

The National Estuarine Research Reserve System: An Observations Pipeline for Moving Monitoring to Management

Dr. Whitley Saumweber, ERD, and Dr. Susan White, NCCOS



Presentation Components

- Introduction to the National Estuarine Research Reserve System (NERRS)
- NERRS system-wide monitoring program (SWMP) data acquisition and dissemination strategies
- Coastal management applications supported with NERRS monitoring data



NATIONAL ESTUARINE RESEARCH RESERVES

A network of 27
protected areas



- | | | | |
|-----------------------------------|--|--------------------------------|---|
| 1. Wells, Maine | 8. Chesapeake Bay, Maryland | 15. Rookery Bay, Florida | 22. San Francisco Bay, California |
| 2. Great Bay, New Hampshire | 9. Chesapeake Bay, Virginia | 16. Apalachicola, Florida | 23. South Slough, Oregon |
| 3. Waquoit Bay, Massachusetts | 10. North Carolina | 17. Weeks Bay, Alabama | 24. Padilla Bay, Washington |
| 4. Narragansett Bay, Rhode Island | 11. North Inlet-Winyah Bay, South Carolina | 18. Grand Bay, Mississippi | 25. Old Woman Creek, Ohio |
| 5. Hudson River, New York | 12. ACE Basin, South Carolina | 19. Mission-Aransas, Texas | 26. Proposed—St. Lawrence River, New York |
| 6. Jacques Cousteau, New Jersey | 13. Sapelo Island, Georgia | 20. Tijuana River, California | 27. Kachemak Bay, Alaska |
| 7. Delaware | 14. Guana Tolomato Matanzas, Florida | 21. Elkhorn Slough, California | 28. Jobos Bay, Puerto Rico |

national estuarine research reserve system

NOAA & NERRS Mission

- NOAA: To conduct research, develop products, provide scientific understanding and leadership and to conduct outreach towards fostering NOAA's evolving environmental and economic mission.
- NERRS: To practice and promote coastal and estuarine stewardship through innovative research and education using a system of protected areas.



NERRS Goals

1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research, and education.
- 2. Increase the use of reserve science and sites to address priority coastal management issues.**
3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.



System Wide Monitoring Program Phases

I. Abiotic Monitoring

Water Quality & Nutrients

Weather Parameters



II. Biological Monitoring

Habitat Change

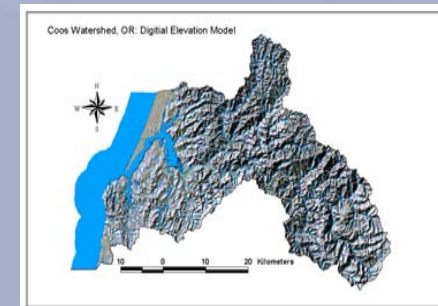
Biodiversity



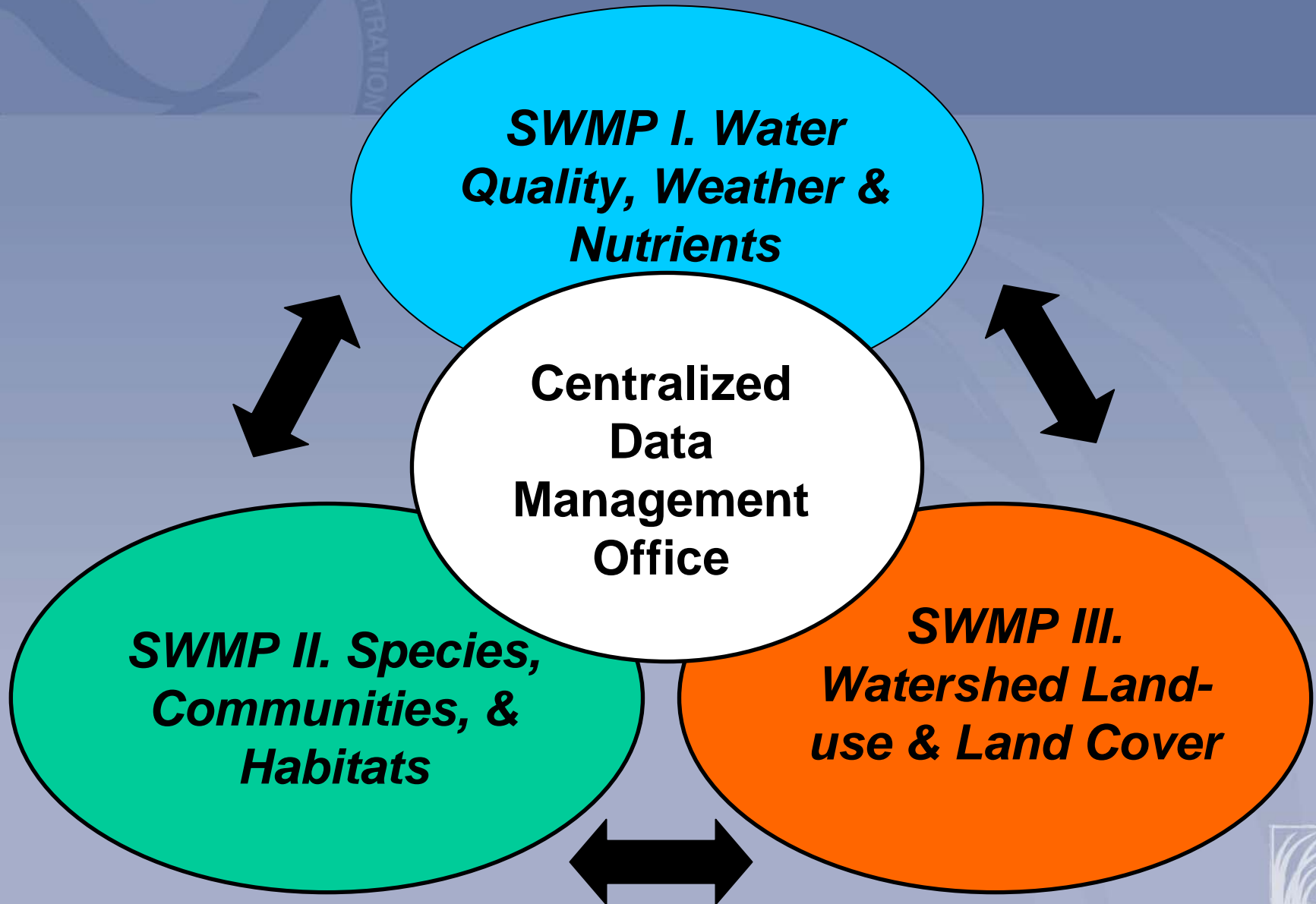
III. Land Cover/Use and Habitat Change

Spatial Patterns

Human Impacts



**NATIONAL ESTUARINE RESEARCH RESERVE
SYSTEM-WIDE MONITORING PROGRAM**



SWMP Phase I

Parameters Monitored

Water parameters:

pH
Conductivity
Salinity
Temperature
Dissolved Oxygen
Turbidity
Nitrate
Ammonia
Ortho-Phosphate
Chlorophyll a

