

Potential Role Of Index Tools in the 2010 Assessment

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Data Inventory and Report Card Framework Project – *Pasquotank and Chowan*

- Data collection
- Data transformation
- Data assessment
- Water Quality Index Development
- Report card development

Focus Area

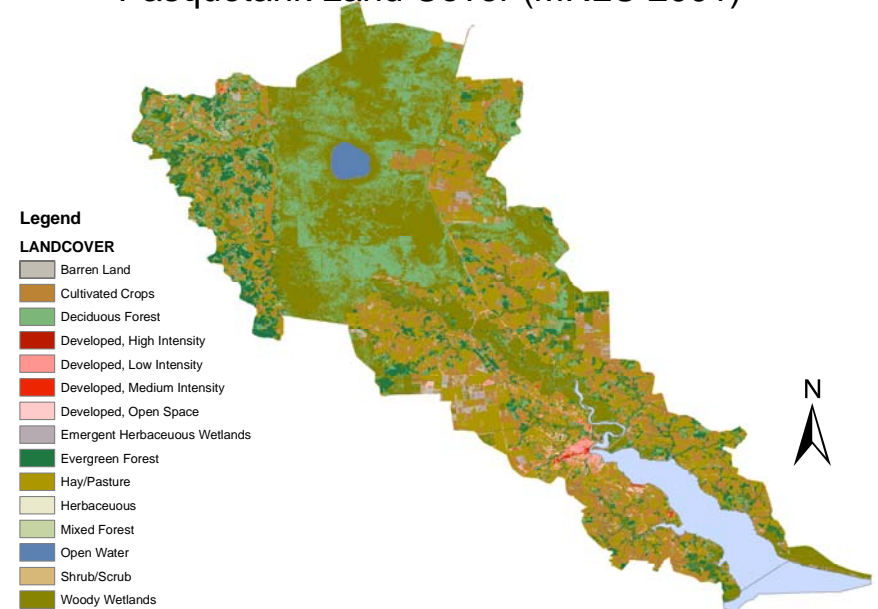


Focus Area

Chowan Land Cover (MRLC 2001)



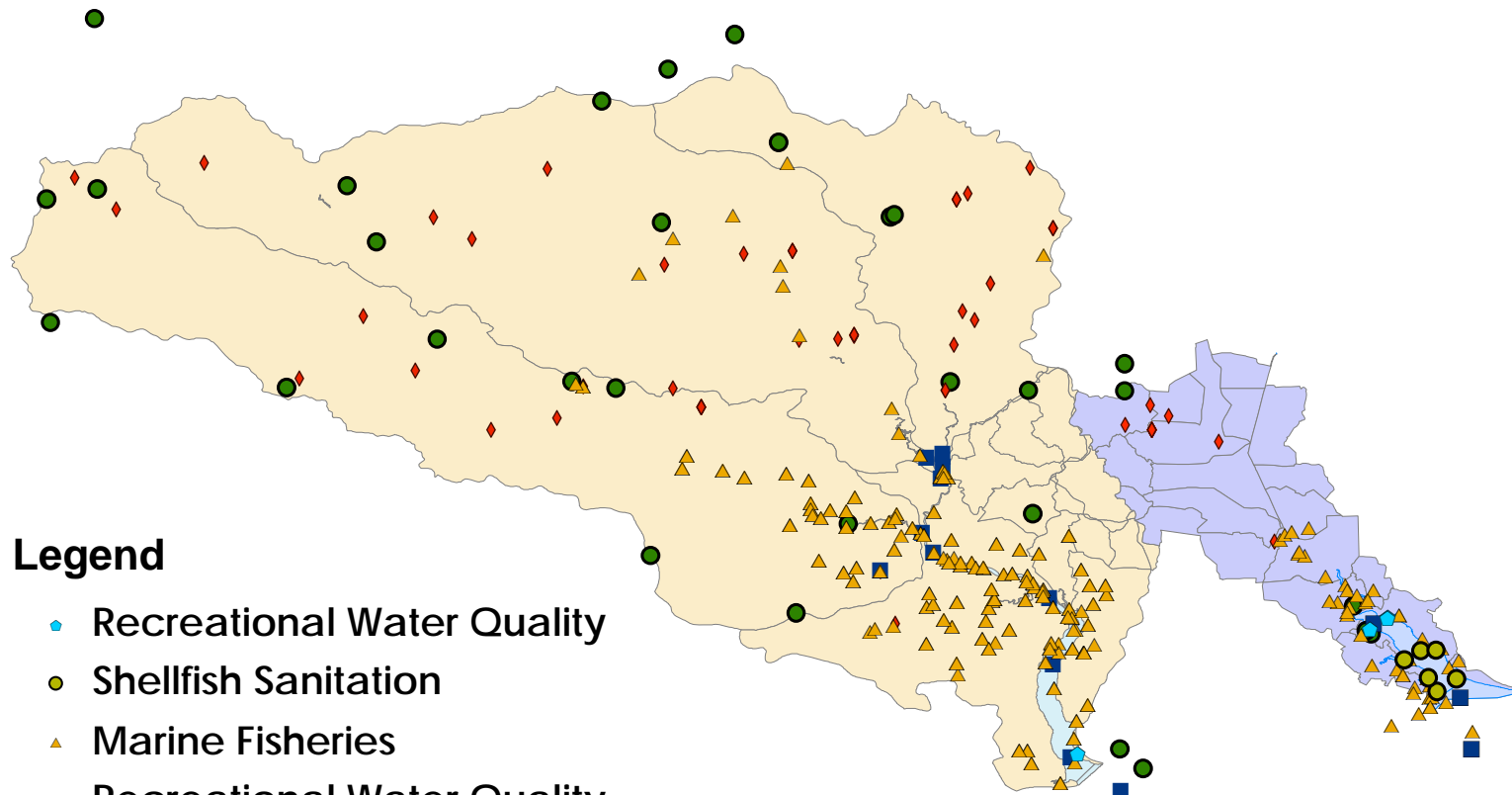
Pasquotank Land Cover (MRLC 2001)



