

Drought and Coastal Ecosystems: Monitoring and Modeling Using the Coastal Salinity Index

National Conference on Ecosystem Restoration

New Orleans, LA

August 30, 2018

In Honor of

Paul Anthony Conrads

(1957 - 2017)



Drought

a deficiency of precipitation over an extended period of time, often resulting in a water shortage for some activity, sector, or the environment



Meteorological

- Standardized Precipitation Index (SPI)

Agricultural

- Palmer Drought Severity Index (PDSI)
- Crop Moisture Index (CMI)

Hydrological

- Surface Water Supply Index (SWSI)

What does drought look like... ... on the coast?



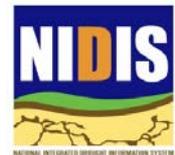
Presentations

1. *Coastal Drought and the Need for a Coastal Salinity Index*
Kirsten Lackstrom
2. *Monitoring Drought along the Gulf of Mexico and the Southeastern Atlantic Ocean Using the Coastal Salinity Index*
Matt Petkewich
3. *Linking the Coastal Salinity Index with Freshwater Inflows to Characterize Salinity in Gulf of Mexico Estuaries*
Chris Swarzenski
4. *Predicting Long Term Performance and Risk of Oyster Reef Restorations Under Deep Uncertainty in Climate and Management Policy*
Simeon Yurek

Coastal Drought and the Need for a Coastal Salinity Index

Kirsten Lackstrom and Lauren Rouen
Carolinas Integrated Sciences & Assessments (CISA)
University of South Carolina

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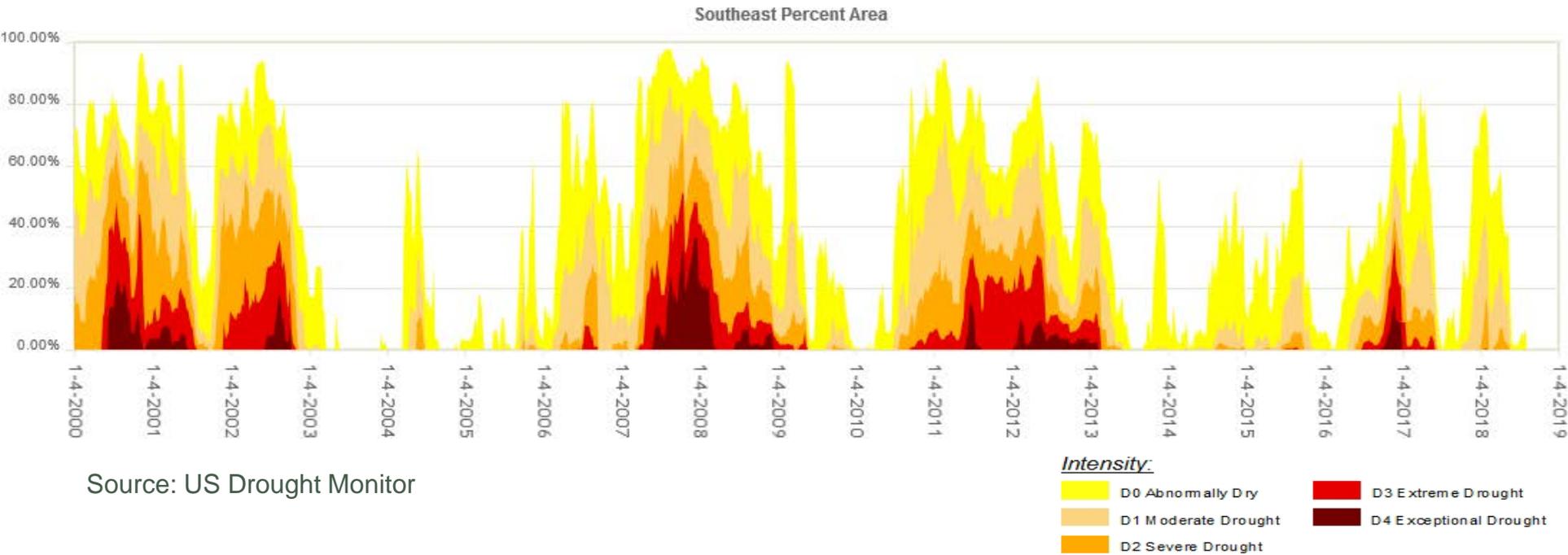


Outline

- Introduction
 - Coastal Carolinas Drought Early Warning System (DEWS)
 - Ecological drought: definition and framework
- Estuarine ecosystems in the Carolinas