Weather parameters:

Temperature
Wind speed and direction
Relative humidity
Barometric pressure
Rainfall
Photosynthetic
Active Radiation



- *Identify and track short-term variability and long-term changes in the integrity and biodiversity of estuarine ecosystems.*



Deployment Strategy

Initial Deployment Coverage

**Non-point
Source-influenced**

Reference site



Impacted site

Enhanced Deployment Coverage

- “Estuarine Gradients”**
- *Salinity*
 - *Land-use*
 - *Habitat*
 - *Vertical*



Telemetry through Geostationary Operational Environmental Satellites (GOES)

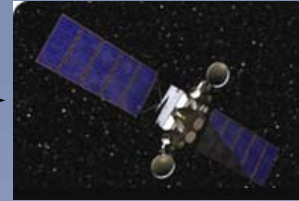
GOES Satellite



Wallops Island
Command
and Data
Acquisition
Facility



DOMSAT



HADS

Hydrometeorological Automated Data System
NOAA's National Weather Service
Office of Hydrologic Development
Hydro-Meteorological
Automated Data System

**NERRS Weather
& Water**

**Data
Collection
Platforms**



**NERRS Satellite
Receive Station at
the University of
South Carolina,
Columbia**



**NERRS/
Centralized
Data
Management
Office
(CDMO)**



Annually

NODC
National Ocean Data
Center Archive

Centralized Data Management Office (CDMO):

- **Mission:**

To oversee the management, documentation, and publication of the NERRS monitoring data on the Internet.

- **Provides:**

- QA/QC
- Data management strategies and protocols
- Data Availability –
 - Interactive Tools
 - Downloads
 - Web Services

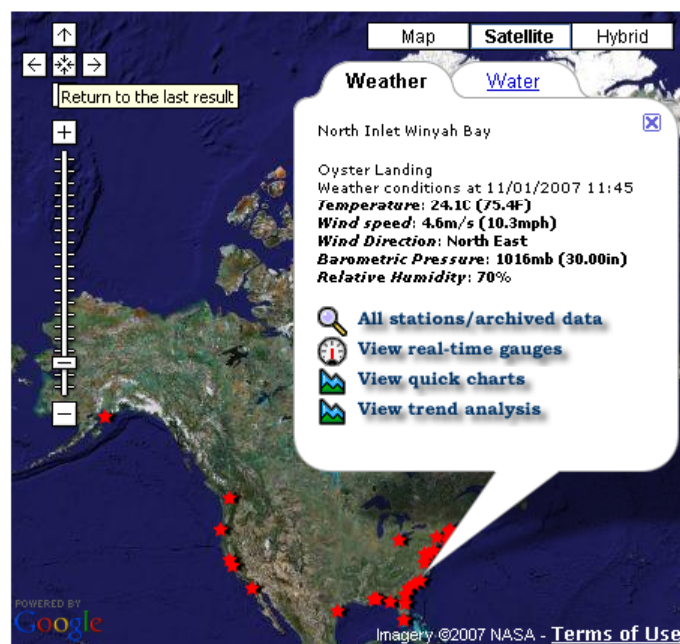
<http://cdmo.baruch.sc.edu/>





- CDMO Home
- About CDMO
- About Data
- Get Data
- Links
- Web Services

Choose the reserve to query data from by single-clicking on the reserve icon on the large map. Real-time data will be displayed in a popup window and visual charts and gauges are also available for viewing the data.



NERR Reserves

All times are local standard time.

0. ACE Basin, SC
1. Apalachicola, FL
2. Chesapeake Bay, MD
3. Chesapeake Bay, VA
4. Delaware, DE
5. Elkhorn Slough, CA
6. Grand Bay, MS
7. Great Bay, NH
8. Guana Tolomato Matanzas, FL
9. Hudson River, NY
10. Jacques Cousteau, NJ
11. Jobos Bay, PR
12. Kachemak Bay, AK
13. Mission-Aransas, TX
14. Narragansett Bay, RI
15. North Inlet Winyah Bay, SC
16. North Carolina, NC
17. Old Woman Creek, OH
18. Padilla Bay, WA
19. Rookery Bay, FL
20. Sapelo Island, GA
21. San Francisco Bay, CA
22. South Slough, OR
23. Tijuana River, CA
24. Wells, ME
25. Weeks Bay, AL
26. Waquoit Bay, MA

All real time data reported on the CDMO website are considered provisional and have not been edited or reviewed. Only data out of the instrument range have been removed through an automated quality control process.

Map Tips For Navigation

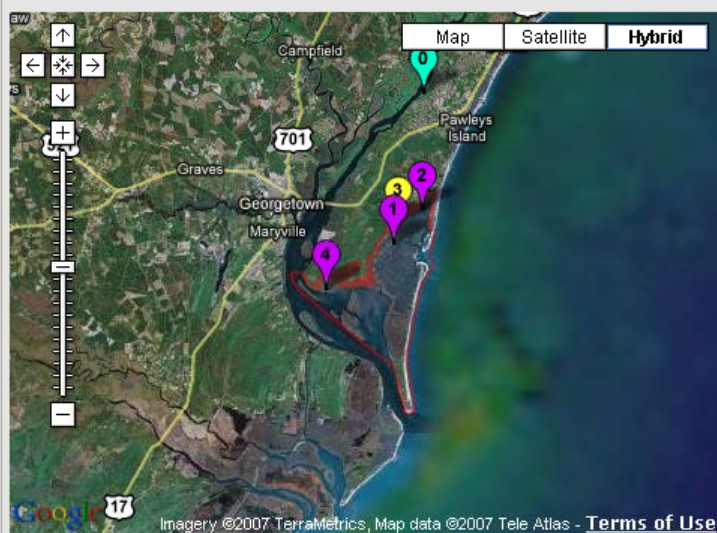
1. Single-click Reserve star for graph links and real-time data.
2. Double-click satellite map to center map image.



- CDMO Home
- About CDMO
- About Data
- Get Data
- Links
- Web Services

>> [NERR Map](#) >> [NOAA Info](#) >> North Inlet Winyah Bay

For station links and additional information, click on the colored map pin or the station name listed to the right.



Sampling Stations

- ☒ Reporting real-time data
- ☐ Inactive Station

- ☒ [0. Caledonia](#)
- ☐ [1. Clambank](#)
- ☐ [2. Debidue Creek](#)
- ☐ [3. Oyster Landing](#)
- ☐ [4. Thousand Acre](#)

The Reserve boundaries are shown in red on the map.
The following table shows the type of data available at this reserve.

