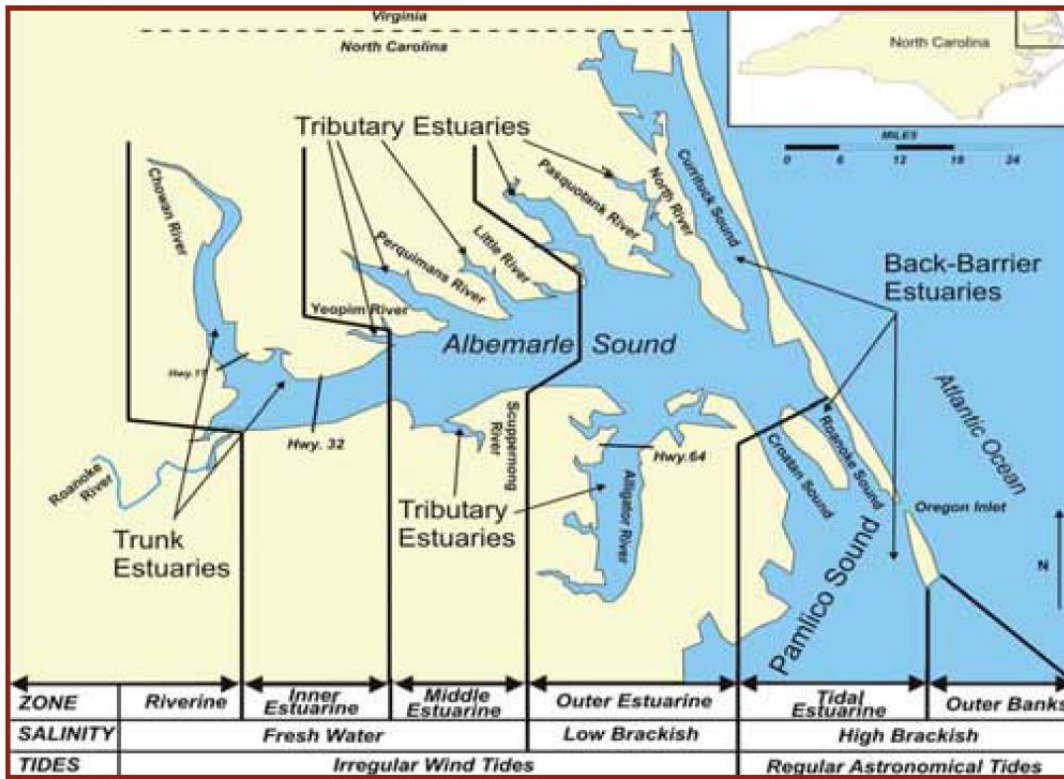


Albemarle Sound demonstration study for the National Monitoring Network for U.S. Coastal Waters and their tributaries

Michelle Moorman





From Riggs and Ames, 2003

Year 1

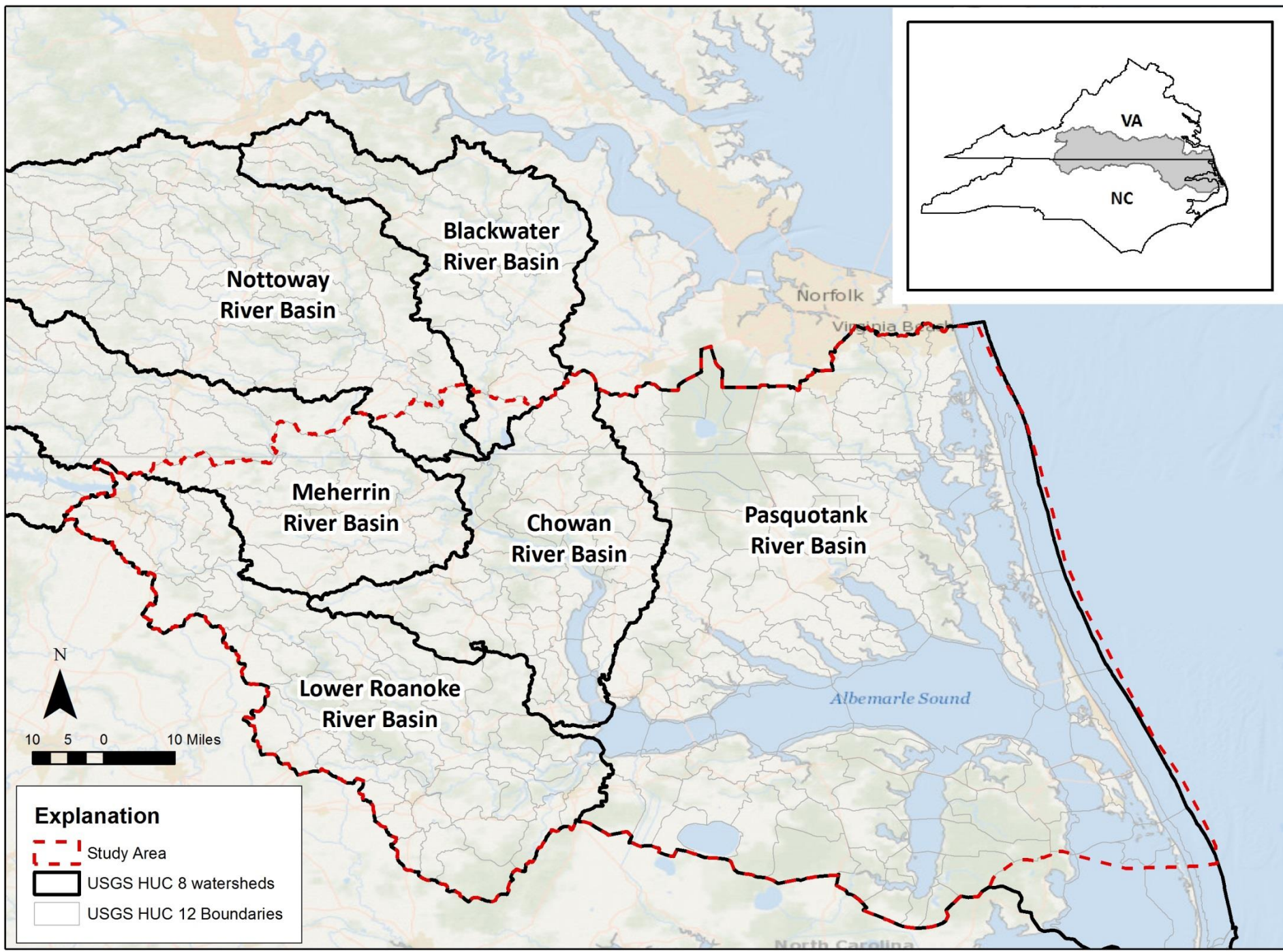
- Inventory current monitoring programs in the Albemarle Sound
- Conduct a gap analysis to determine current monitoring needs
- Conduct a soundwide water-quality synoptic

Years 2 and 3

- Implement a pilot monitoring program to address nutrient and phytoplankton data gaps
- Publish Albemarle Region monitoring database and report