Data Sources

- NADP  National Atmospheric Deposition Program
- NC Division of Water Quality  "To preserve, protect and enhance North Carolina's water..."
- Climate Office of NC 
- NCDEP Recreational Water Quality  Division of Environmental Health
- USGS  science for a changing world
- Marine Fisheries 
- Shellfish Sanitation  "To preserve, protect and enhance North Carolina's water..."
- Land Use, MRLC

Data Sources on a Map



Legend

- Recreational Water Quality
- Shellfish Sanitation
- ▲ Marine Fisheries
- Recreational Water Quality
- ◆ USGS
- Climate Data



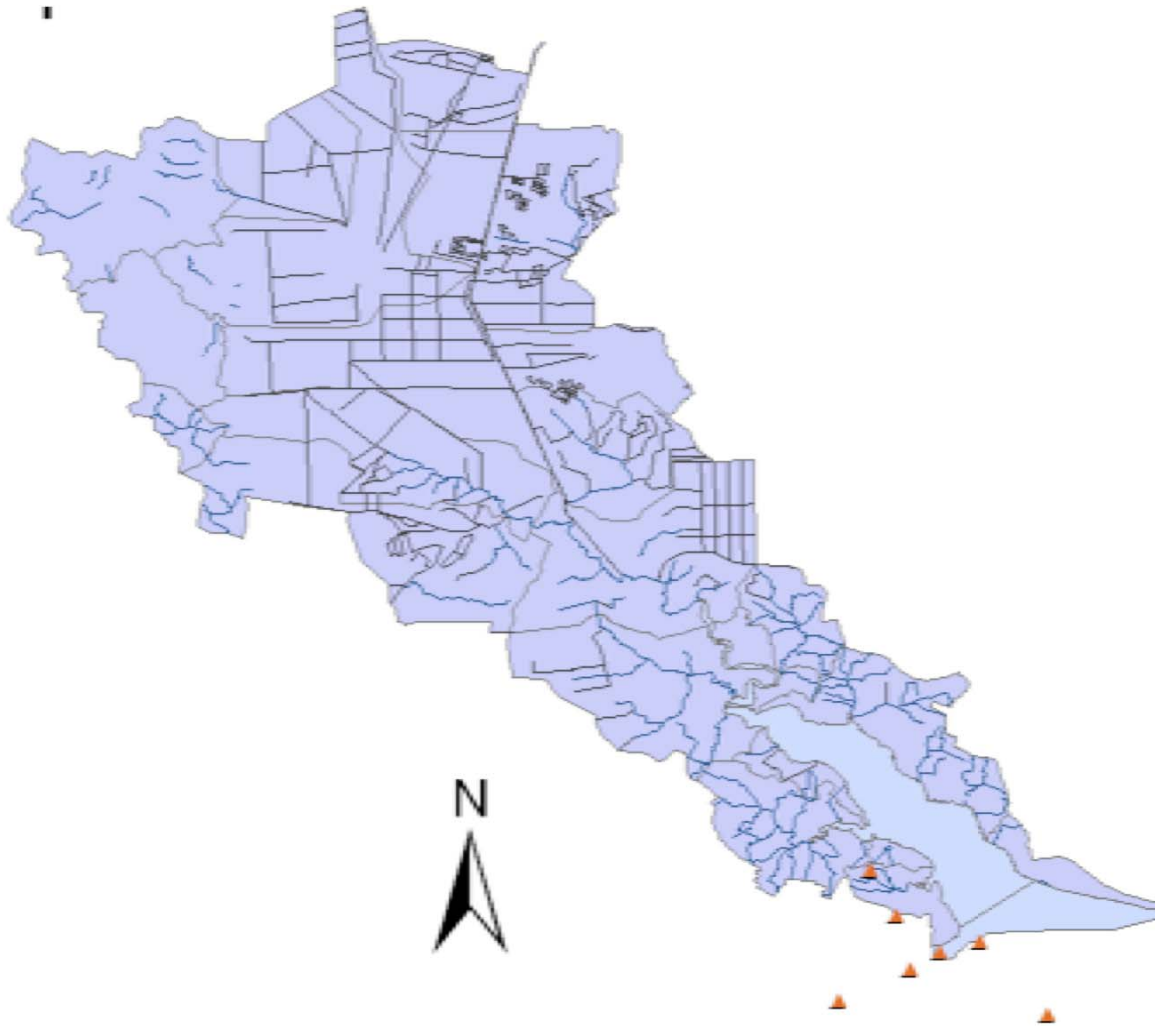
Data Transformation

- Various data formats from each source
- Data from all sources put into a consistent, horizontal format.
- Station coordinates were obtained
- Access data base was created
- Import programs written to bring data into SAS

Data Assessment

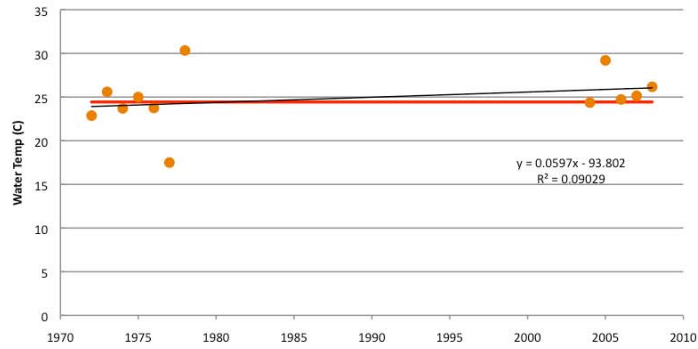
- **NADP** – *Lots of parameters, no stations in either basins, interpolated results.*
- **NC-DWQ** – *13 stations in Chowan; 2 in Pasquotank, Phys/Chem parameters, Variable data density in time and space*
- **Climate** – *Temp and Precip, Long data record, several stations*
- **RWQ** – *2 stations in Pasquotank and 1 in Chowan, bacteria, temp and salinity, data 2001-present*
- **USGS** – *5 stations, Daily flow back to 1930s*
- **Marine Fisheries** – *Out of 166 stations, only 7 with decent WQ data*
- **Shellfish Sanitation** – *6 stations in the Pasquotank; Sal, WT, FC; 1998-present*
- **Land Cover** – *Land cover data from 2001*

