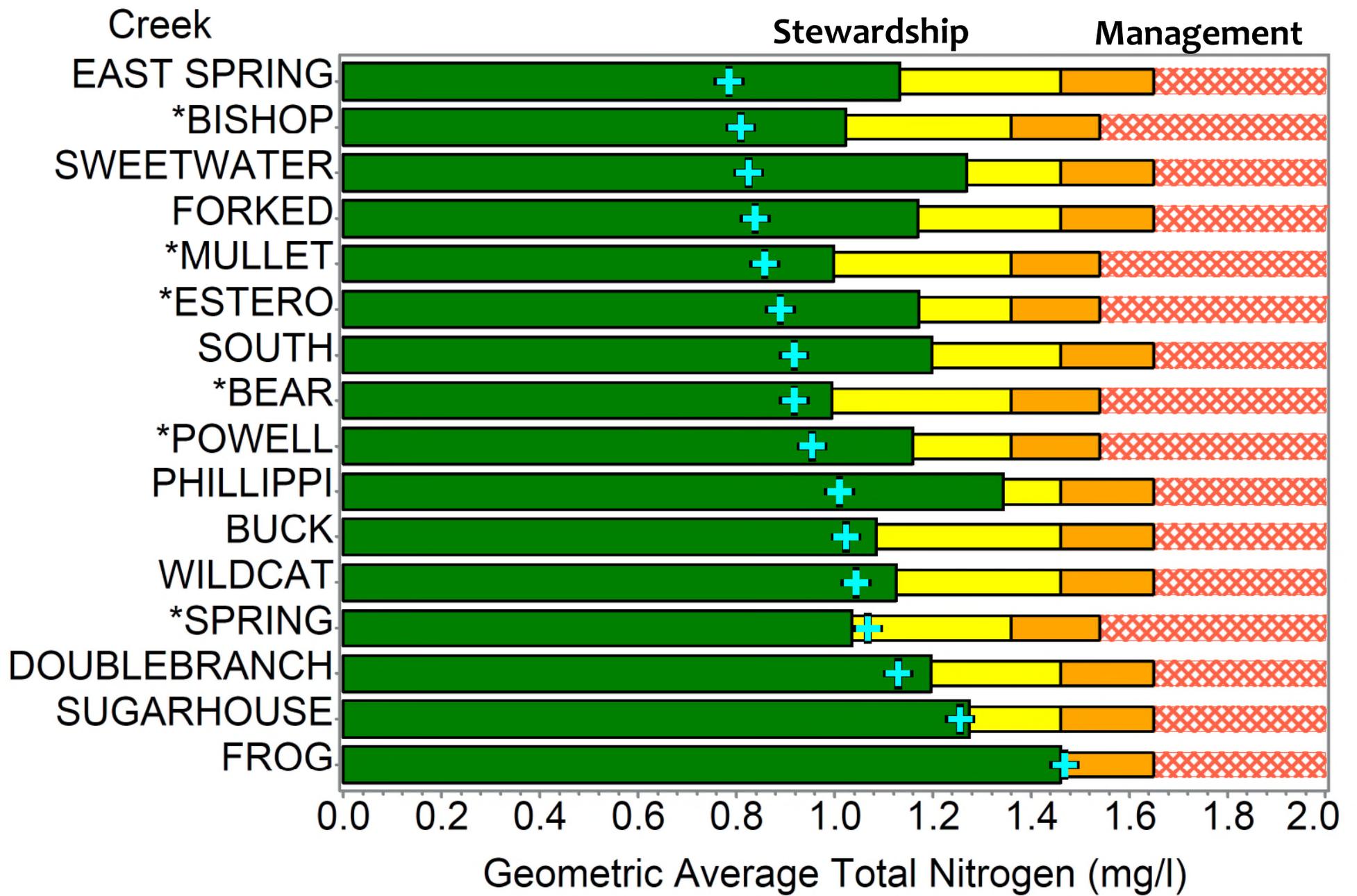
# Computer Simulation