Year 4

- Synthesize available data to report on water quality in the Albemarle Sound



**Nottoway
River Basin**

**Blackwater
River Basin**

**Meherrin
River Basin**

**Chowan
River Basin**

**Pasquotank
River Basin**

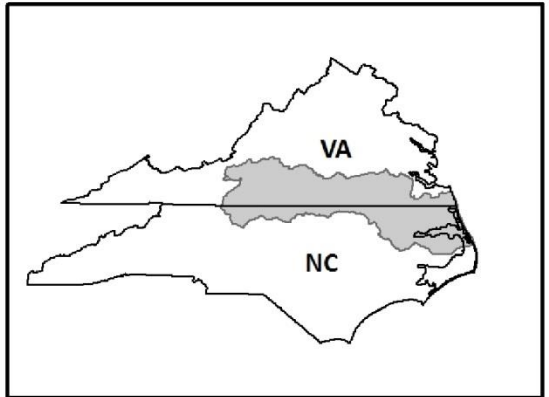
**Lower Roanoke
River Basin**

Norfolk

Virginia Beach

Albemarle Sound

North Carolina



N

10 5 0 10 Miles



Explanation

-  Study Area
-  USGS HUC 8 watersheds
-  USGS HUC 12 Boundaries












BEWARE OF
SWAMP LAND
AROUND HERE
DONTGET STUCK



**WEIGHT
LIMIT**
SINGLE VEHICLE
25 TONS

TRUCK TRACTOR
SEMITRAILER
38 TONS

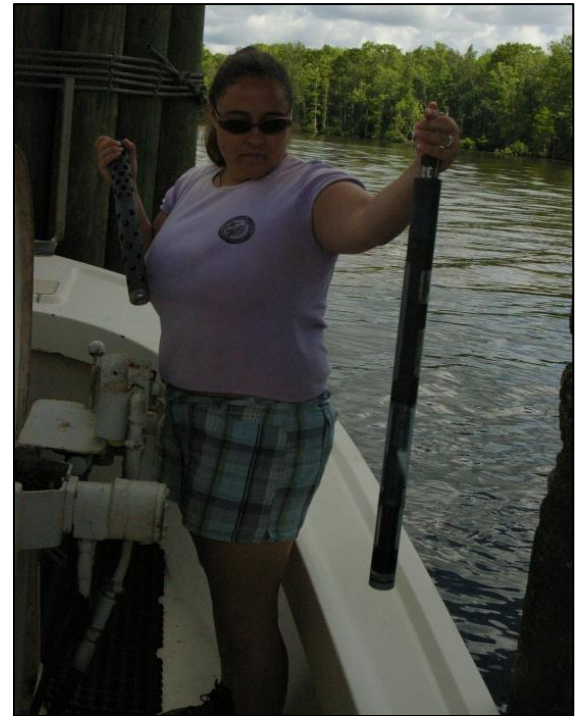
→ SR
1243 **MULLEN** DR

 **Dismal Swamp Canal**
US Army Corps
of Engineers
Atlantic Intracoastal Waterway

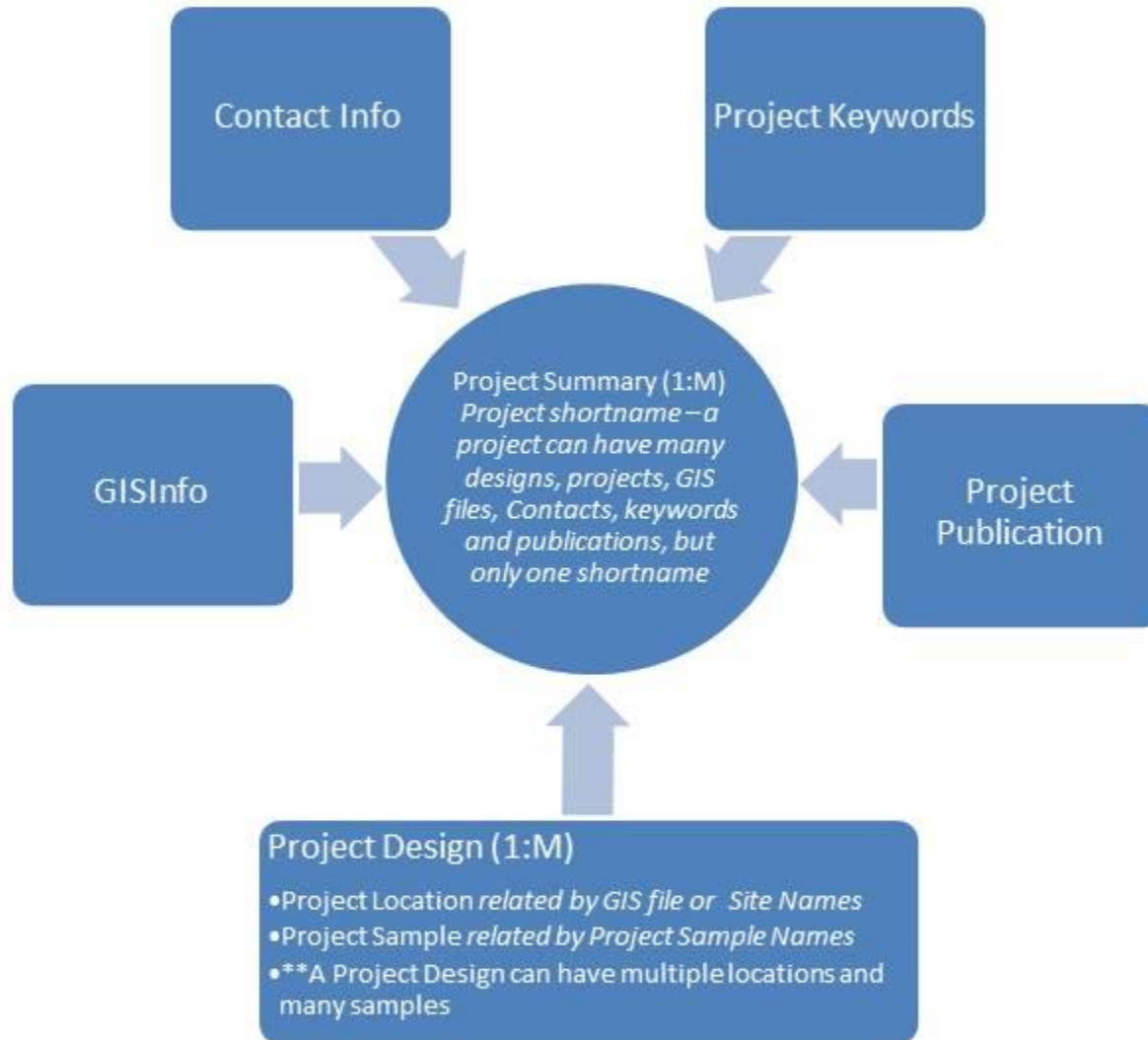


Partner collaboration has been used

- Document current monitoring programs including
 - Location of monitoring sites
 - Agency contacts
 - Type of data collected
 - Links to on-line holdings
 - Metadata
- Identify specific management issues that research and monitoring could address
- Collaborate on monitoring and research



ER Chart for Albemarle Monitoring Gap Analysis



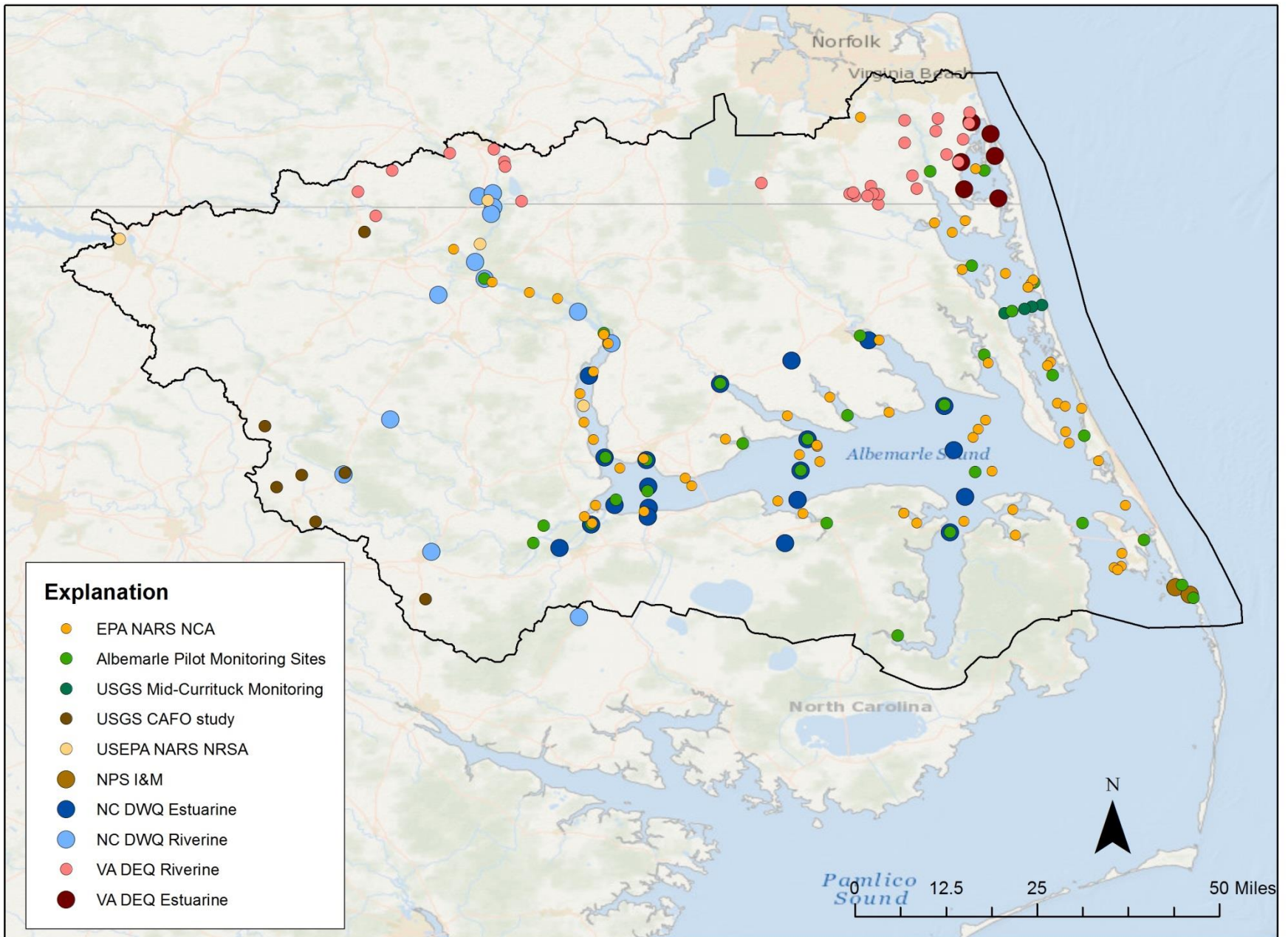
We have created a many to many relationship through Project design because multiple projects can use the same locations or sample designs

Monitoring Report

- Worked in partnership with APNEP
- Compiled spreadsheets into a geospatial database that could be queried
- We have received information from over 20 organizations documenting 58 current monitoring projects, 19 current research studies, and 20 recently discontinued monitoring and research projects.
- Final report will be ready in FY14

Org	Estuary/ embayment	<u>Nearshore</u>	Offshore	Rivers	Ground water	<u>Atm Dep</u>	Wetland	Beaches
APNEP	++							
CRONOS						++		
ECU	+			+			+	
IMS	+		+					
NADP						++		
NC DCM	++							++
NC DMF	++			++				++
NC DWQ	++			++				
NC DWR					++			
<u>NC Seagrant</u>		+						
NCSU				+				
NOAA	+		++			+		
NPS	+							+
US ACOE	+	++	+					+
US EPA	++			++		+	+	
US FWS	+				+		+	+
USFS						+		
USGS	++			++	++			
VA DEQ	++	+		++				

Nutrient monitoring in surface waters of the Albemarle Sound Region



Major management issues identified for the Albemarle Sound

- Loss of fisheries
 - Decline of fisheries, especially river herring, shad, sturgeon, and blue crab
 - Loss of submerged aquatic vegetation
 - Eutrophication
 - Shellfish closures
- Impacts of climate change
 - Changing estuarine salinity concentrations
 - Estuarine and coastal shoreline migration