Climate Change analysis at Marine Fisheries stations

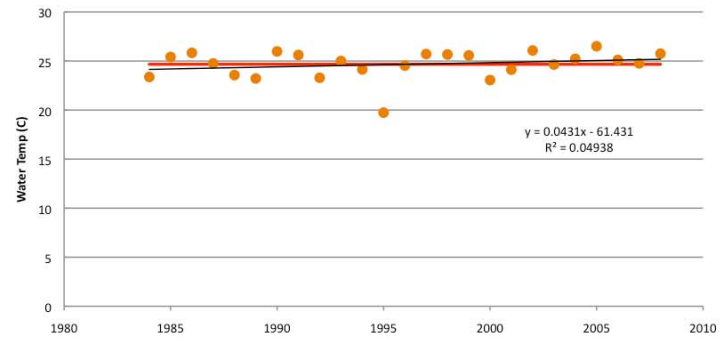


Climate Change?

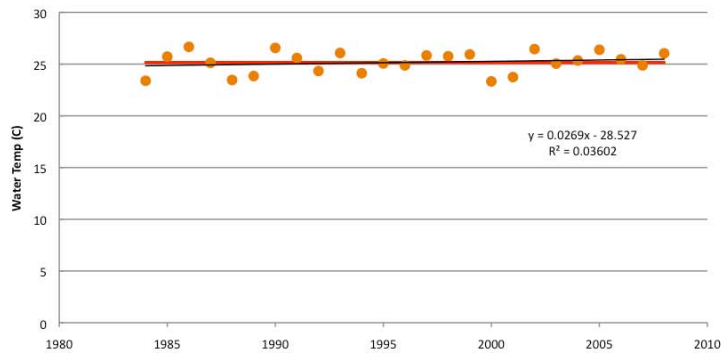
Bottom Temperature at Marine Fisheries station 14S



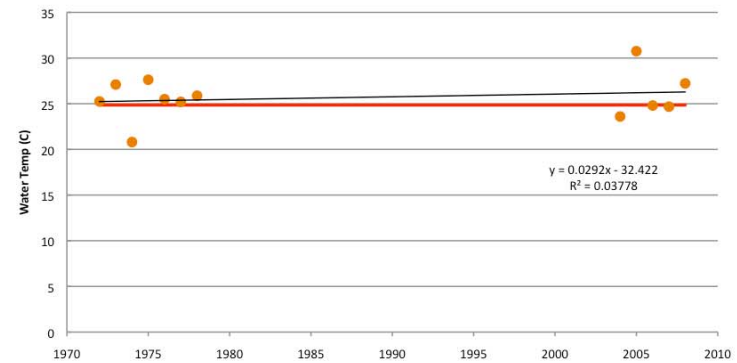
Bottom Temperature at Marine Fisheries station 158



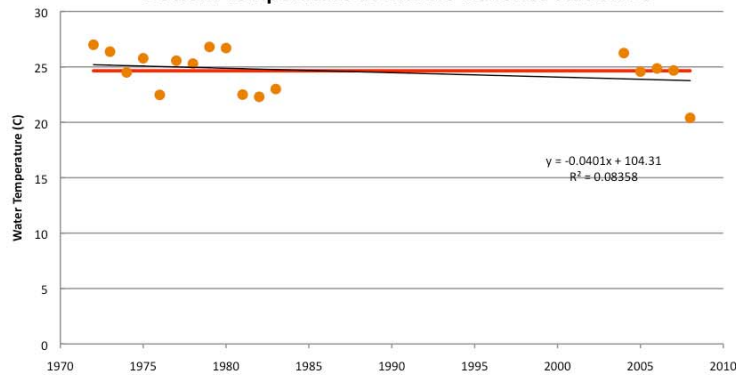
Bottom Temperature at Marine Fisheries station 159



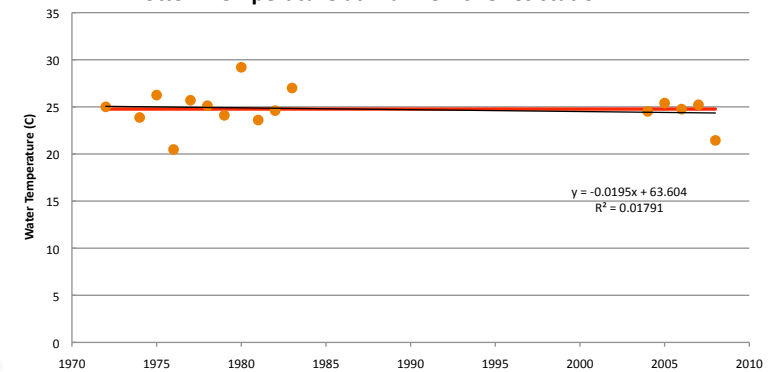
Bottom Temperature at Marine Fisheries station 15S