Water Quality Data

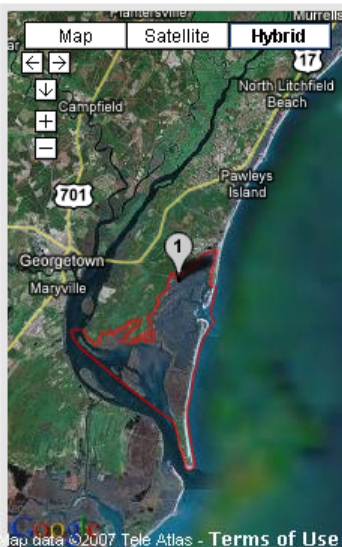
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007

Weather Quality Data

2001 2002 2003 2004 2005 2006 2007

Nutrient Data

2002 2003 2004 2005

**Water Station: niwolwq**

Name: Oyster Landing, SC
33° 20' 57.66 N, 79° 11' 19.97 W

Current Conditions:

Timestamp: 11/01/2007 11:45
Water Temp: 20.7 C
Percent Saturation: 83.4 %
Turbidity: 8 NTU
Specific Conductivity: 53.59
Salinity: 35.5 ppt
Dissolved Oxygen: 6.1 mg/l
Depth: 2.29 meters
pH: 8.0 units

 [Show Reserve](#) [Graph 3 Days](#) [Graph Week](#) [Graph Month](#) [Graph This Year](#) [View quick charts](#) [View advanced chart](#) [View trend analysis](#)**North Inlet Winyah Bay**

Real-Time Sampling Stations
(M) Meteorological, (W) Water

[0. \(M\) Oyster Landing](#)[1. \(W\) Oyster Landing](#)

All times are local standard time.
Standard deviations are based on the last ten years of historical seasonal averages.
Click current value pointer on gauge to drill down to a large chart representation of the data.

Current Value Daily High & Low 2 Standard Deviations

[NERR Site Map](#)[Charting Options](#)[Export Data](#)

All real time data reported on the CDMO website are considered provisional and have not been edited or reviewed. The reflected data may contain values that are missing or erroneous due to satellite transmission

SWMP Phase II Biomonitoring: A Toolbox Approach

Biotic monitoring will build upon Phase I SWMP (water, weather, nutrients)

Datasets generated by biotic monitoring will use a toolbox approach to address:

- **SWMP Mission – short-term variability & long-term change**
- **Questions of national, regional, & local significance**

Definitions:

Tools = written protocol for assessment and monitoring of particular sub-units of the estuarine biotic community

Toolbox = collection of written protocols, tailored to address the balance between system-wide standardization and site-based flexibility

Flexible Approach = NERR sites select proper suite of tools to address question





SWMP Phase II Biomonitoring: A Toolbox Approach

Site Profile of the NERR Estuary

Local Management Issue / Problem to Address

Target Biomonitoring Indicators & Protocols

- ❶ Submerged Aquatic Vegetation / Emergent Marsh
- ❷ Aquatic Invasive Species / Native Biodiversity
- ❸ Nekton – Fishes & Decapod Crustaceans
- ❹ Benthic Organisms & Shellfish
- ❺ Plankton Communities
- ❻ Secretive Marsh Birds

Data Analysis and Delivery

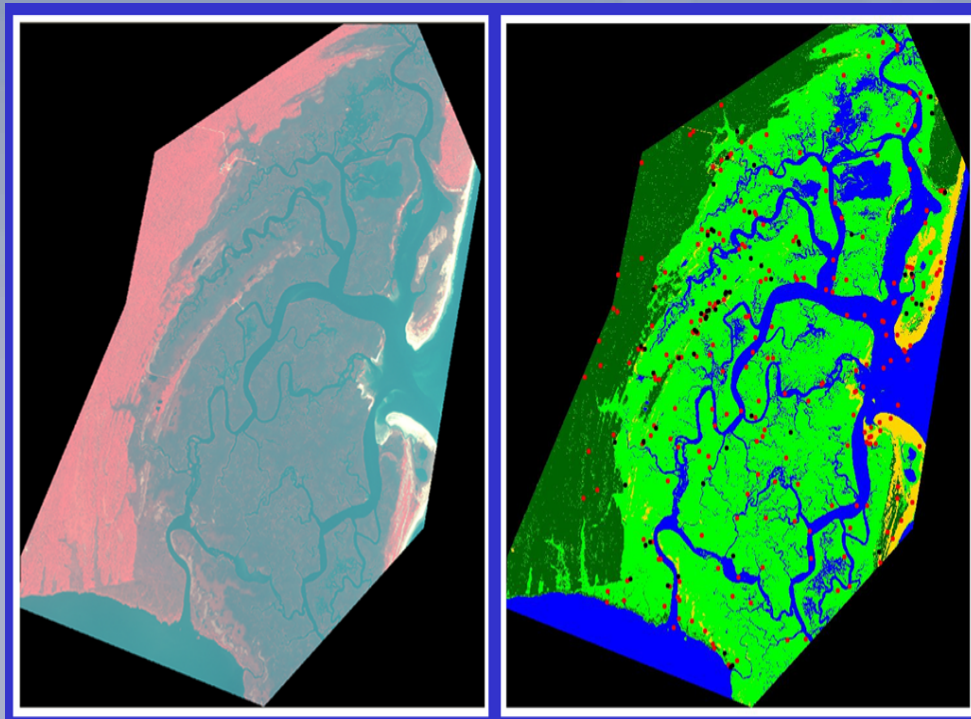


SWMP Phase II Biomonitoring Pilot Projects

Biological Monitoring of Emergent Marshes and Submerged Aquatic Vegetation

SAV/EM Tier 1 – Habitat Quantity: Remote Sensing, Aerial & Ground Surveys of Changes in Spatial Cover and Distribution

False CIR (left) and classified (right) IKONOS images of North Inlet-Winyah Bay NERR land cover



SWMP Phase II Biomonitoring Pilot Projects

Pilot Projects: Biological Monitoring of Emergent Marshes and Submerged Aquatic Vegetation

SAV/EM Tier 2 – Habitat Quality: Ground-based Surveys of Seasonal Changes in Species & Communities



Cordgrass: *Spartina alterniflora*

Eelgrass: *Zostera marina*

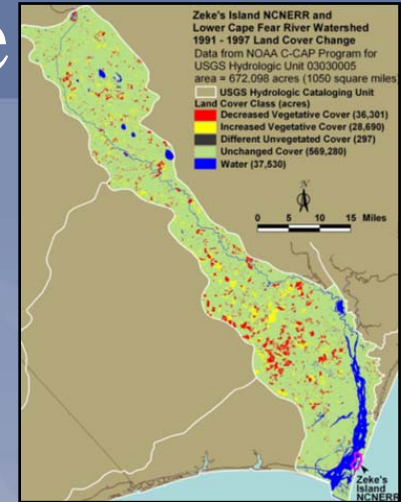




SWMP Phase III: Land Use and Land Cover Change

Goals

- Applying geospatial land use / land cover data to facilitate an understanding of changes in land use and climate on estuarine habitats
- Translating information to decision makers and the general public



Products

- GIS land cover datasets and change analysis for reserves and watersheds
- DEMs and Tidal Datums for each reserve and watershed
- Analysis and dissemination of trends in land use and habitat change at multiple scales to targeted audiences