Stewardship Goals

Management Thresholds



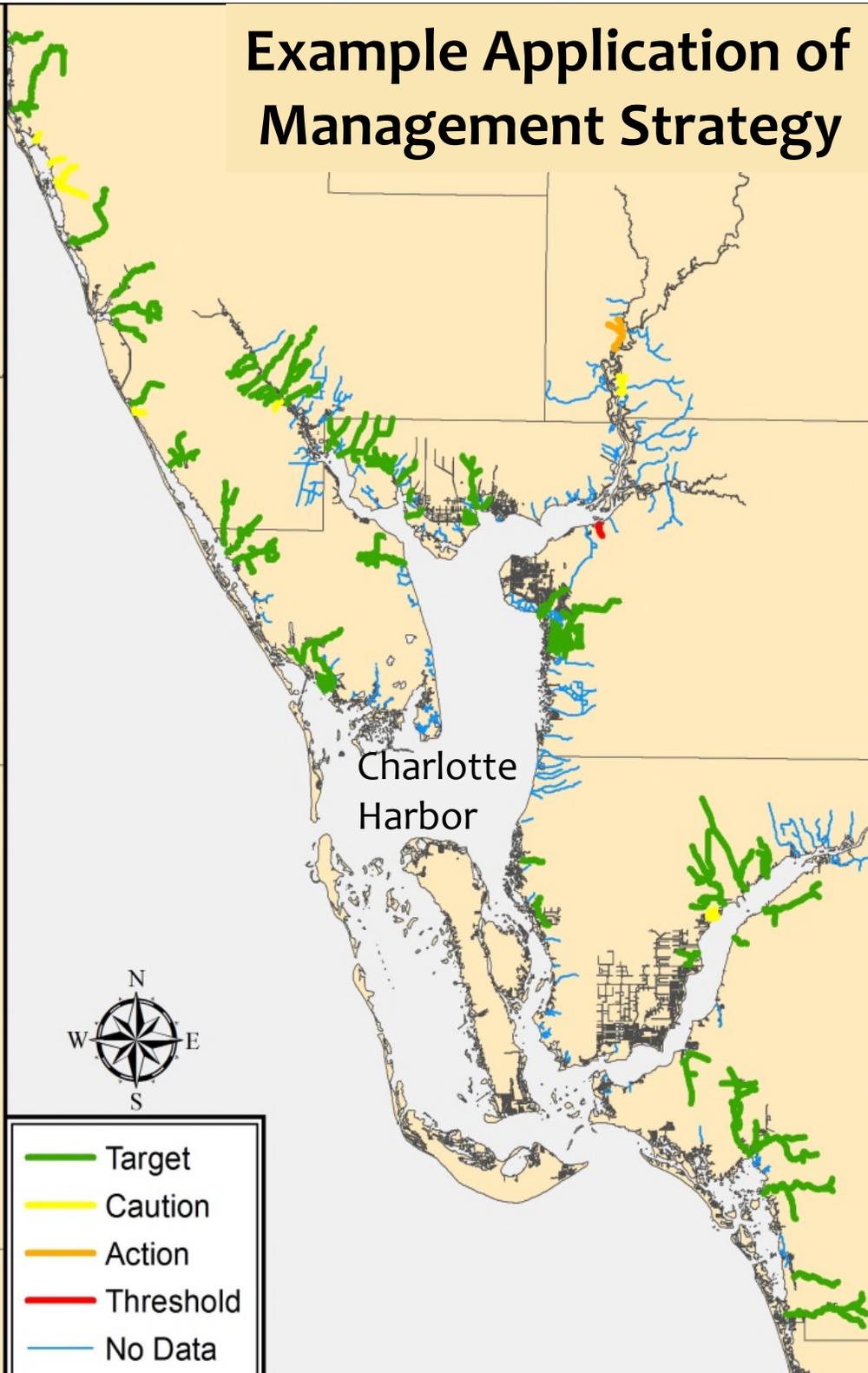