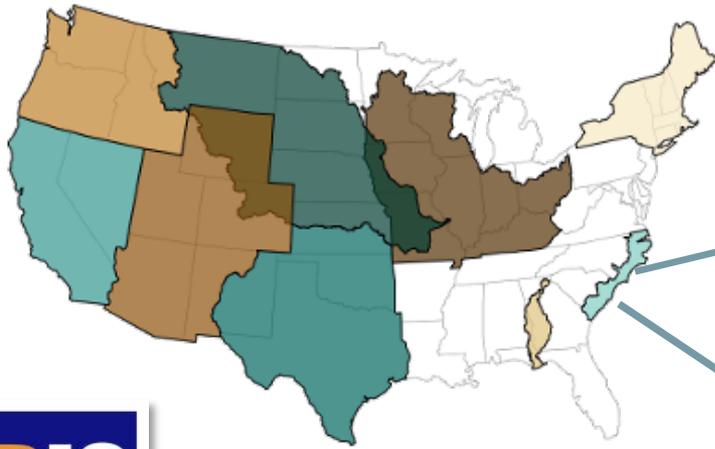


Drought in the Southeast U.S., 2000-present

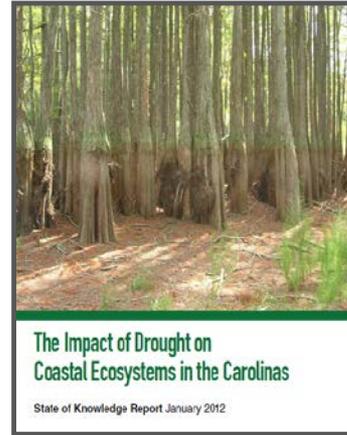


Source: US Drought Monitor

Coastal Carolinas Drought Early Warning System (DEWS)



<https://www.drought.gov/drought/>

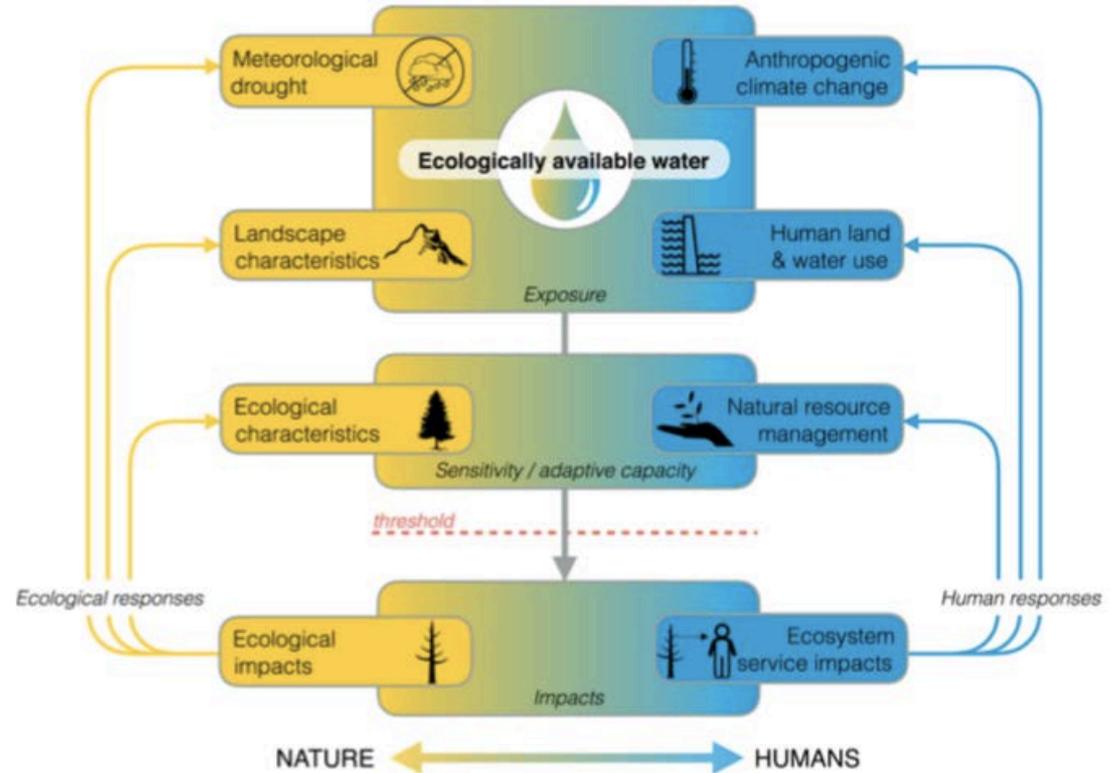


Drought and coastal ecosystems

- *Drought matters!*
 - One component of the weather-climate continuum
 - Extremes, flooding, “drought busters”
- *Impacts*
 - Salinity is a key stressor
- *Information needs*
 - Limited use of existing drought information and tools by ecosystem and resource managers
 - Limited use of ecological/coastal information in drought monitoring systems

Ecological Drought

“a deficit in water availability that drives ecosystems beyond thresholds of vulnerability, impacts ecosystem services, and triggers feedbacks in natural and/or human systems”