Habitat Mapping

NCNERR Habitat Classification Key

Cultural Land Cover

Rocky In-water Structure

Estuarine Habitats

Intertidal Mud

Intertidal Persistent Wetland

Intertidal Reef Mollusk

Intertidal Sand

Intertidal Scrub-Shrub BLD

Subtidal Organic

Subtidal Sand

Supratidal Persistent Wetland

Supratidal Sand

Supratidal Scrub-Shrub BLD

Supratidal Scrub-Shrub BLE

Marine Habitats

Intertidal Sand

Upland Habitats

Supratidal Forest BLE

Supratidal Forest Mixed

Supratidal Grassland

Supratidal Sand

Supratidal Scrub-Shrub BLD

Supratidal Scrub-Shrub BLE

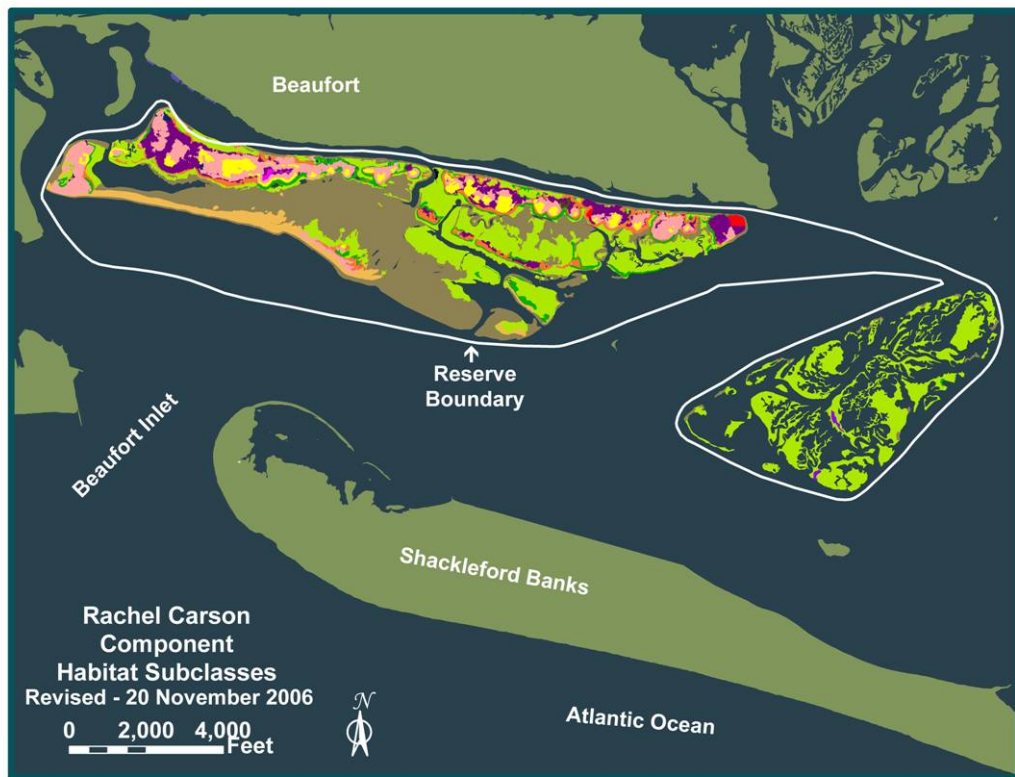
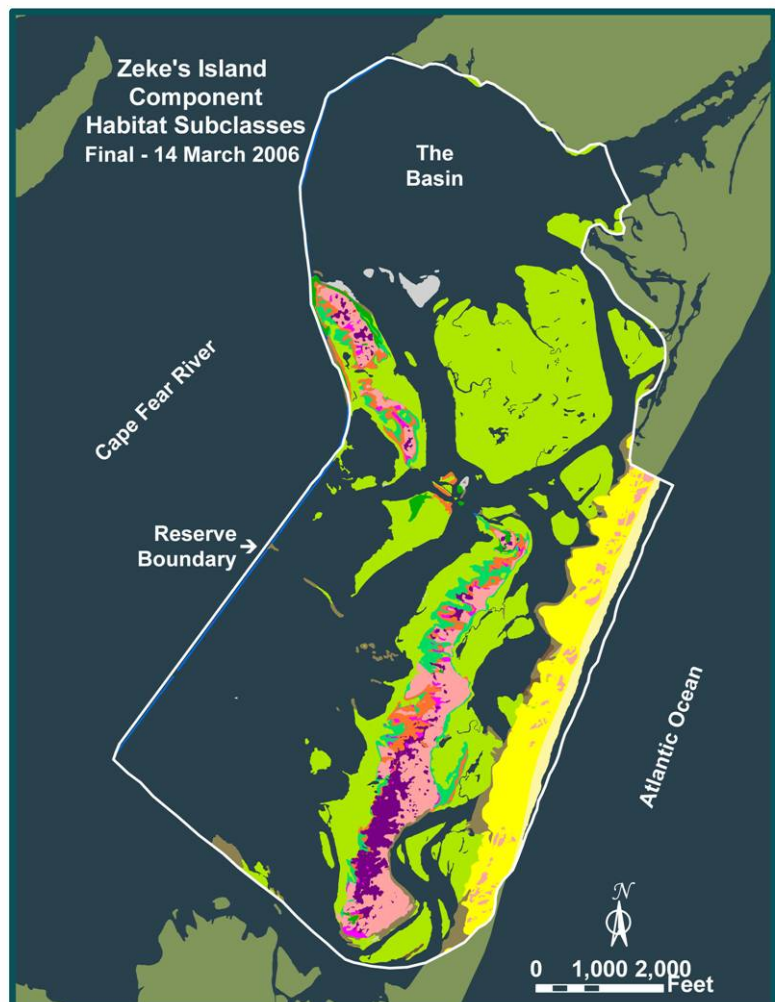
Supratidal Scrub-Shrub NLE