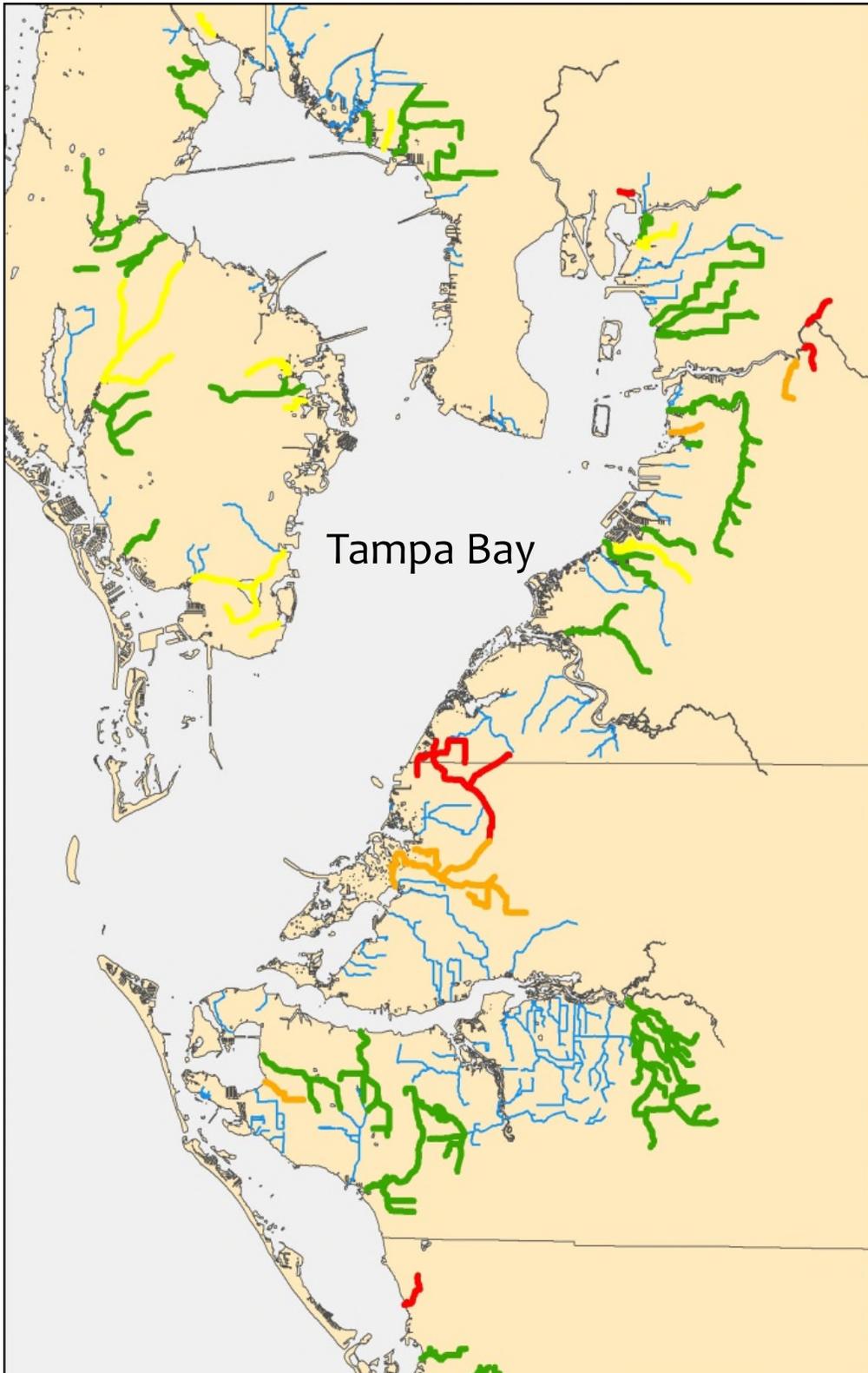
1.65  
Standard