Bottom Temperature at Marine Fisheries station 18

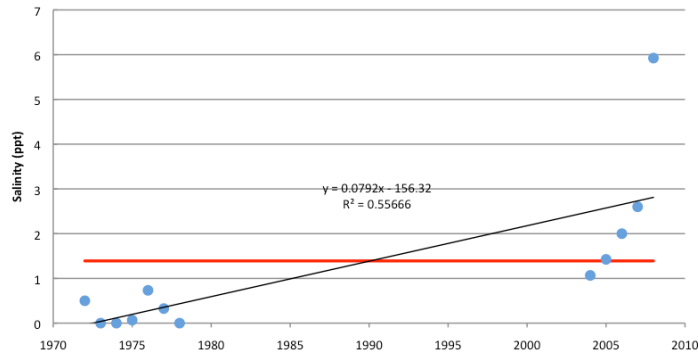


Bottom Temperature at Marine Fisheries station 24

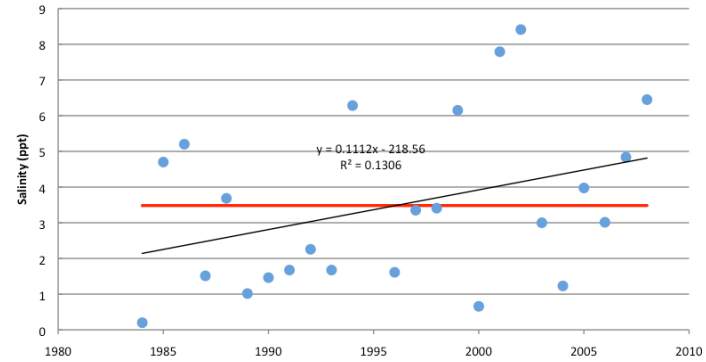


Sea Level Rise – Bottom Salinity

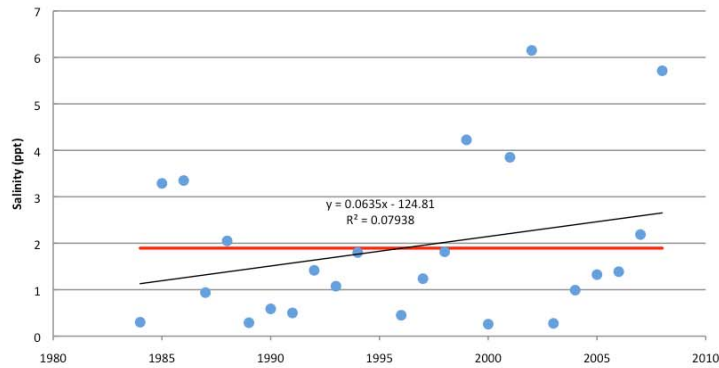
Bottom Salinity at Marine Fisheries station 14S



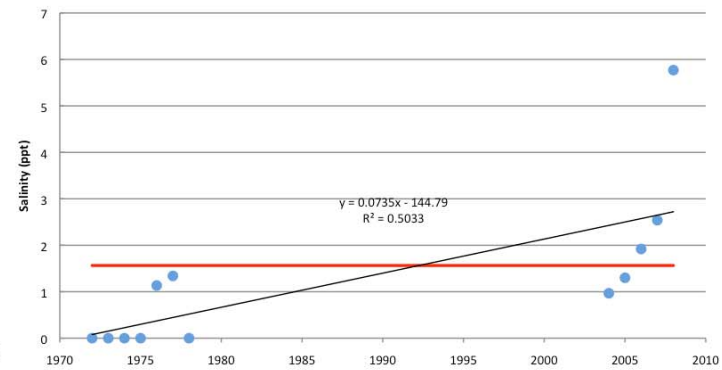
Bottom Salinity at Marine Fisheries station 158



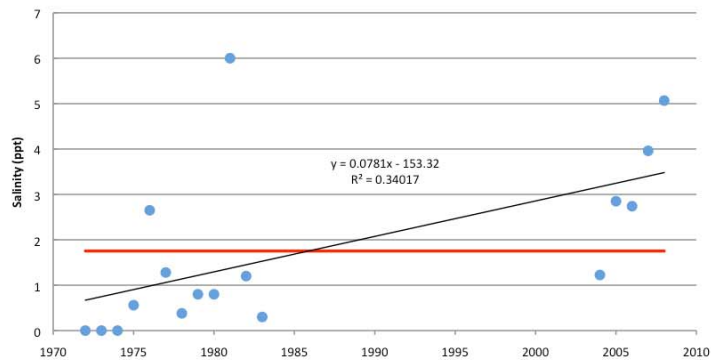
Bottom Salinity at Marine Fisheries station 159



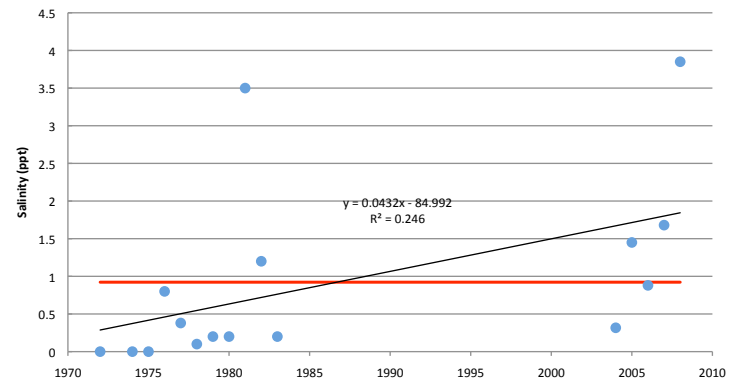
Bottom Salinity at Marine Fisheries station 15S