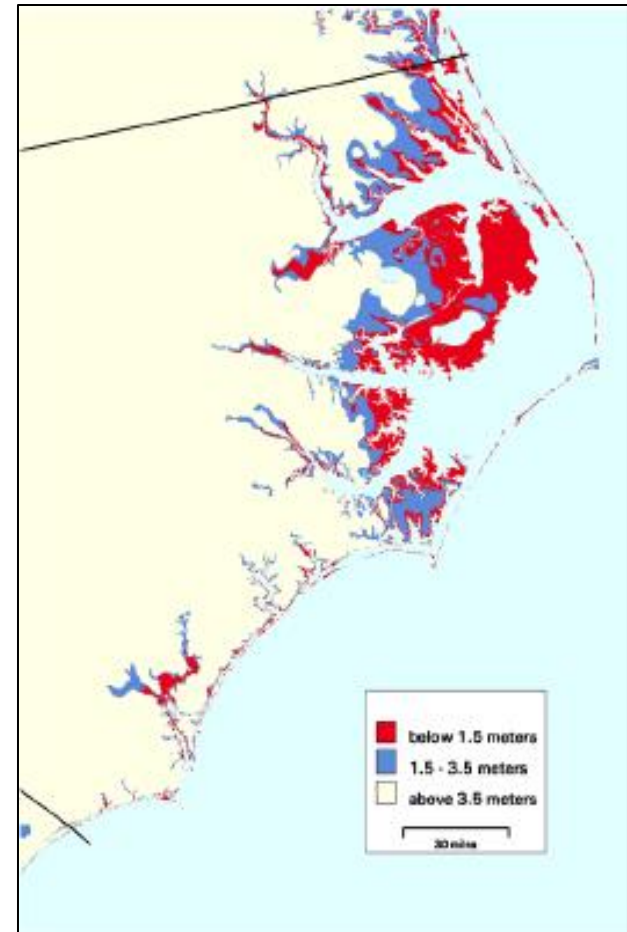
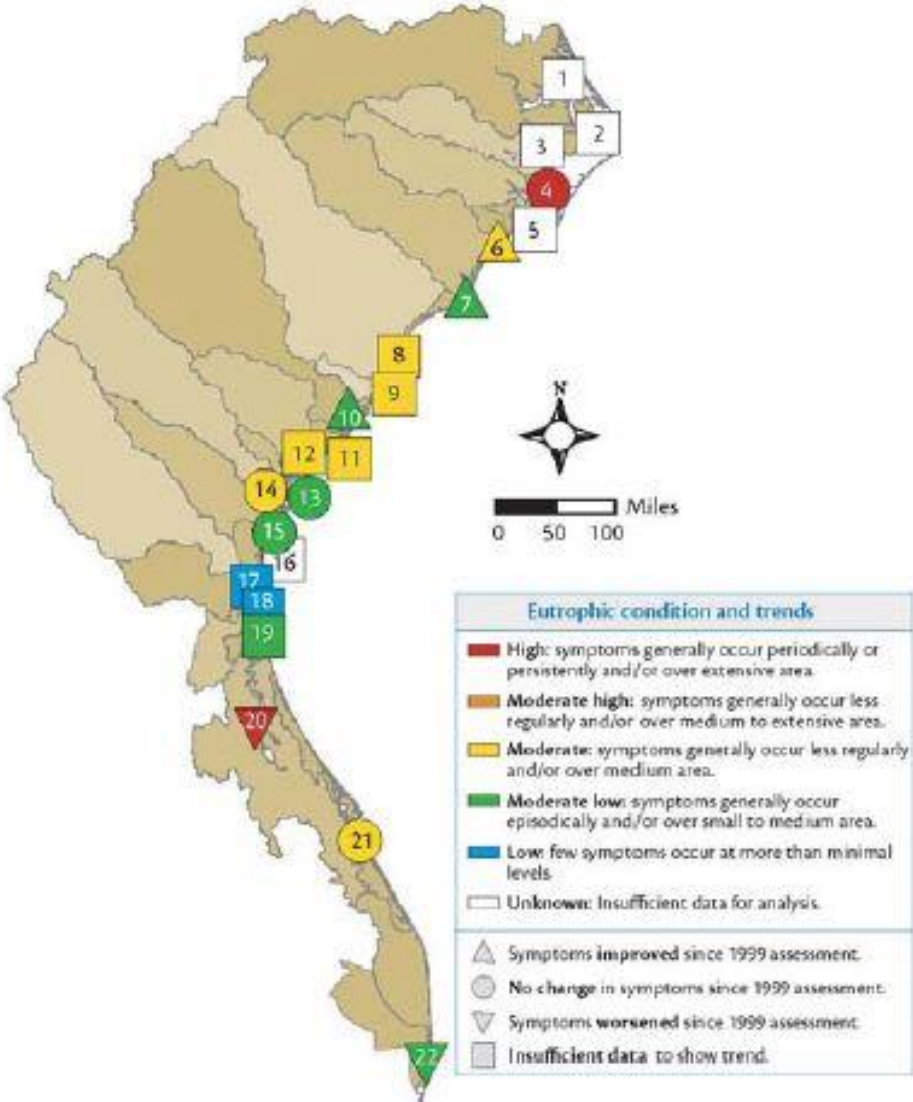


Figure 1. A map published by Titus (2001) illustrating areas of the VA and NC coasts that are at elevations at risk of being affected by rising sea level.

Nutrient Pollution (Eutrophic) Condition of Southeast Coastal Region Estuaries in 2004



DAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri

Potential data gaps the demonstration project can address



- Provide a synthesis of all current monitoring efforts in the region
- Evaluate spatial variation in water and sediment-quality in the Albemarle Sound from data collected in 2012
- Analyze how nutrients, primary production and algal communities vary seasonally in the Sound during 2012-2014
- Analyze available datasets to better understand temporal and spatial trends in water quality

Albemarle Sound Monitoring

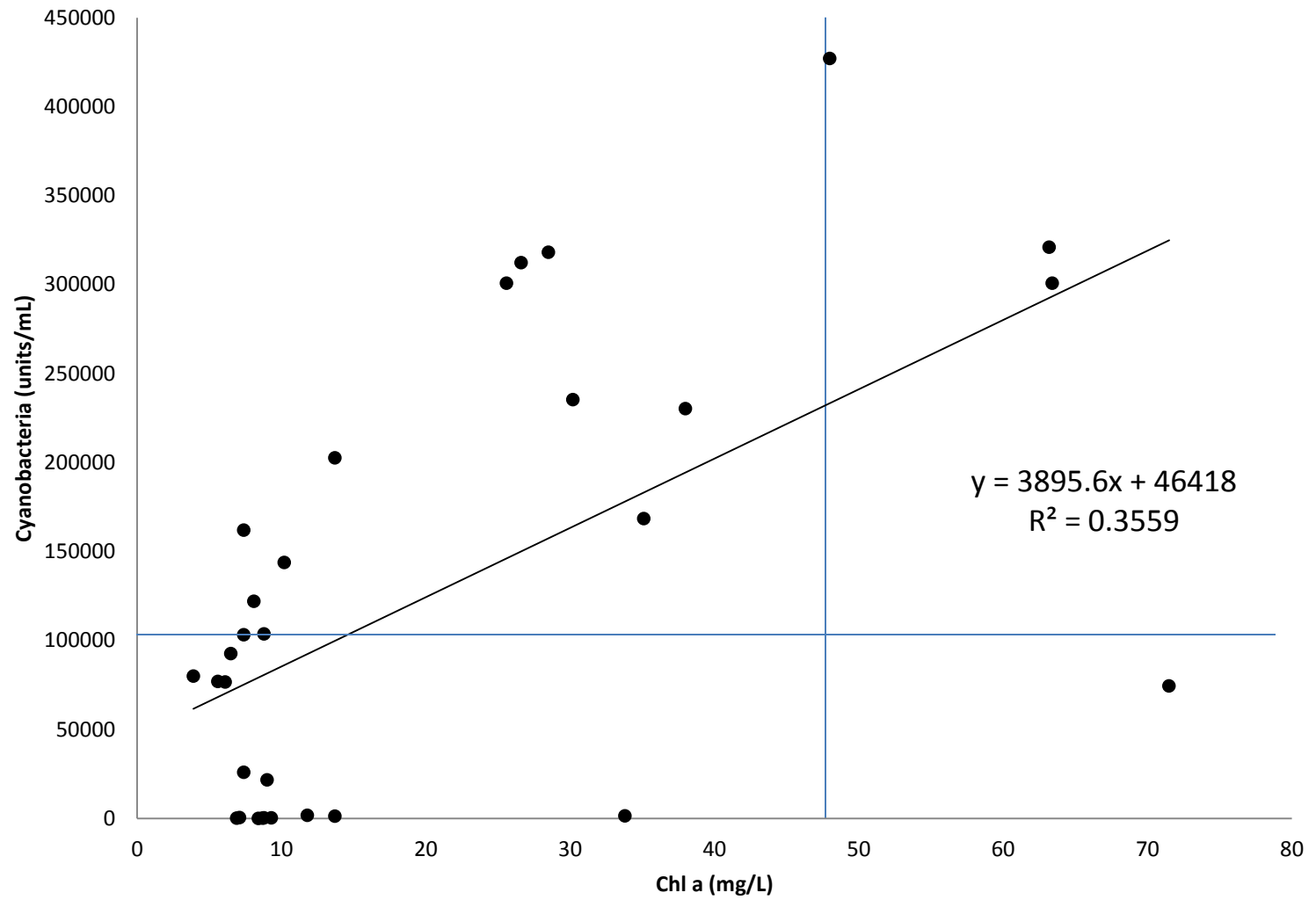
- **Objective:** Improve understanding of water quality in Albemarle Sound with a specific emphasis on eutrophication and harmful algal blooms
- **Samples Analyzed for:**
 - Phytoplankton composition, Nutrients, Silica, DOC, Cyanotoxins
 - Total Suspended Solids
 - Chlorophyll α , Temp, DO, pH, conductivity, turbidity, PAR, secchi depth, alkalinity
 - Pesticides (Atrazine and glyphosate)
 - Metals in water and sediment



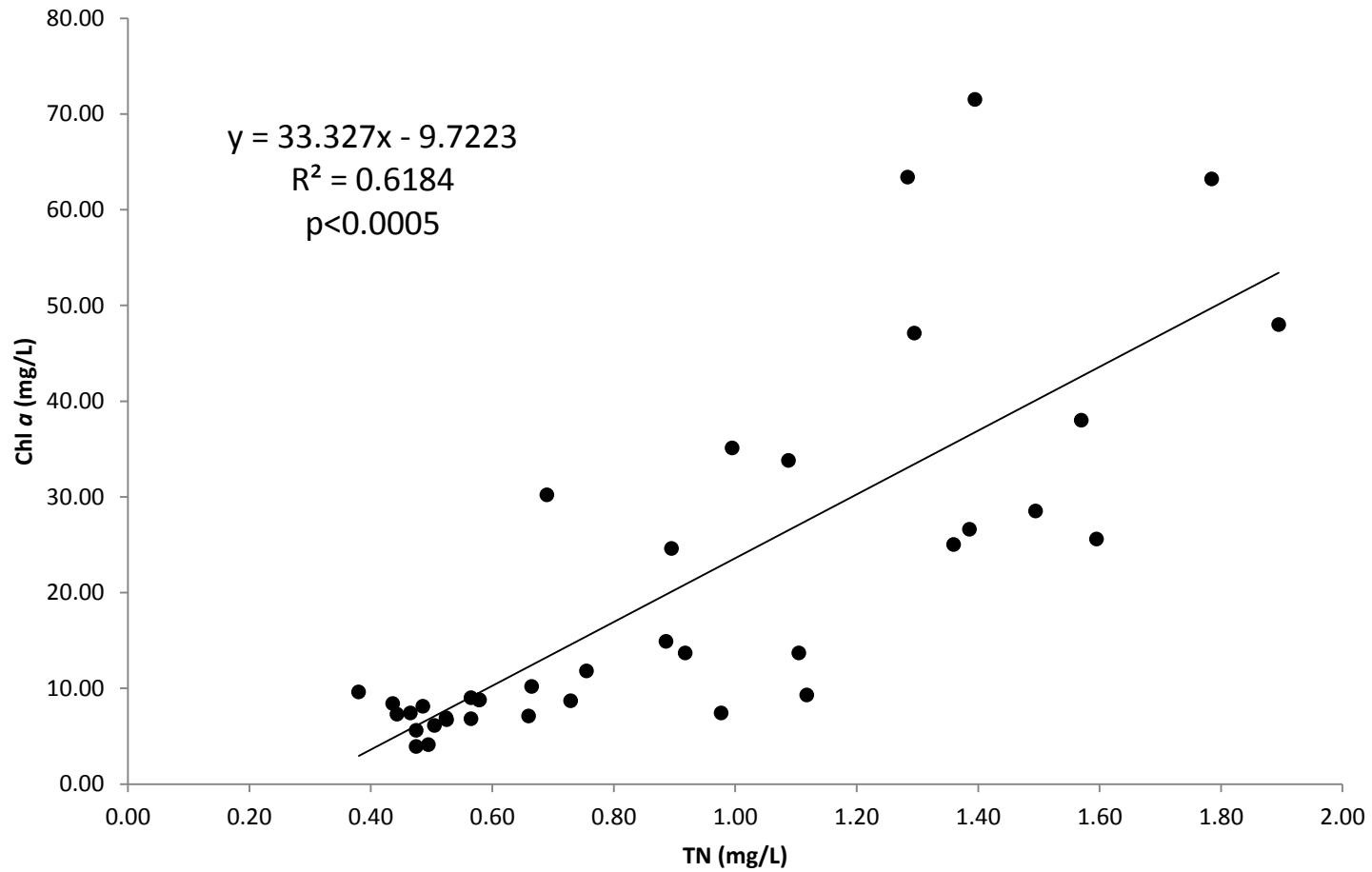
2012 exceedances of regulatory limits or NOAA guidelines