\*= Peninsula Region



# Example Application of Management Strategy



- Target
- Caution
- Action
- Threshold
- No Data

# Benefits of Management Strategy

- \* Includes stewardship, management and regulatory components.
- \* Based on observed, locally derived data.
- \* Includes nutrients, not just assumptions about DO/Chla and nutrients.
- \* Provides early detection mechanism with associated management responses.
- \* Provides a mechanism to further NEP CCMP goals.
- \* Encourages more science as basis for improving site-specific targets.

# Future Efforts/Challenges

- \* Recognize that tidal creeks are wetland environments.
- \* Investigate interaction between source water, wetland vegetation, organic decomposition, and nutrients.
- \* Analyze data from larger tidal rivers to understand larger systems with longer time series of data.
- \* Develop and test nekton indices that can be used to evaluate creek condition as habitat.



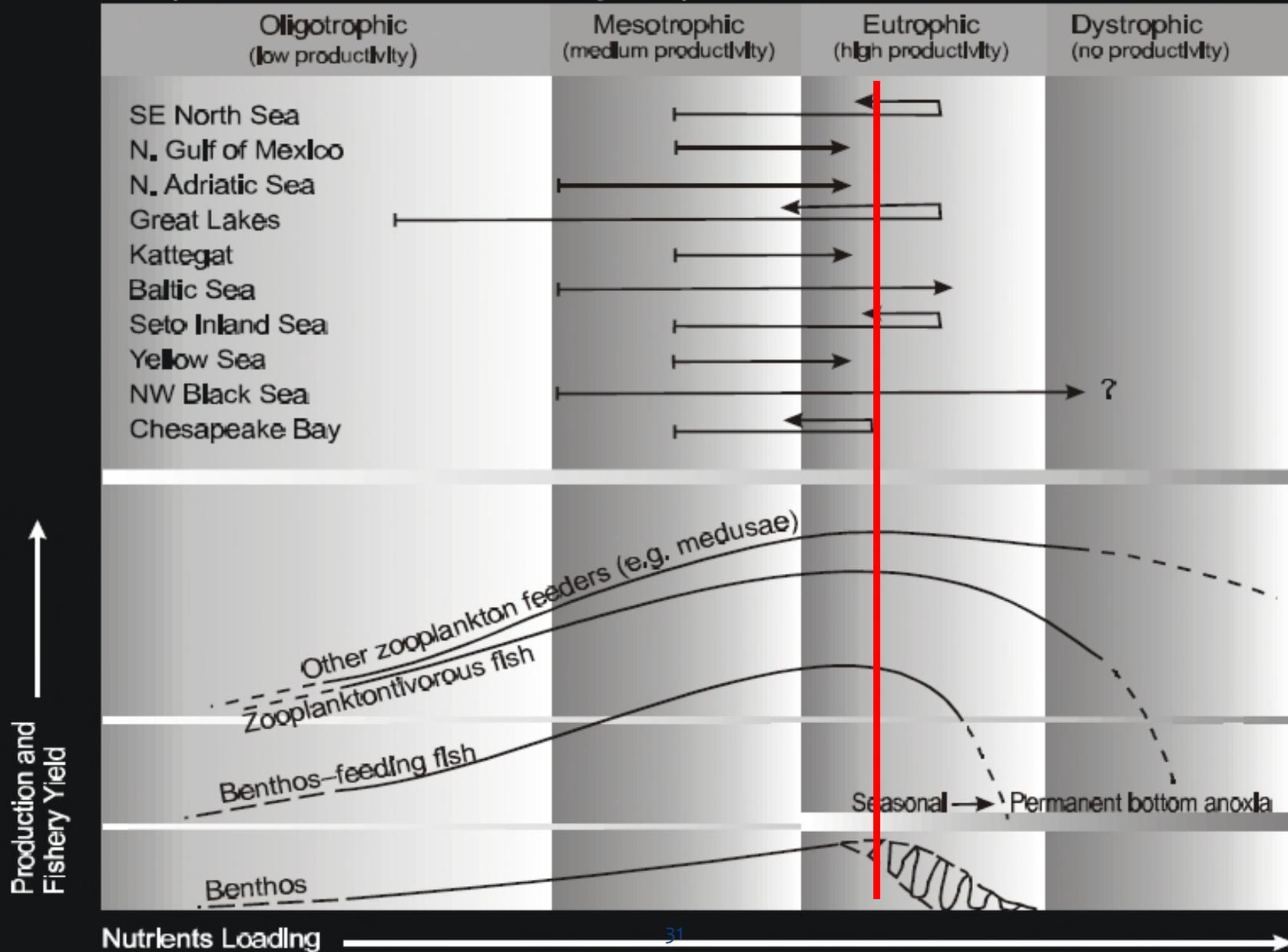
Thanks!