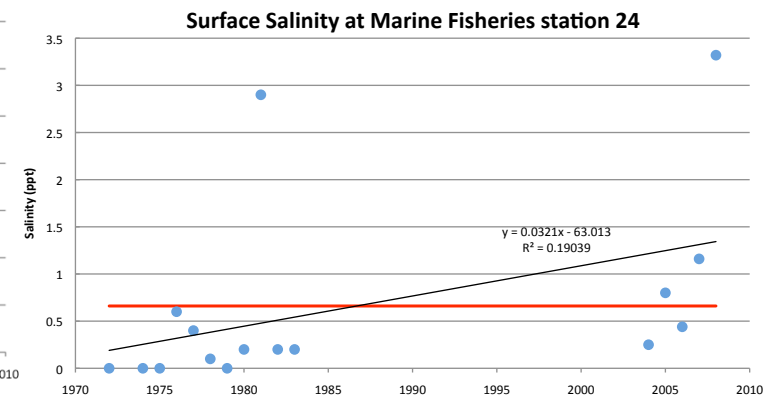
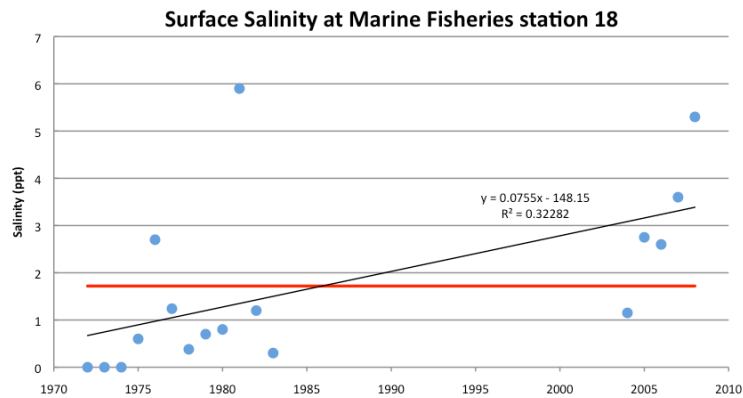
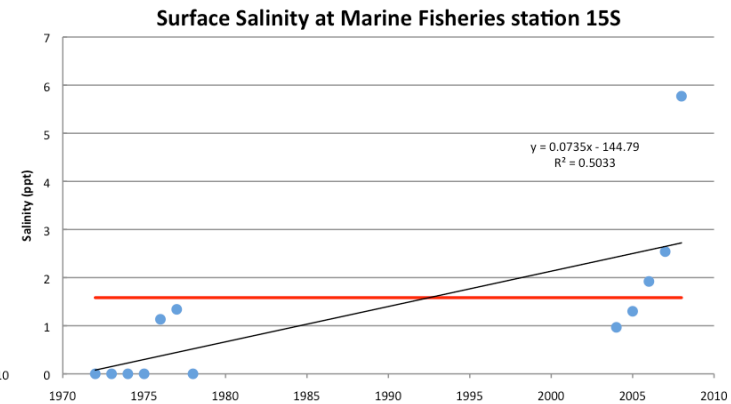
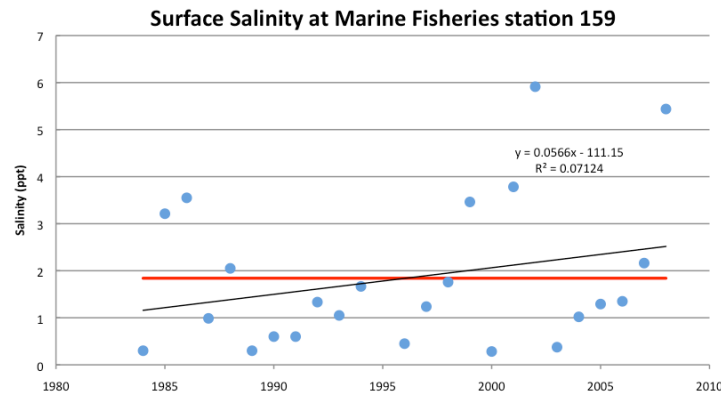
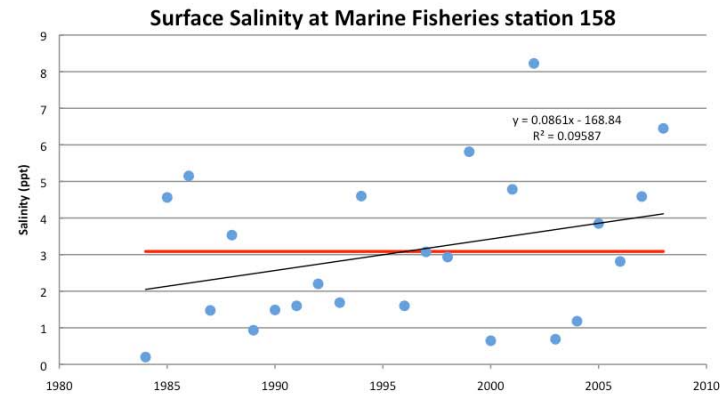
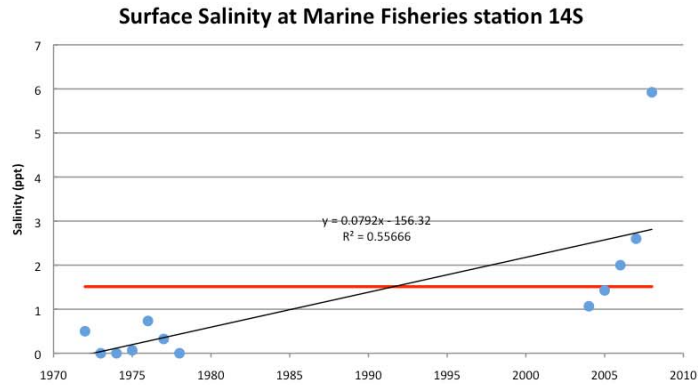
Bottom Salinity at Marine Fisheries station 18



Bottom Salinity at Marine Fisheries station 24



Sea Level Rise – Surface Salinity



The Water Quality Index

Based on the index used by the National Estuary Program



This document contains the introduction of the Estuary Program Coastal Condition Report. The Introduction contains a statement of the object report, a description of the environmental indicators, evaluate the condition of the estuaries of the National Estuary Program and the criteria used to develop indices. The entire can be downloaded from <http://www.epa.gov/owow/oceans/nepccr/index.htm>

National Estuary Program Coastal Condition Report

Chapter 1: Introduction

June 2007

Water Quality Index	
Nitrogen (DIN)	Good
Phosphorus (DIP)	Good
Chlorophyll <i>a</i>	Good
Water Clarity	Good
Dissolved Oxygen	Good

Figure 1-5. Component indicators of the water quality index.