BLD = Broad Leaf Deciduous

BLE = Broad Leaf Evergreen

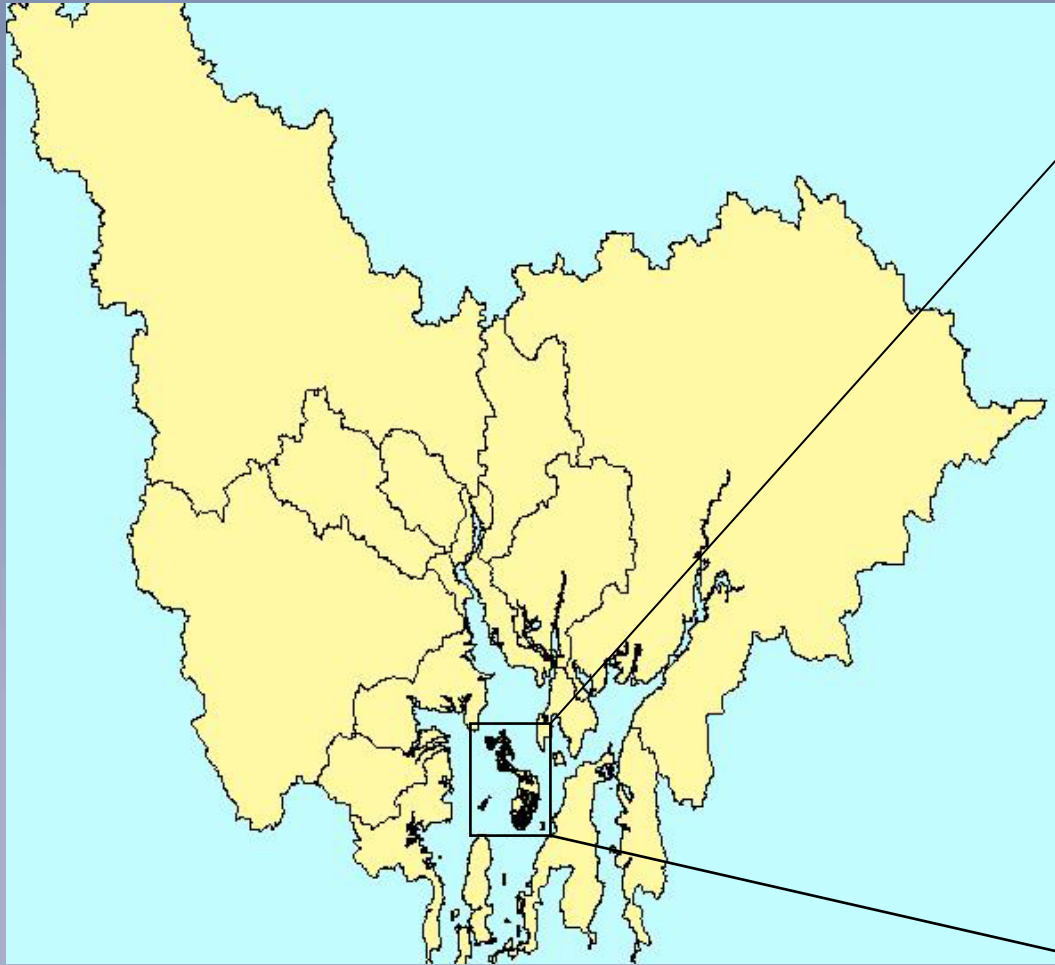
NLE = Needle Leaf Evergreen

Scrub-Shrub < 20' tall > Forest

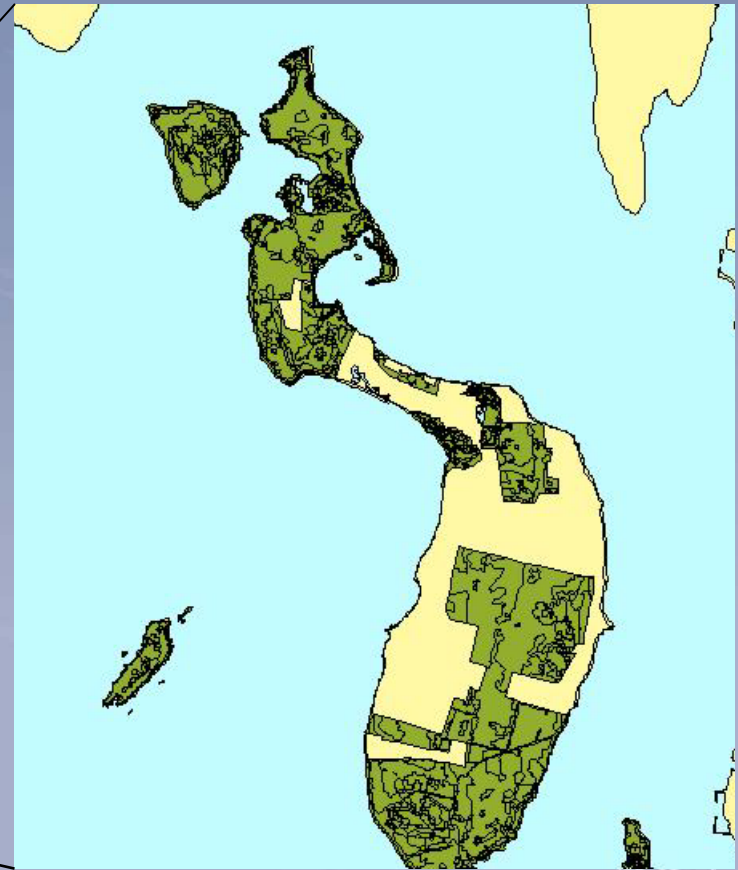


Slide courtesy of John Fear, NCNERR 2006

Habitat Mapping at Multiple Scales



1. WATERSHED-SCALE



2. SITE-SCALE

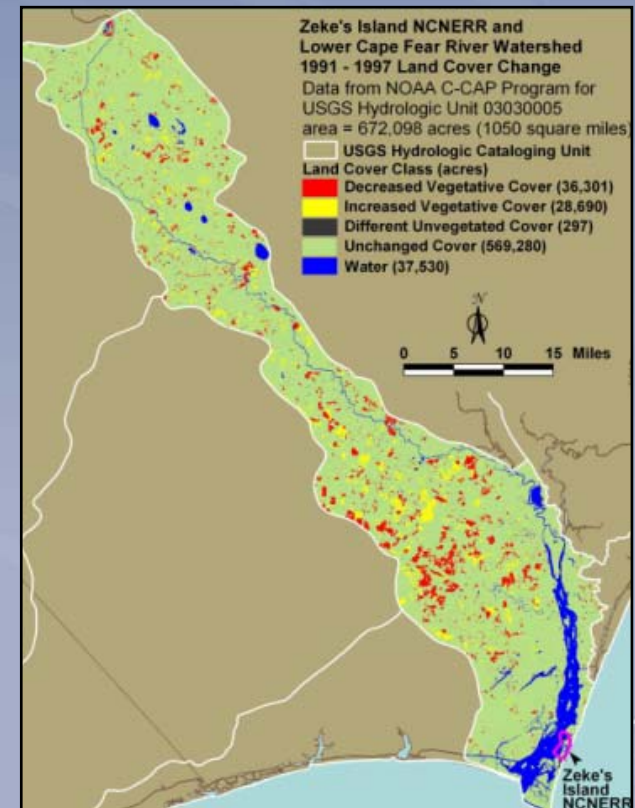
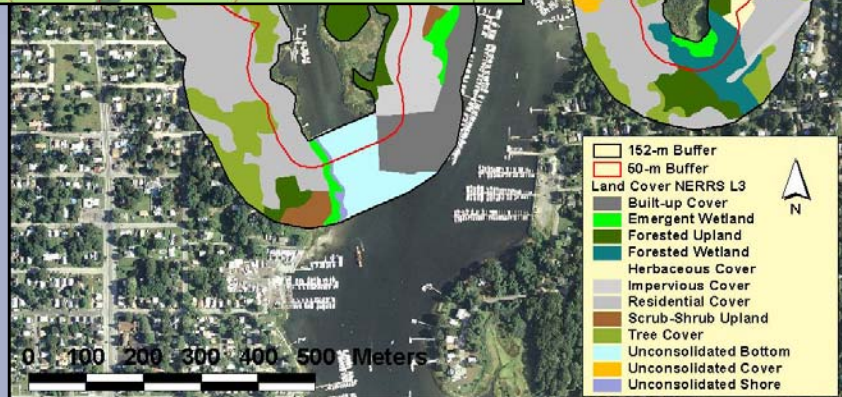
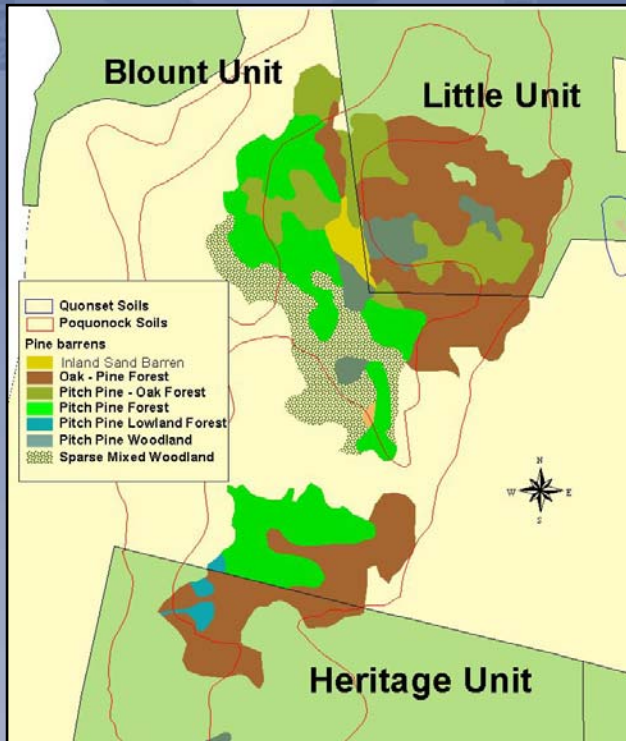
Anticipated Near Term SWMP Phase III Products