END

# The Eutrophication Paradigm

Comparative Evaluation of Fishery Response to Nutrients

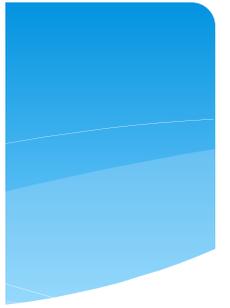
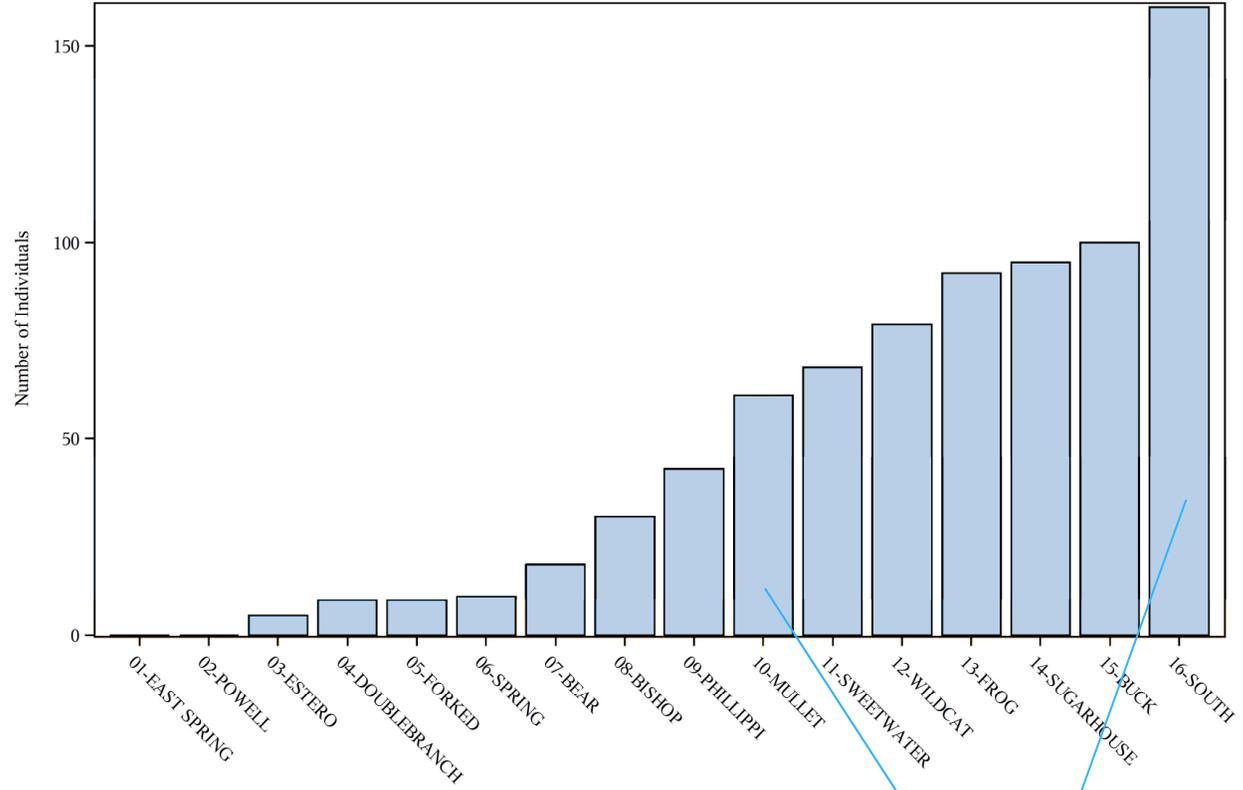