Water Quality Index
The water quality index (WQI) is a single number that represents the overall water quality. The WQI is calculated based on the following indicators: dissolved inorganic phosphorus, dissolved inorganic nitrogen, water clarity, and dissolved oxygen. The WQI is a composite index that is calculated based on the following indicators: dissolved inorganic phosphorus, dissolved inorganic nitrogen, water clarity, and dissolved oxygen.

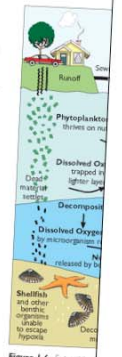


Figure 1-6. Eutrophication of available nutrients from land to water.

CHAPTER 1 | INTRODUCTION

The water quality index used in this report is intended to characterize acutely degraded water quality conditions and does not consistently identify sites experiencing occasional or infrequent hypoxia, nutrient enrichment, or decreased water clarity. As a result, a rating of poor for the water quality index means that the site is likely to have consistently poor condition during the monitoring period. If a site is designated as fair or good, the site did not experience poor condition on the date sampled, but could be characterized by poor condition for short time periods. In order to assess the level of variability in the index at a specific site over time, increased or supplemental sampling is needed.

Dissolved Nitrogen and Phosphorus DIN and DIP are necessary and natural nutrients required for the growth of phytoplankton, the primary producers that form the base of an estuary's food chain; however, excessive DIN and DIP can result in large, undesirable phytoplankton blooms. For this report, DIN and DIP were determined chemically through the collection of filtered surface water at each site. NCA surveys were conducted in late summer—not the most likely period for maximal nutrient values in East Coast and Gulf Coast estuaries, but the period of expected peak concentrations for West Coast estuaries.

NCA monitoring sites were rated good, fair, or poor for DIN and DIP using the criteria shown in Tables 1-4 and 1-5. These ratings were then used to calculate DIN and DIP ratings for each NEP estuary and region.

Chlorophyll *a* For this report, the surface concentrations of chlorophyll *a* were determined from a filtered portion of water collected at each site. Surface chlorophyll *a* concentrations at a site were rated good, fair, or poor using the criteria shown in Table 1-6. These ratings were then used to calculate chlorophyll *a* ratings for each NEP estuary and region.

Water Clarity Clear waters are valued by society and contribute to the maintenance of healthy and productive ecosystems. Light penetration into estuarine waters is important for the healthy growth of SAV, which serves as food and habitat for the resident biota. The NCA estimates water clarity using specialized equipment that compares the amount and type of light reaching the water surface to the light at a depth of

1 meter, as well as by using varies naturally among different estuaries; therefore, the water clarity rating of observed clarity at 1 meter (WCI). The rating of NEP estuaries and regions is based on the following available data for each monitoring site:

Table 1-4. Criteria for Assessing Nitrogen (DIN)

Area	Good
East/Gulf Coast sites	< 0.1 mg/L
West Coast sites	< 0.5 mg/L
Puerto Rico sites	< 0.05 mg/L

NEP Estuary or Region: Less than 10% of the NEP estuarine area is in poor condition, and more than 50% of the NEP estuarine area is in good condition.

Table 1-5. Criteria for Assessing Phosphorus (DIP)

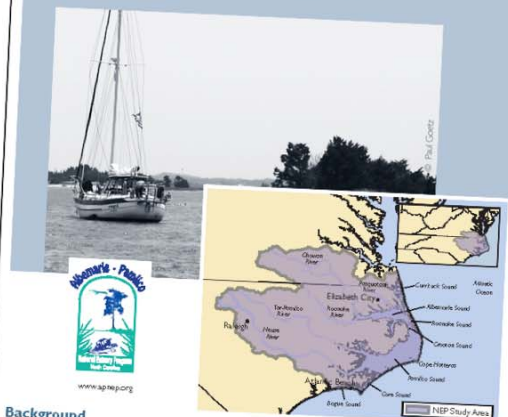
Area	Good
East/Gulf Coast sites	< 0.01 mg/L
West Coast sites	< 0.01 mg/L
Puerto Rico sites	< 0.005 mg/L

NEP Estuary or Region: Less than 10% of the NEP estuarine area is in poor condition, and more than 50% of the NEP estuarine area is in good condition.

CHAPTER 1 | SOUTHEAST NATIONAL ESTUARY PROGRAM COASTAL CONDITION

Albemarle-Pamlico National Estuary Program

Albemarle-Pamlico National Estuary Program



Background

The Albemarle-Pamlico Estuarine Complex drains approximately 20,000 mi² of watershed and comprises the largest regional estuarine system in the United States. This NEP has a 23,000-mi² study area that extends south from Prince George County, VA, to Currituck County, NC, and includes 7 sounds (Albemarle, Bogue, Core, Croatan, Currituck, Pamlico, and Roanoke) (APNEP, 2006).

Freshwater inputs to this system are provided by five major rivers—the Nequaque, Chowan, and Roanoke rivers that flow into Albemarle Sound and the

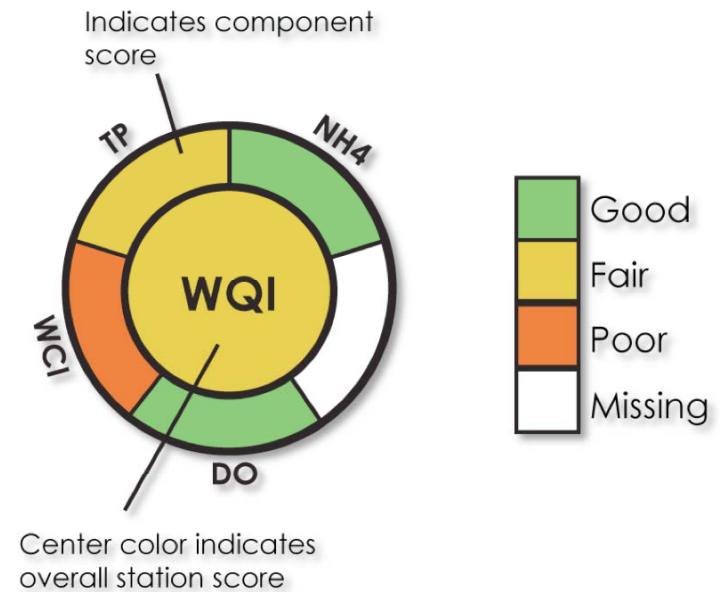
Tar-Pamlico and Neuse rivers that flow into Pamlico Sound. This region features a variety of habitat types, including significant portions of salt marsh, bald cypress swamps, salt marshes, brackish marshes, freshwater marshes, and beds of SAV (Martin et al., 1990). On the eastern side of the Albemarle-Pamlico Estuarine Complex, a chain of islands forms a barrier with the Atlantic Ocean. The Complex is uniquely characterized by random wind-driven tides, which result in less predictable variations in water circulation and salinity patterns (Roosza, 2006a). Economically, this estuarine