- Moderate resolution (30m) dataset for each watershed
- High resolution (5m) GIS Land Cover dataset for each reserve
- National dataset of combined HR data
- National dataset of MR data
- Change analyses of MR data at 5-year intervals
- National plan for analysis/outreach
- Site-based plans for vertical infrastructure needs



Applications

- **BASELINE INVENTORY/MAPS**
- **MANAGEMENT PLANNING**
- **RESEARCH**
- **EDUCATION**
- **OUTREACH**



NERRS SWMP Data Applications

- Water Quality Analysis
- Estuarine Research
- Estuarine Restoration



- Storm Analysis
- State and Federal Regulatory Activities
- K-12 Education, Public Education, and Training Programs



Research: Nutrient Dynamics



Available online at www.sciencedirect.com

ScienceDirect

Estuarine, Coastal and Shelf Science 71 (2007) 368–380

ESTUARINE
COASTAL
AND
SHELF SCIENCE
www.elsevier.com/locate/estcs

High nutrient pulses, tidal mixing and biological response in a small California estuary: Variability in nutrient concentrations from decadal to hourly time scales

Jane M. Caffrey ^{a,*}, Thomas P. Chapin ^{b,c}, Hans W. Jannasch ^c, John C. Haskins ^d

^a Center for Environmental Diagnostics and Bioremediation, University of West Florida, 11000 University Parkway, Pensacola, FL 32514, USA

^b U.S. Geological Survey, P.O. Box 250460MS 971, Denver Federal Center, Denver, CO 80225, USA

^c Monterey Bay Aquarium Research Institute, 7700 Sandhole Road, Moss Landing, CA 95039, USA

^d Elkhorn Slough National Estuarine Research Reserve, 1700 Elkhorn Road, Watsonville, CA 95076, USA

Received 15 November 2005; accepted 15 August 2006

Available online 26 September 2006

Abstract

Elkhorn Slough is a small estuary in Central California, where nutrient inputs are dominated by runoff from agricultural row crops, a golf course, and residential development. We examined the variability in nutrient concentrations from decadal to hourly time scales in Elkhorn Slough to compare forcing by physical and biological factors. Hourly data were collected using in situ nitrate analyzers and water quality data sondes, and two decades of monthly monitoring data were analyzed. Nutrient concentrations increased from the mid 1970s to 1990s as pastures and woodlands were converted to row crops and population increased in the watershed. Climate variability was also a significant factor controlling interannual nutrient variability, with higher nutrient concentrations during wet than drought years. Elkhorn Slough has a Mediterranean climate with dry and rainy seasons. Dissolved inorganic nitrogen dry season and high (20–160 $\mu\text{mol L}^{-1}$) during the rainy season. Dissolved nitrate concentrations were higher during the dry season. Nitrate concentrations lagged runoff events by process controlling nutrient concentrations, particularly near the mouth concentrations during the dry season and were less important during pulses. Chlorophyll *a* concentrations were not. We believe that the peak in Elkhorn Slough occurred because the short residence time and tidal © 2006 Elsevier Ltd. All rights reserved.

Keywords: nutrients; nitrogen; phosphorus; runoff; Mediterranean climate; pulse

1. Introduction

Nutrient inputs to estuaries have increased as a result of population growth (Peters et al., 1991; Nixon, 1995), intensification of agriculture (Howarth et al., 1996; Jordan et al., 1997) and changing land use in watersheds (Hopkinson and Vallino, 1995). Application of nitrogen fertilizer worldwide has increased exponentially since the 1940s (Vitousek et al.,

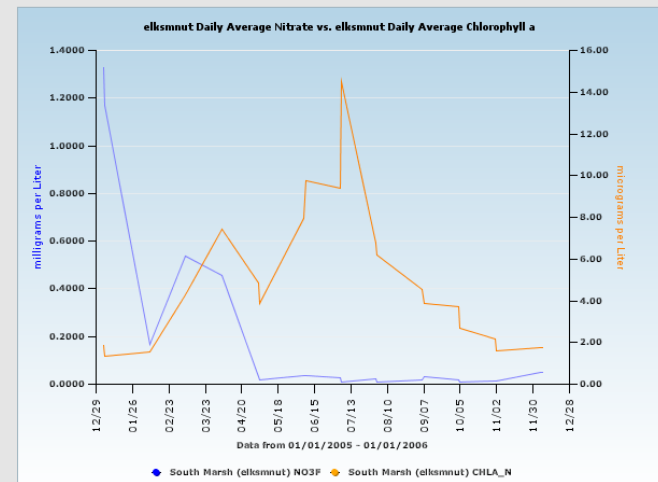
* Corresponding author.
E-mail address: jcaffrey@uwf.edu (J.M. Caffrey).

0272-7714/\$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ecss.2006.08.015



Selected Stations	StationCode	Station Name	Latitude Longitude
Nutrient Station:	elksmnut	South Marsh, CA	36° 49' 4.44 N, 121° 44' 21.84 W

Advanced Chart
All times are local standard time.



Retrieve Raw Chart Data





Real-time Water Quality Data for Shellfish Growers in the Pacific NW

A pilot project between NANOOS and the National Estuarine Research Reserve System


[home](#)
[about](#)
[reference](#)
[e-mail alerts](#)
[contacts](#)
[links](#)

 email address:

 password:

☐ remember me

[forgot?](#) | [join](#)

Make Informed Decisions Based on Real-Time Data!