- 20 Sediment Samples at 20 sites
 - ERM Lead (>8.0 ppm, 13 sites)
 - ERL for Mercury (≥ 0.15 mg/kg, 7 sites)
- 41 Water Samples at 33 sites
 - Chl a (≥ 40 mg/L, 5 samples)*
 - high pH (≥ 8.5 , 5 samples)*
 - low DO (<5 mg/L, 2 samples)*
 - Zinc (86 $\mu\text{g/L}$, 1 sample)*
 - Copper (3 $\mu\text{g/L}$, 4 samples)*
 - Cyanobacterial cell count ($\geq 100,000$ units/mL, 15 samples)**
 - TN (≥ 1 mg/L, 13 samples)
 - TP (≥ 0.1 mg/L, 7 samples)

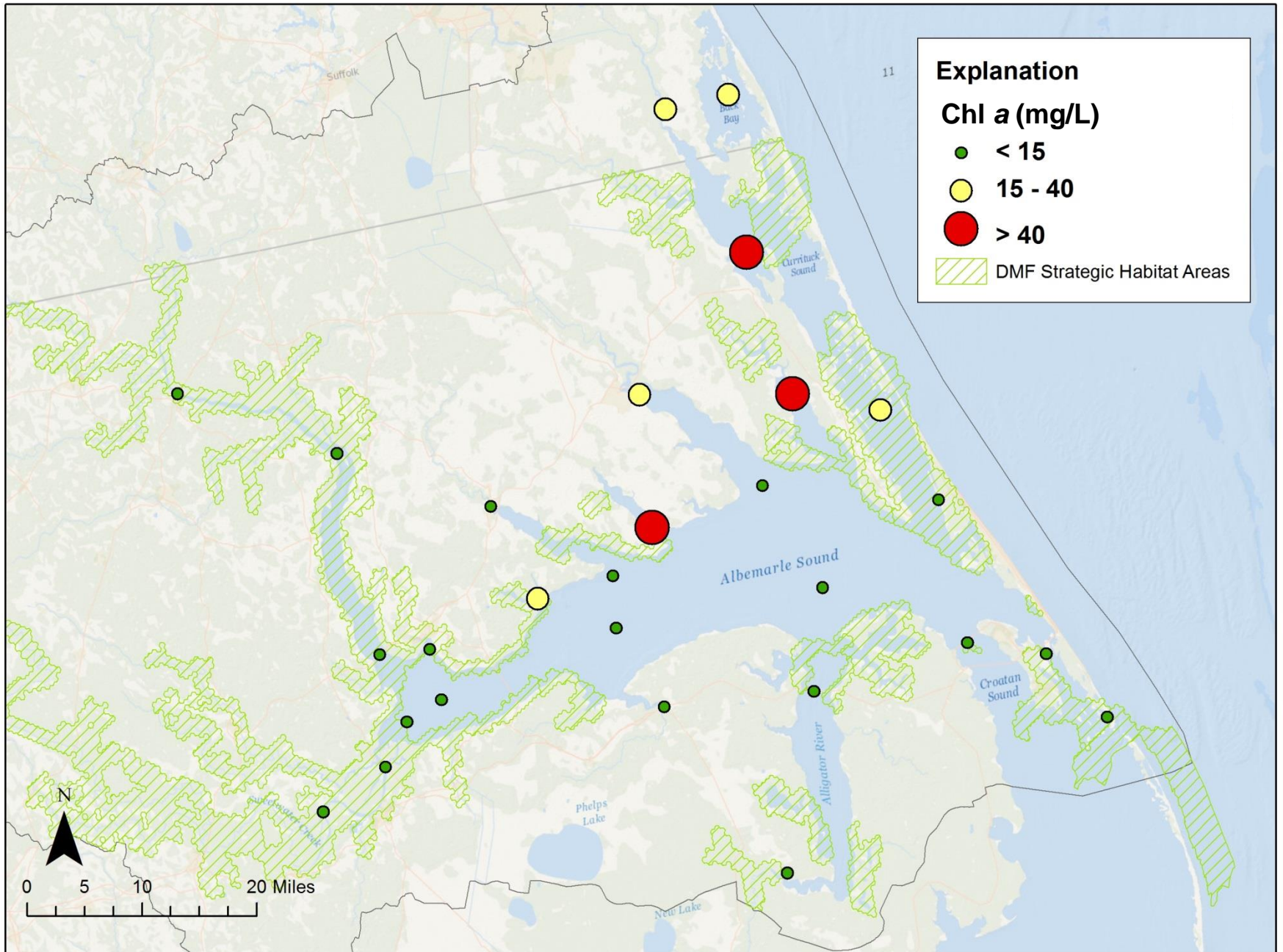
Relationship between cyanobacteria and Chl *a*