The Water Quality Index

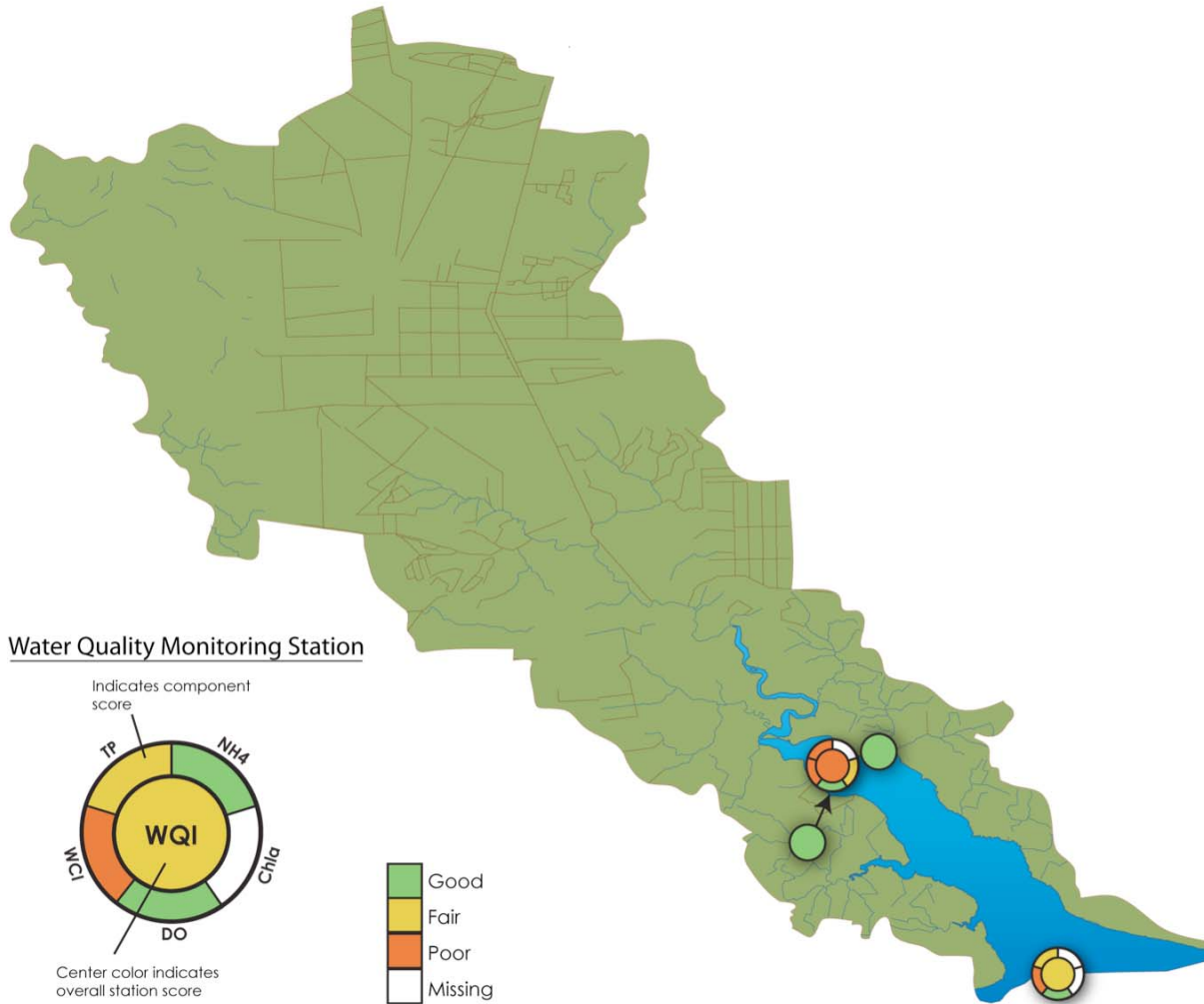
	Good	Fair	Poor
Dissolved Oxygen (mg l ⁻¹)	>5	>2 and ≤5	≤2
NH ₄ (mg l ⁻¹)	< 0.1	< 0.5	> 0.5
Total Phosphorus (mg l ⁻¹)	< 0.01	<0.05	>0.05
Chlorophyll-a (ug l ⁻¹)	< 5.0	<20.0	≥20.0
Water Clarity Index (WCI)	>2	<2 and >1	≤1



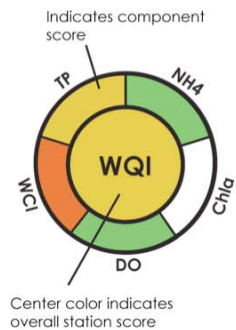
Good	Fair	Poor
≤ 1 <i>Fair</i> AND 0 <i>Poor</i>	1 <i>Poor</i> OR ≥ 2 <i>Fair</i>	≥ 2 <i>Poor</i>