# Example of Potential Integration into Planning/Verified List

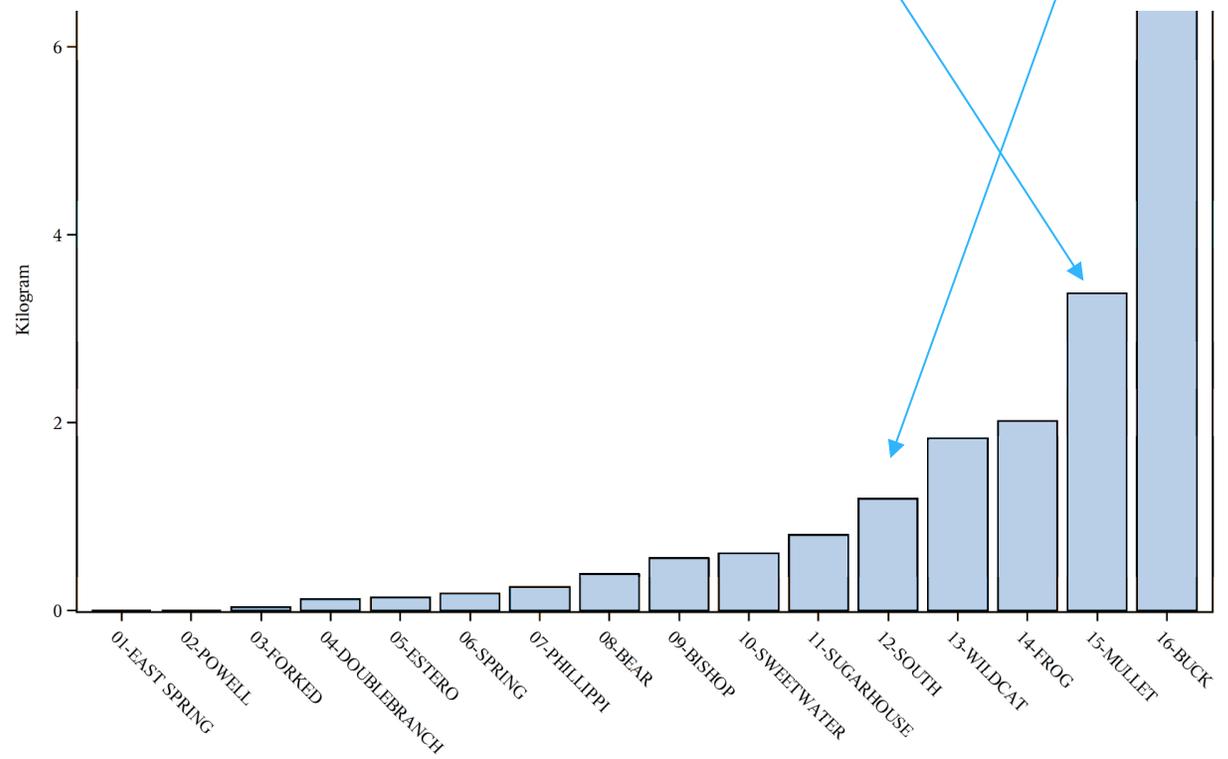
WBID	Water Segment Name	Water-body Type	Water-body Class <sup>1</sup>	Parameters Assessed Using the Impaired Waters Rule (IWR)	Concentration of Criterion or Threshold Not Met	NEP Action Level
1507A	Rocky Creek	Estuary	3M	Nutrients (Historic Chlorophyll-a)	Median TN = 1.35 mg/L	Red
1507A	Channel A	Estuary	3M	Nutrients (Chlorophyll-a)	Median TN = 1.14 mg/l	Yellow
1530	Moccasin Creek	Estuary	3M	Nutrients (Chlorophyll-a)	Median TN = 0.94 mg/L	Green
1563	Lower Rocky Creek	Estuary	3M	Nutrients (Chlorophyll-a)	> 11 µg/L	Yellow
1570A	Sweetwater Creek Tidal - Lower	Estuary	3M	Nutrients (Historic Chlorophyll-a)	Median TN = 1.21 mg/L	Orange
1570A	Sweetwater Creek Tidal	Estuary	3M	Nutrients (Chlorophyll-a)	Median TN = 1.05 mg/l	Green



Number



Biomass



# NO<sub>3</sub> as a Proportion of Total Nitrogen