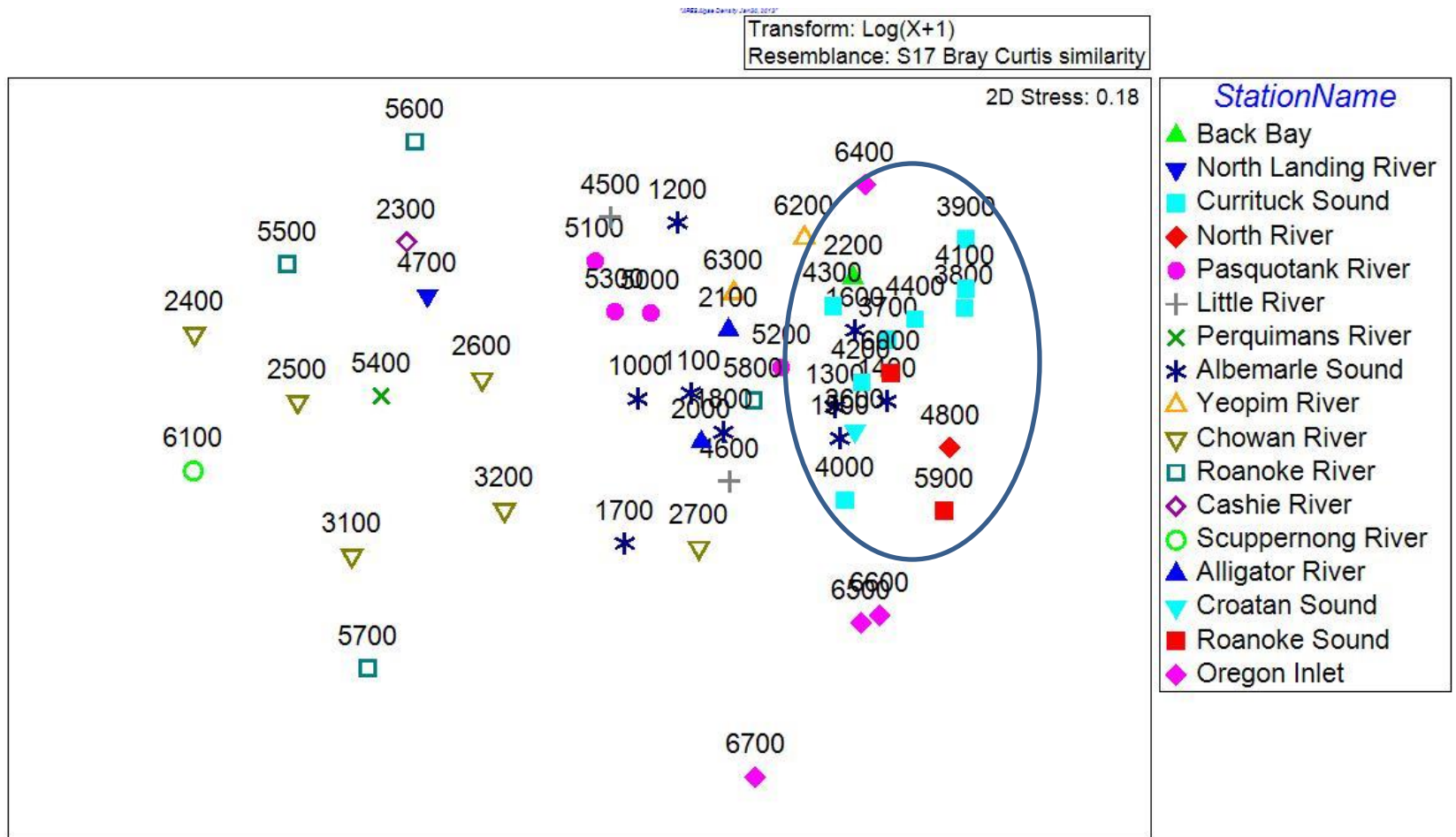
Relationship between TN and Chl a

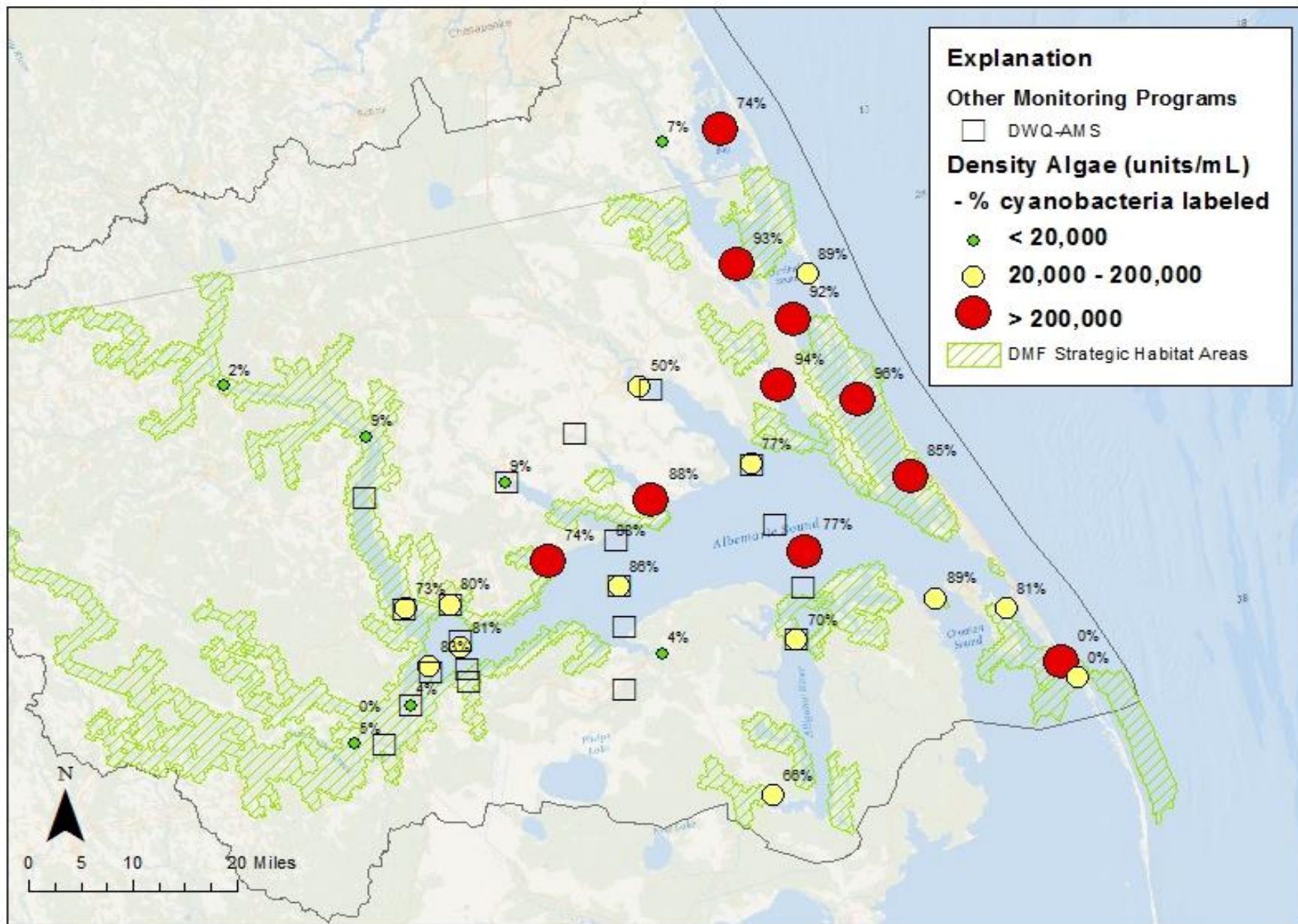


Chl a concentrations, Summer 2012

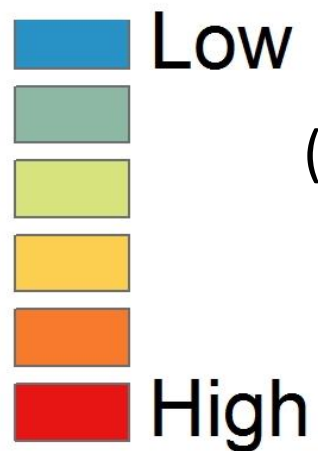


Multidimensional Scaling suggests phytoplankton communities are different in the Currituck Sound

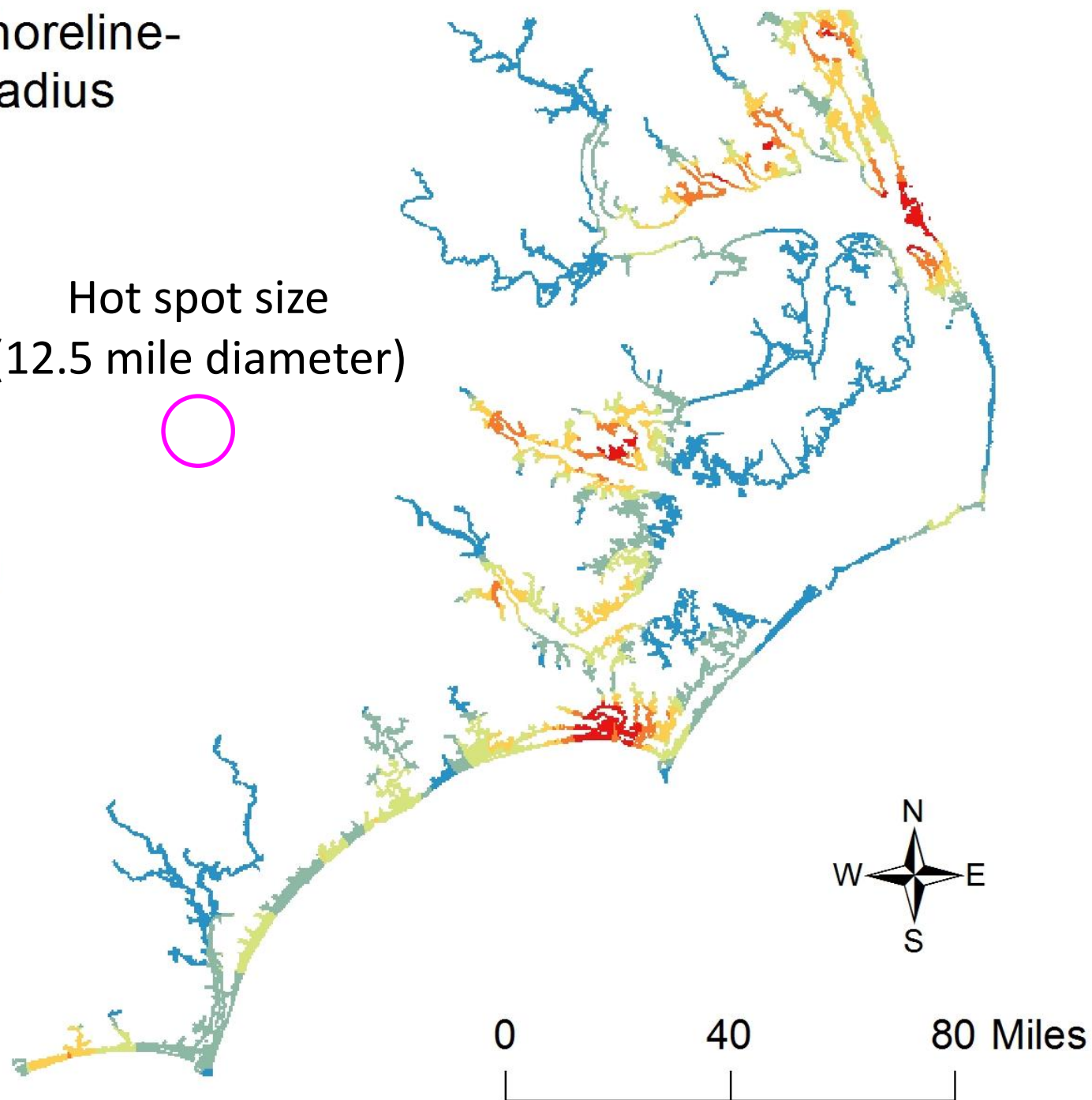
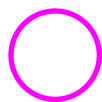


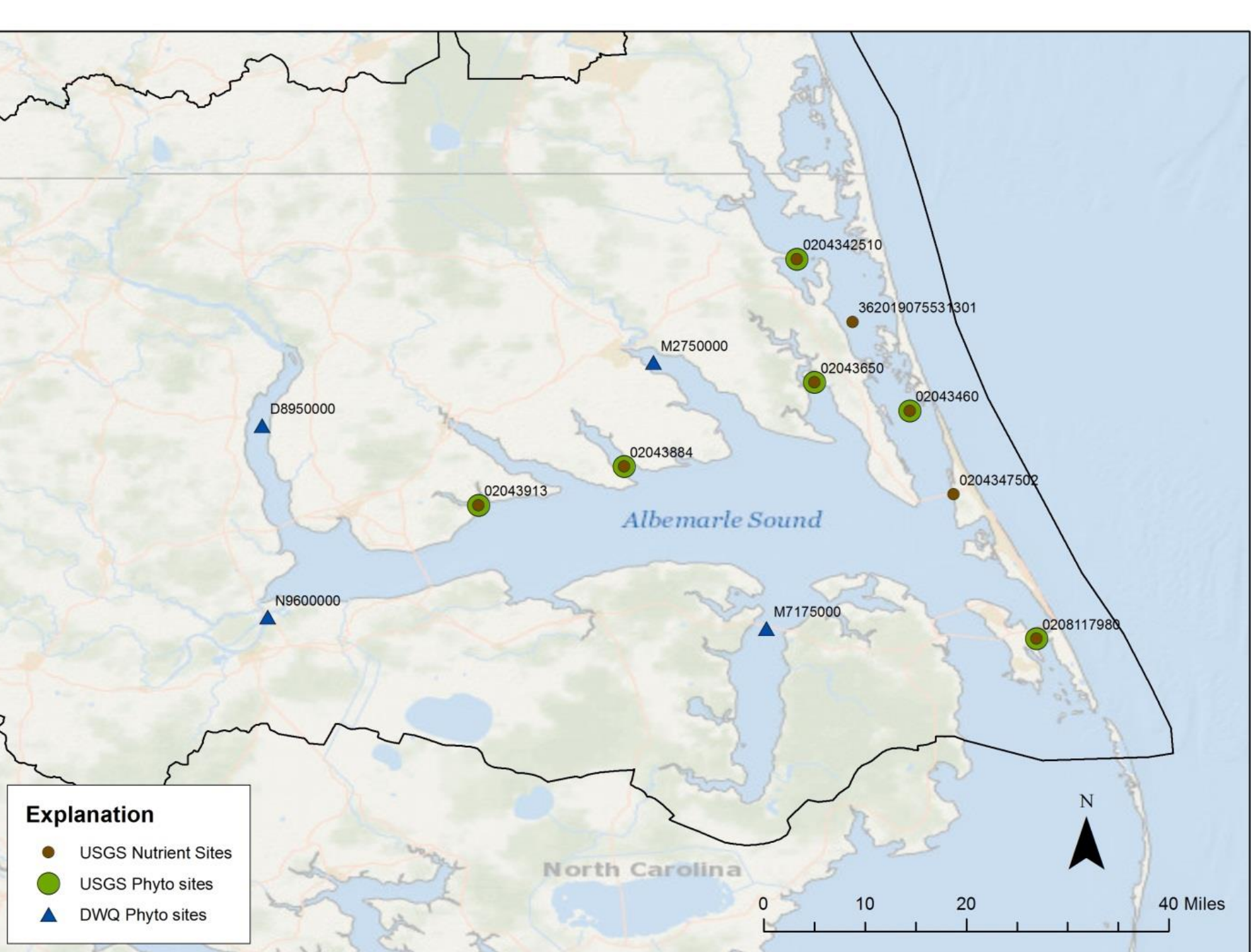


Modified Shoreline- 10 km radius




Hot spot size
(12.5 mile diameter)