Pasquotank WQI Map



Water Quality Monitoring Station



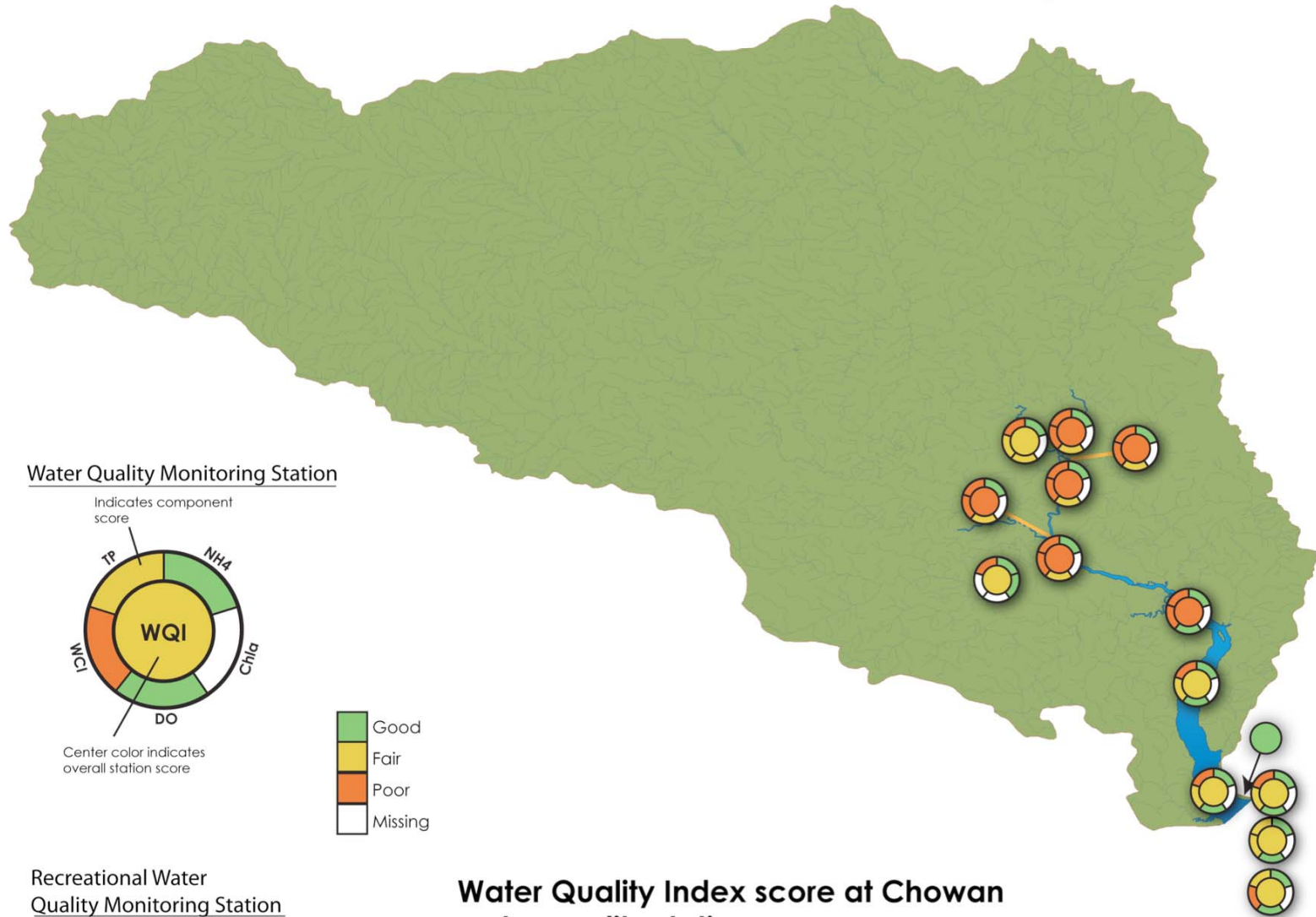
Recreational Water Quality Monitoring Station



Water Quality Monitoring Stations in the Pasquotank River.

- WQI Scores based on 2005-07 spring and summer medians for TP, NH4, Chla, DO and Water Clarity Index (WCI).
- Recreational station scores based on the number of Alerts and Advisories during 2007-2009.

Chowan WQI Map



Water Quality Index score at Chowan water quality stations.

- WQI Scores based on 2005-07 spring and summer medians for TP, NH4, Chla, DO and Water Clarity Index (WCI).
- Recreational station scores based on the number of Alerts and Advisories during 2007-2009.

Pasquotank Report Card







Pasquotank Report Card

Parameter	Grade	Comments
 NH ₄	Fair	NH ₄ not measured sufficiently at either station.
 TP	Fair	TP was "Poor" at the upstream station and "Fair" at the downstream station
 Chl	Fair	Chl only monitored at the upstream station
 WCI	Poor	Water clarity was "Poor" at both stations
 DO	Good	DO was "Good" at both stations
 Bacteria	Good	There were no "Alerts" or "Advisories" for recreational water use.

Overall Grade = C

Chowan Report Card

Chowan Report Card

Parameter	Grade	Comments
 NH ₄	Good	NH ₄ was "Good" at all stations.
 TP	Poor	TP was "Poor" at all stations except the two stations in the lowest part of the estuary which were "Fair"
 Chl	Incomplete	Out of 13 stations Chl only monitored at one upstream station (rated "Good")
 WCI	Fair	Water clarity was "Fair" to "Poor" throughout the estuary.
 DO	Good	Upper estuary stations were "Fair" and lower estuary stations were "Good"
 Bacteria	Good	There were no "Alerts" or "Advisories" for recreational water use.

Overall Grade = C

Issues to Resolve

- Are we on the right track?
- Are the thresholds correct (ie – TP)?
- Different variables/thresholds for fresh/non-tidal?
- Other variables in addition to/instead of?
- Assess rivers by segment?
- Gap analysis – What questions do we have and what parameters and resolutions are needed to answer them? What's the gap between need and have?
- Report on Management efforts?
- Inclusion of additional ecosystem variables?