This pilot project represents an effort to bring real-time water quality data to shellfish growers in the Pacific Northwest. The project has started with nine monitoring sites in Alaska, Washington, and Oregon. Expansion to other sites is anticipated.

Alaska

Are you at risk for a *Vibrio* bacterium outbreak in Kachemak Bay? Check temperature and other readings here.

Washington

Do your oysters have enough oxygen to thrive in the Hood Canal? Get the latest information now.

Oregon

What impact did the last rainfall have on salinity? See what's happening near Charleston and Valino Island.



Spotlight Data



South Slough Research
Reserve: Charleston

Charleston, OR
43° 20' 15.72 N, 124° 19' 13.80 W
11/2/2007 5:15:00 AM

Temperature 49.5 degrees F
Salinity 32.7 ppt

DO concentration 9.2 mg/L

DO Saturation 100 %

Turbidity No Data

pH 8

Insitu Chlorophyll No Data





Real-time Water Quality Data for Shellfish Growers in the Pacific NW

A pilot project between NANOOS and the National Estuarine Research Reserve System

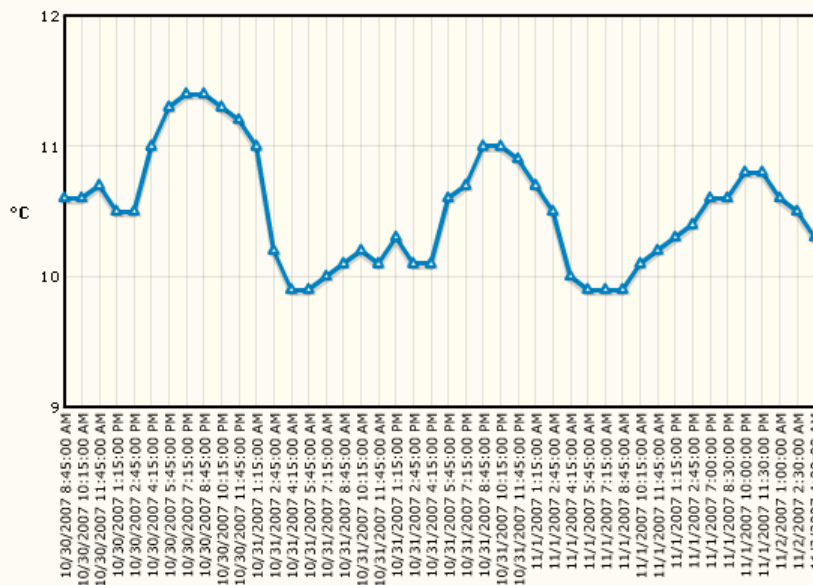


Current Data : Charleston Bridge

Temperature Salinity Dissolved O2 Turbidity PH

Current Data

Last 72 Hours



● Temperature

☐ Fahrenheit ☒ Celsius

home
about
reference
e-mail alerts
contacts
links

email address:

password:

☐ remember me

login

forgot? | join

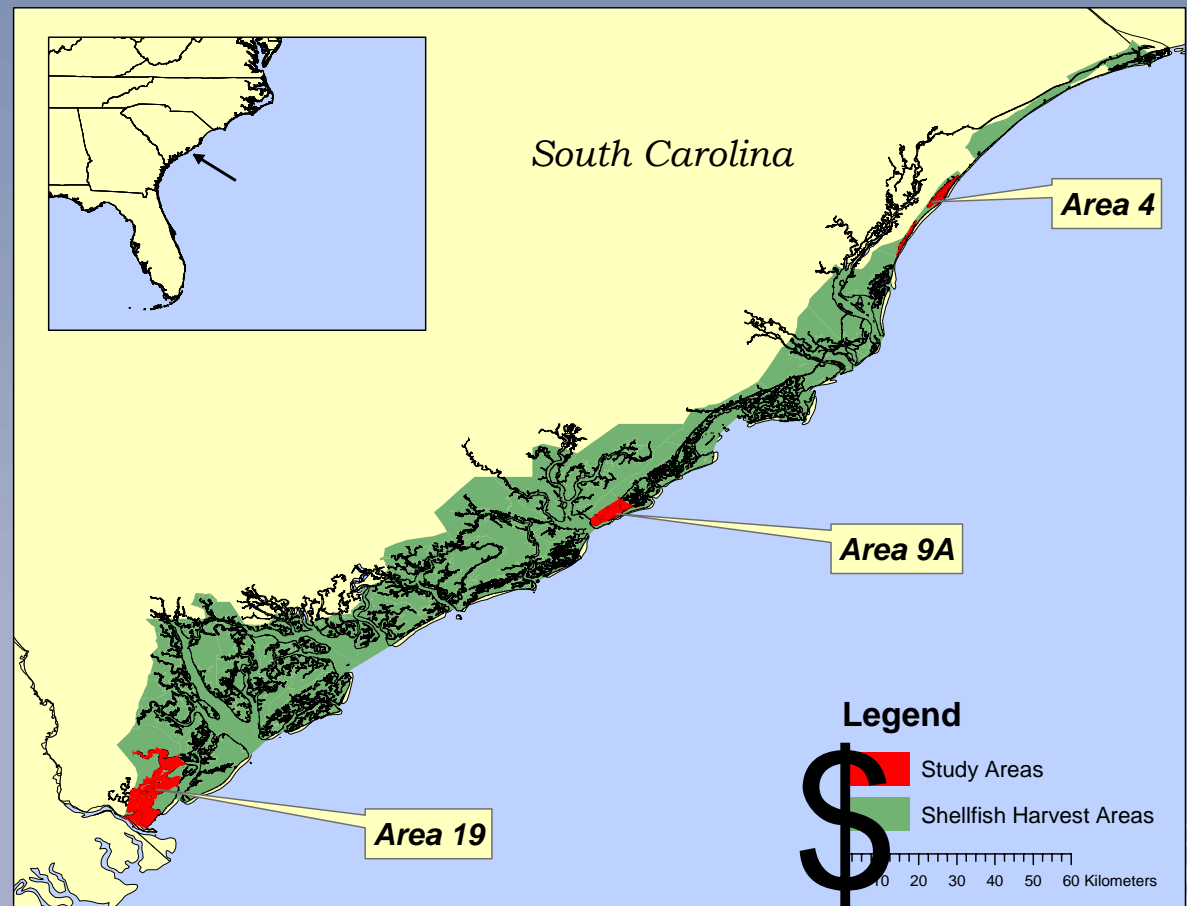


Shellfish Harvest Area Management in South Carolina

Harvest Area
Classification

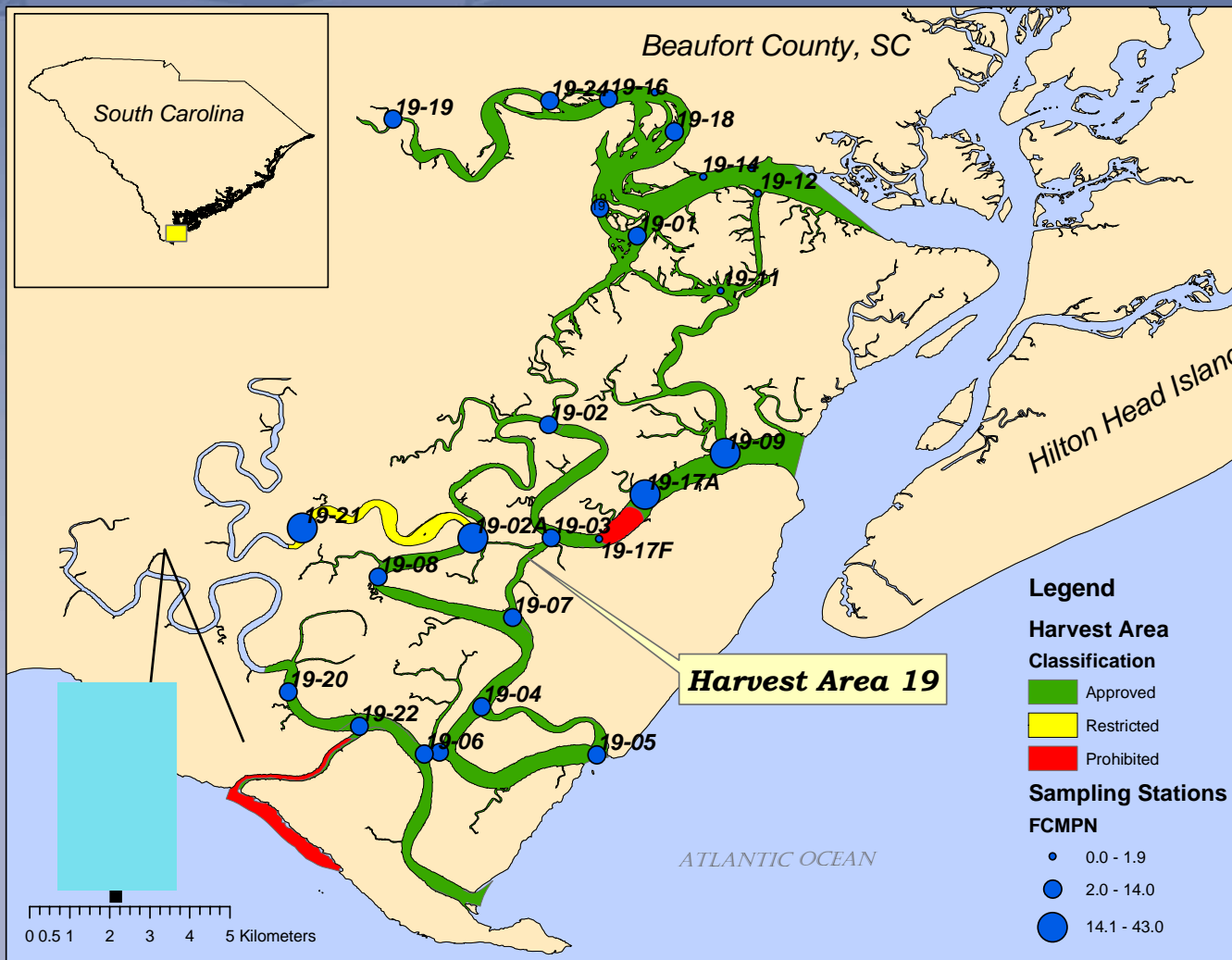
Management for
public health risk

Relationship
between
precipitation and
fecal coliform
bacteria



Data courtesy of SC DHEC/Slide courtesy of D. Porter

Fecal Coliform Modeling



N-R-T data
available:

Tidal cycle
stage

Water and
air temp

Salinity

Weather

Wind
direction



SWMP And Education

The screenshot shows the homepage of the National Estuarine Research Reserve System (NERRS) website, estuaries.gov. The header features the NOAA logo and the text "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE". The main navigation bar includes links for ABOUT ESTUARIES, ESTUARYLIVE, DATA, TEACHERS, STUDENTS, RESOURCES, and TAKE ACTION. Below this is a secondary navigation bar with links for Schedule, How to Participate, Technology, Register, Live broadcast, Archive videos, and Tips from teachers. The main content area is divided into several sections. On the left, there is a large photo of people walking on a boardwalk in a wetland, labeled "ACE Basin Reserve". Below this is a "Welcome" message. On the right, there is a "news" section with three articles: "ACE Weather Station", "Water Quality", and "Lost Turtle Found Again". At the bottom, there are three main content boxes: "estuarylive" with articles "Another Great Year", "The Archives", and "Invasive Species"; "about estuaries" with a map of the United States showing the locations of 27 protected areas and a "List of Reserves" dropdown; and "data" with articles "New Estuaries 101 Curriculum", "Access Real-Time Data", and "System Wide Monitoring Data". A white arrow points from the "data" box to the text on the right. The footer contains links for DOC/NOAA/NOS/OCRM, Site Map, FAQ, Acknowledgements, Disclaimer, Privacy Policy, and How to Use this Site, along with the NOAA logo.

estuaries.gov

SEARCH

About | Contact | En Español

ABOUT ESTUARIES ESTUARYLIVE DATA TEACHERS STUDENTS RESOURCES TAKE ACTION

Schedule | How to Participate | Technology | Register | Live broadcast | Archive videos | Tips from teachers

ACE Basin Reserve

Welcome to National Duis autem vel eum iriure dolor in hendrerit in vulputate velit es se molestie consequat, vel illum dolore eu accumsan. Lto the National Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse consequat, vel illum dolore eu accumsan. Mto the National Duis autem vel eum in hendrerit in vulputate.

news

ACE Weather Station
Duis autem vel eum iriure dolor in hendrerit vulputate velit esse vero vulputate velit.

Water Quality
molestie consequat, vel illum dolore eu feug iat nulla facilisis at veroeros vulputate velit.

Lost Turtle Found Again
nulla facilisis at eros et accumsan et iusto odio dignissim. vero eros et vulputate velit.

MORE ▶

estuarylive

Another Great Year
Duis autem vel eum iriure vulputate velit essenibh feugiat nulla facilisis.

The Archives
Dolore eu feugiat nulla facilisis at vero eros et nibh feugiat nulla facilisis.

Invasive Species
Consectetuer adipiscing diam nonum-my nibh feugiat nulla facilisis atl.

MORE ▶

about estuaries

A network of 27 protected areas ...

List of Reserves

data

New Estuaries 101 Curriculum
Duis autem vel eum iriure vulputate velit essenibh feugiat nulla facilisis.

Access Real-Time Data
Dolore eu feugiat nulla facilisis at vero eros et nibh feugiat nulla facilisis.

System Wide Monitoring Data
Consectetuer adipiscing diam nonum-my nibh feugiat nulla facilisis atl.

MORE ▶

DOC/NOAA/NOS/OCRM | Site Map | FAQ | Acknowledgements | Disclaimer | Privacy Policy | How to Use this Site

“SWMP/Web Interface” provides access to real-time data & archived data.