Explanation

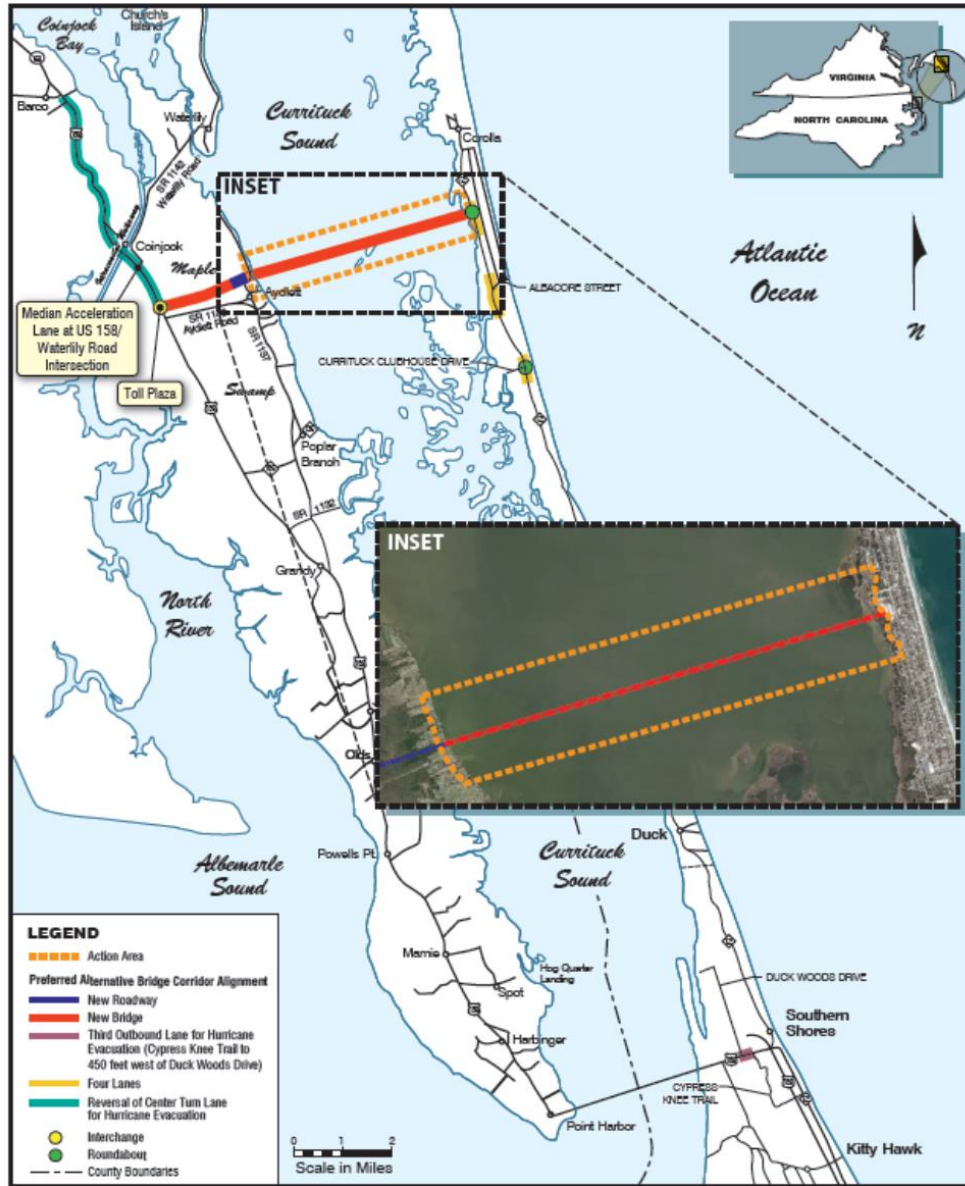
-  USGS Nutrient Sites
-  USGS Phyto sites
-  DWQ Phyto sites



Comparison of USGS and DWQ data, 2012

Organization	Date	Time	Depth of photic zone (m)	TKN (mg/L)	NH4 (mg/L)	NO2+NO3 (mg/L)	TP (mg/L)	Chl a (mg/L)
USGS	Jul 18 2012	1200	1.6	.67	<.010	<.040	.038	10.2
DWQ	Jul 18 2012	11:50	1.6	0.62	<0.02	<0.02	0.04	
USGS	Jul 17 2012	1330	2.7	.50	<.010	<.040	.031	3.9
DWQ	Jul 17 2012	13:13	2.5	0.54	<0.02	<0.02	0.02	
USGS	Jul 17 2012	1300	1.9	.48	<.010	<.040	.023	5.6
DWQ	Jul 17 2012	12:35	2.4	0.57	<0.02	<0.02	0.02	14
USGS	Jul 17 2012	1200	1.6	.51	<.010	<.040	.022	6.1
DWQ	Jul 17 2012	11:35	2.4	0.52	<0.02	<0.02	0.02	17
USGS	Jul 19 2012	1030	2.6	.59	.011	<.040	.027	8.8
DWQ	Jul 19 2012	10:30	2	0.59	<0.02	<0.02	0.02	13

Data will be leveraged with USGS Mid-Currituck Bridge Study



August Bloom on the Chowan, August 2013





IT'S TIME
SOMETHING
WAS DONE TO
MODERNIZE
THE DRAINAGE
AND PLUMBING
AROUND HERE.

Outcomes of Albemarle Demonstration Project



- A geospatial catalogue of current and historical monitoring and research efforts in the sound
- A summary of the current distribution of measured contaminants in the Sound
- An improved understanding of how water quality has changed through time in the Sound

Albemarle Demonstration project being used to build future work

- Working with UNC Coastal Studies Institute and US Army Corps of Engineers to expand continuous monitoring effort in the Albemarle Sound
- Working with Duke Masters' students to analyze historic datasets and develop visualization tools
- Working with partners to identify funds that can be used to address monitoring gaps in the Albemarle Sound



Huge thanks to our partners!

- Albemarle-Pamlico National Estuary Partnership
- Division of Water Resources
 - Estuarine Monitoring Team
 - Environmental Sciences Section
- Division of Marine Fisheries
 - Elizabeth City Office
- Coastal Studies Institute
- US Fish and Wildlife Service
- US Army Corps of Engineers – Duck FRF
- Eastern North Carolina/Southeast Virginia Ecoteam
- Every person who took the time to report about their monitoring program – Thank you!

For more information:

National Monitoring Network:

<http://acwi.gov/monitoring/network/design>

Albemarle Demonstration Project:

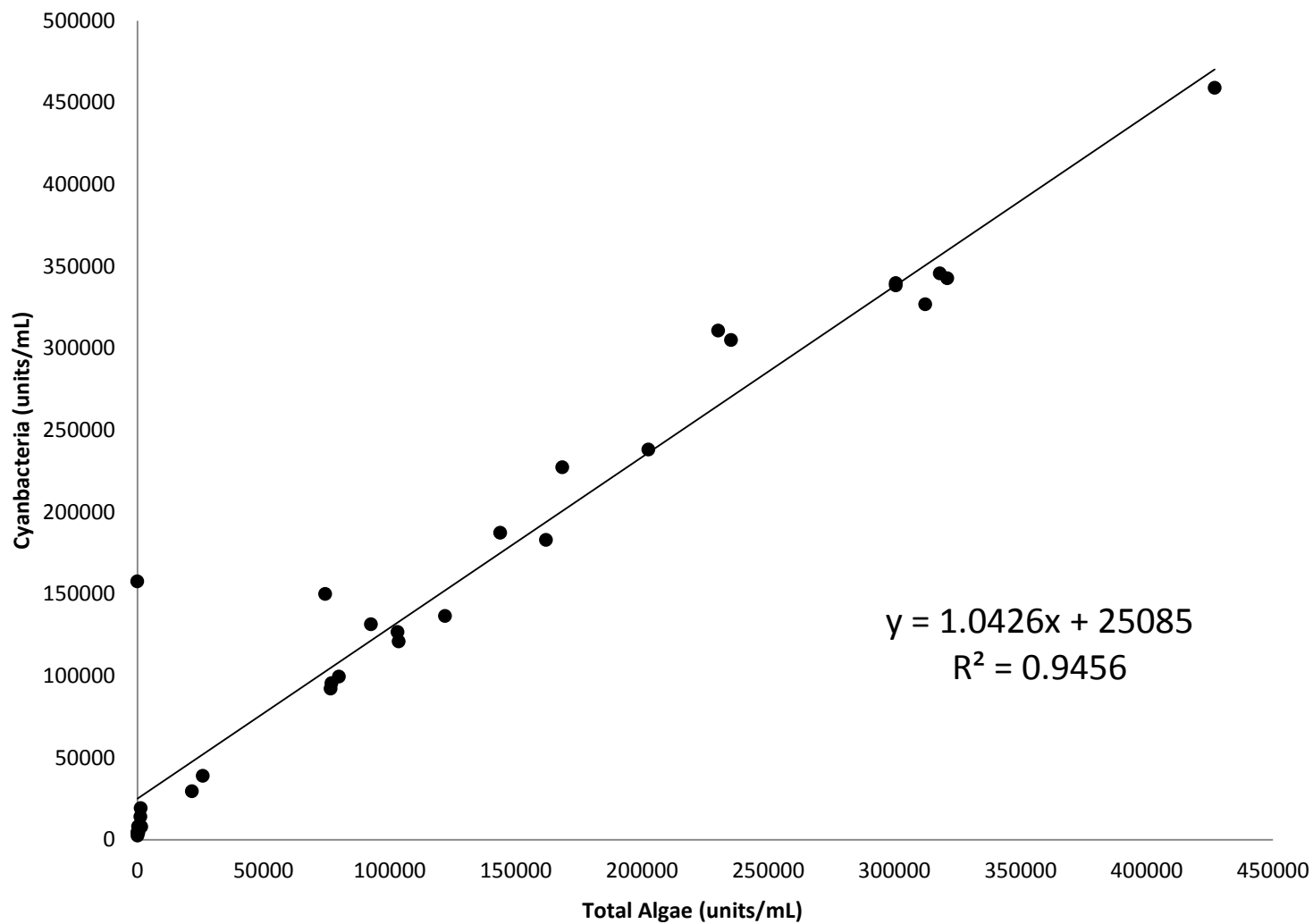
Michelle Moorman

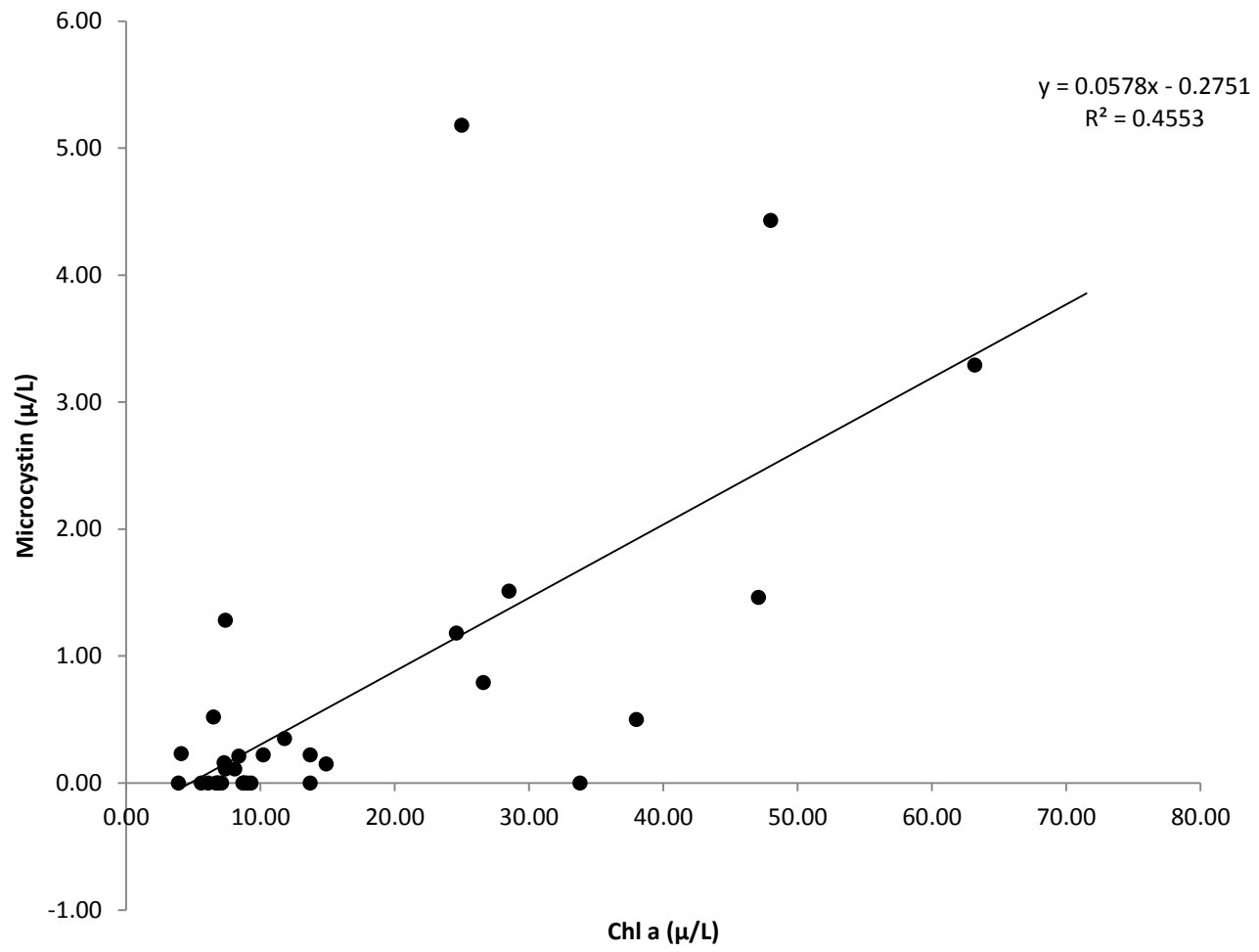
mmoorman@usgs.gov

919-571-4013

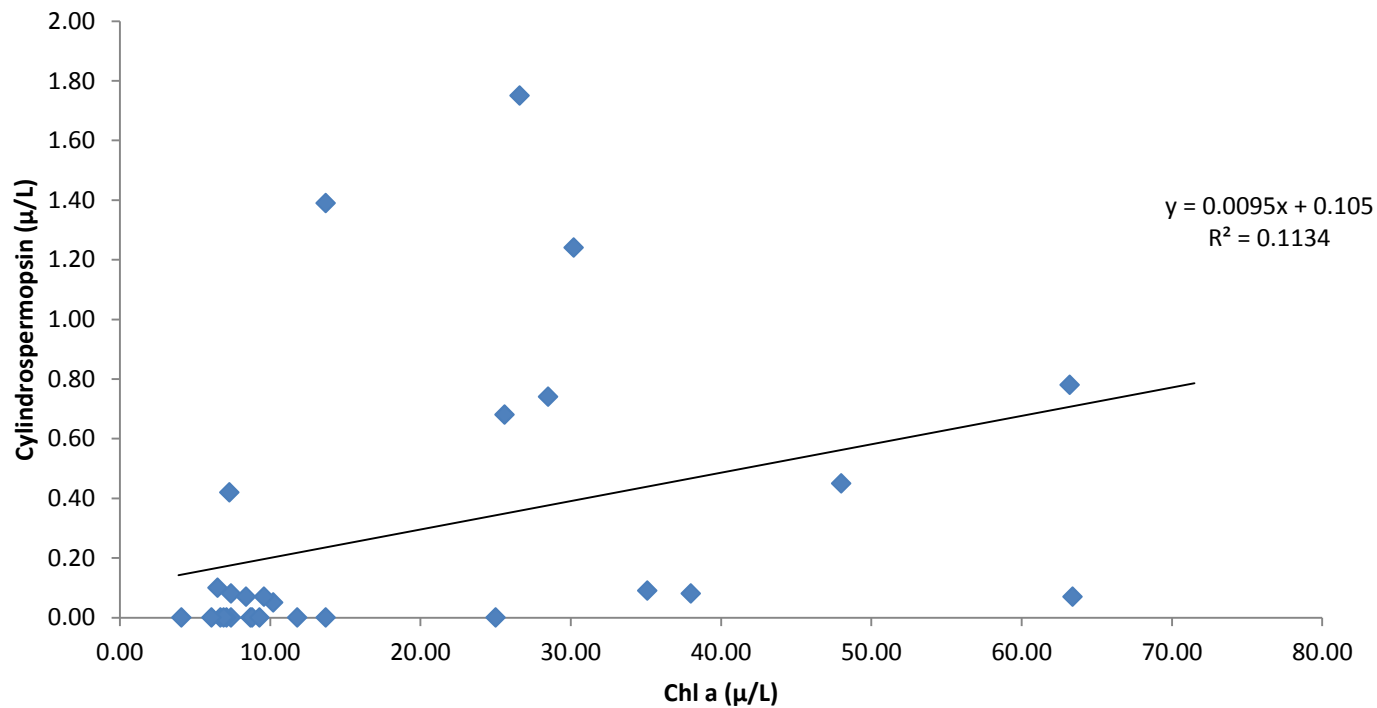


Relationship between Total Algal Density and Cyanobacteria

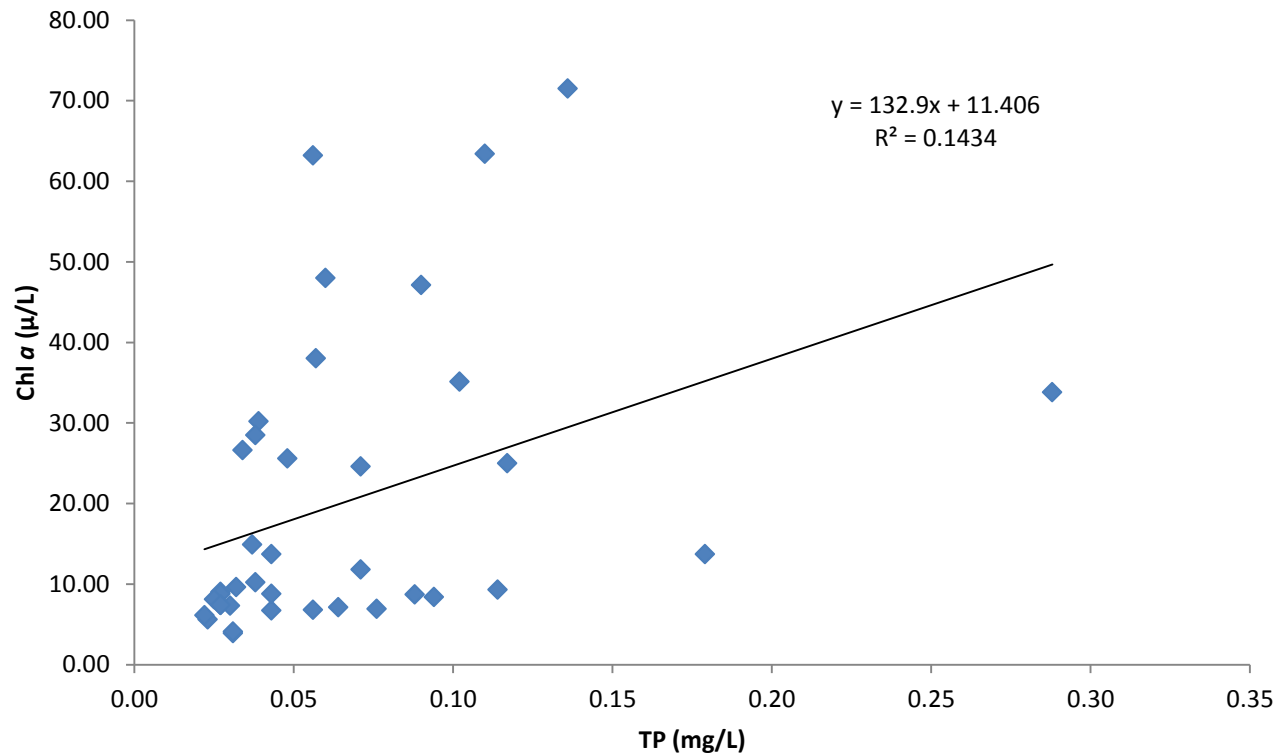


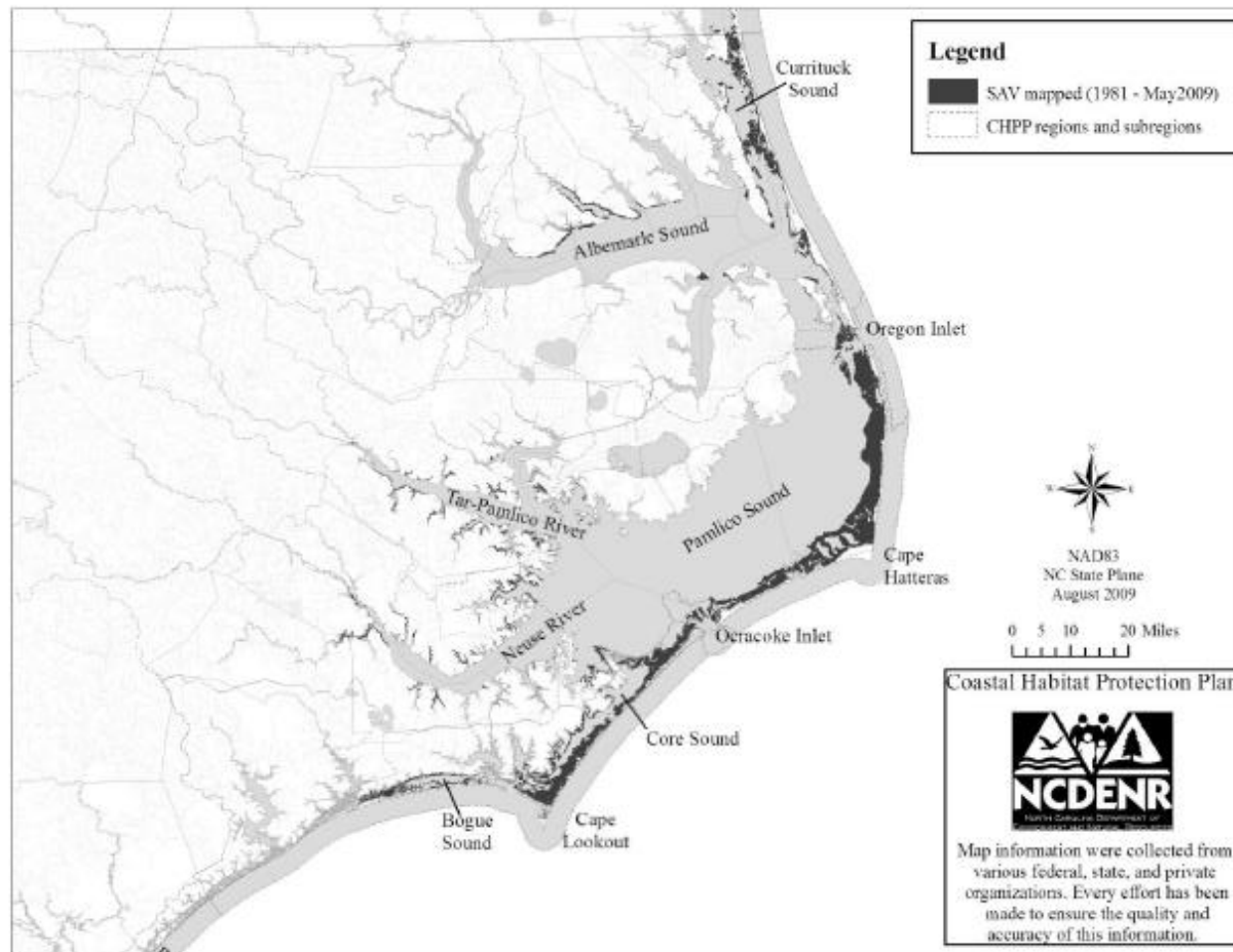


Relationship between Chl *a* and Cylindrospermopsin

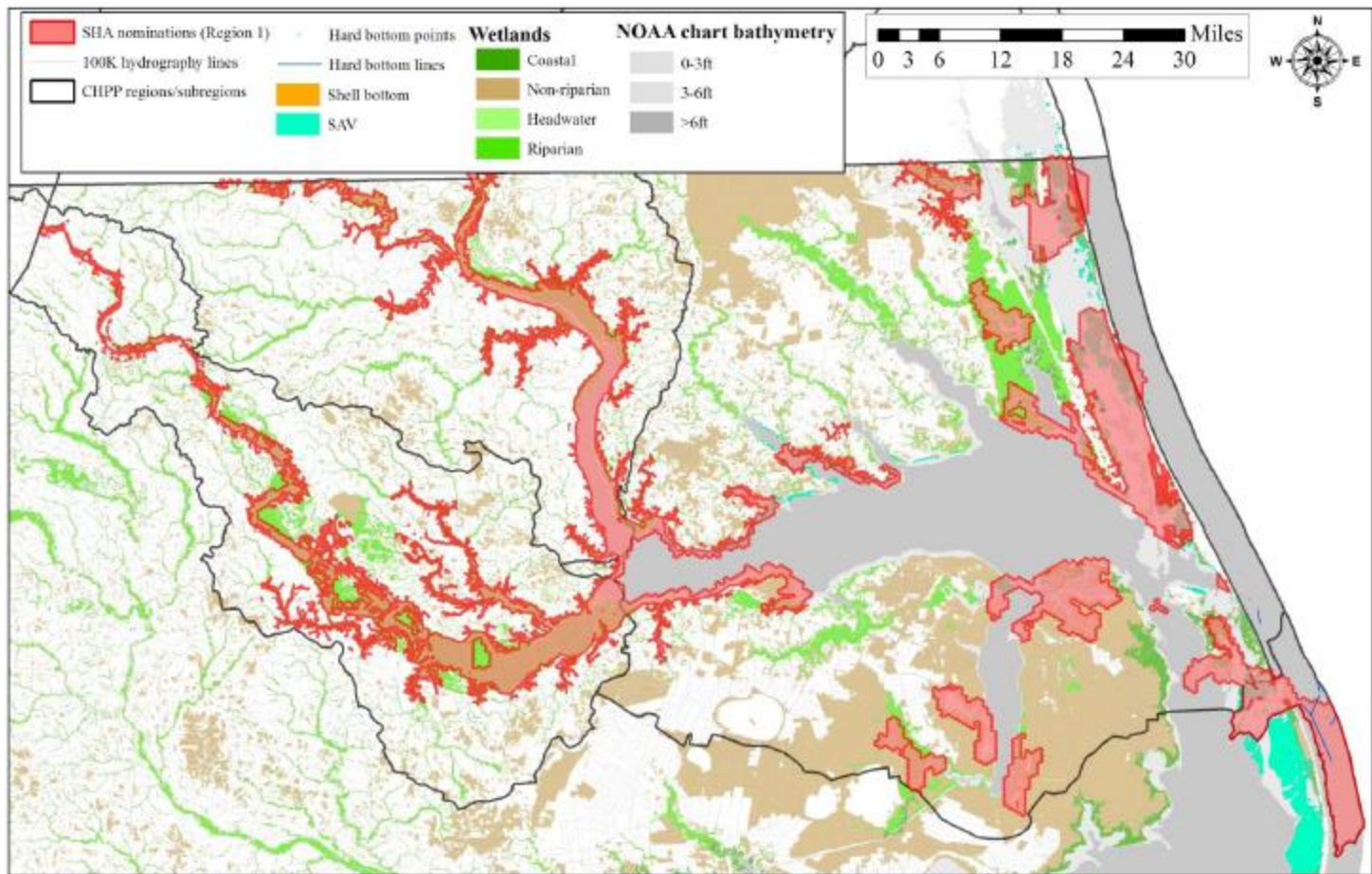


Relationship between TP and Chl a

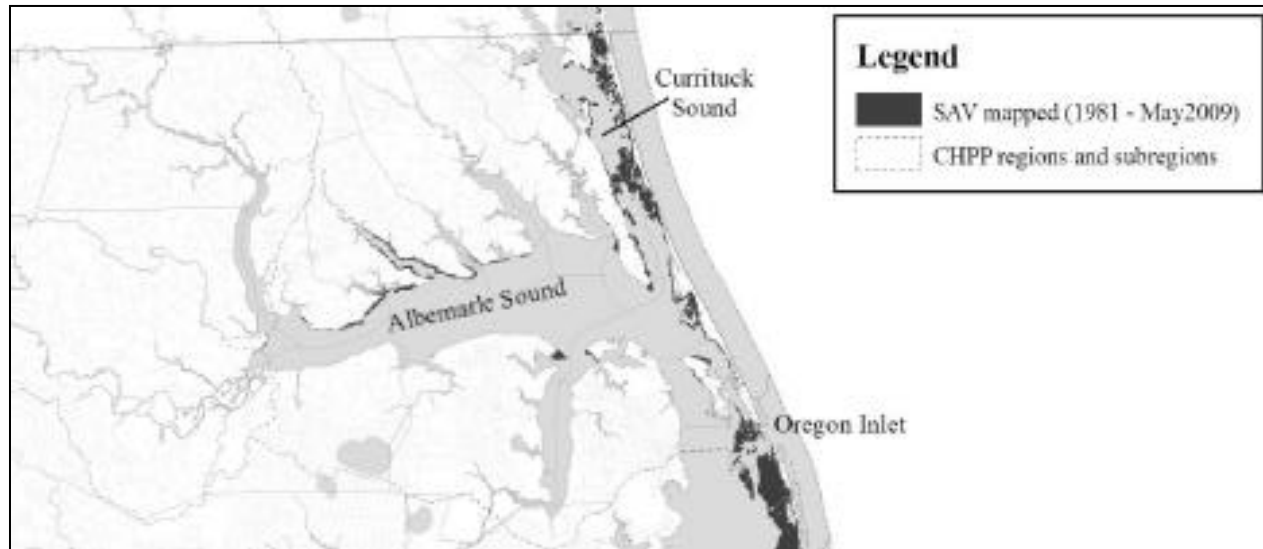




Map 4.1. Location of mapped submerged aquatic vegetation (SAV) habitat in coastal North Carolina (1981-2009). See “Distribution” section for mapping efforts included. Note: Absence of SAV beds in a given area does not suggest actual presence/absence of SAV because surveys have not been conducted in all areas.



Map 8.1. Strategic Habitat Area nominations presented and approved by the Marine Fisheries Commission in January 2009.



- Continuous monitoring of DO, temp, salinity, water level, and turbidity to understand temporal dynamics
- Probabilistic sampling of nutrients in sediment and water
- Synoptic study of endocrine disrupting chemicals (EDCs)
- Deriving historical shoreline erosion rates for the sound
- Developing spatial turbidity models from remotely sensed data
- Model development to improving understanding of how physical and chemical parameters in the system impact biological endpoints (i.e. SAV distribution, oyster restoration success, spawning success, algal blooms)