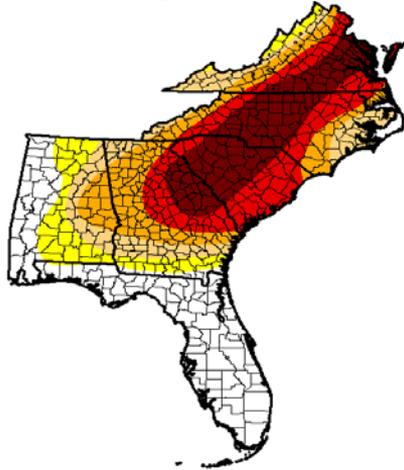


Application to
estuarine
systems and
landscapes

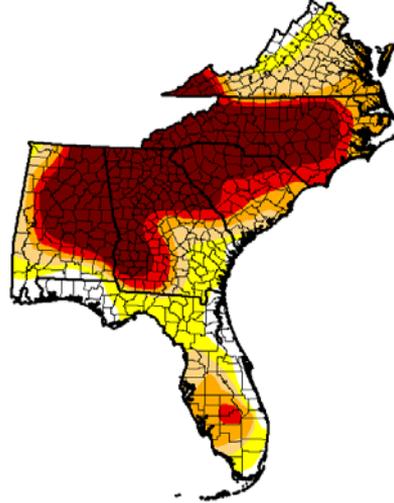
- Exposure
 - Freshwater timing and availability
- Sensitivity/adaptive capacity
 - Tolerance of, and adaptability to, varying salinities
- Impacts

Drought

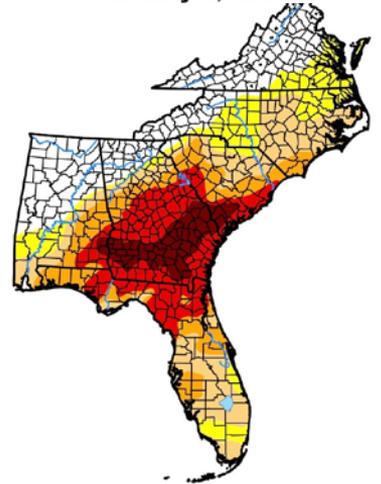
U.S. Drought Monitor
Southeast
August 20, 2002



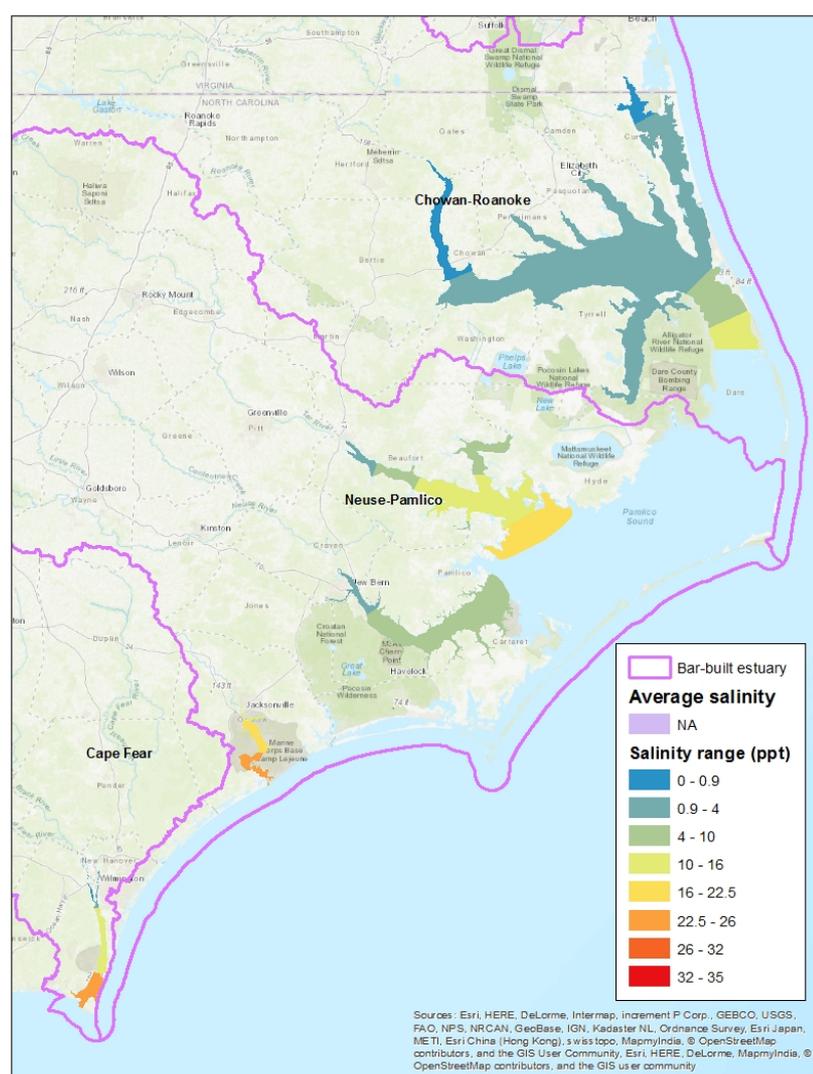
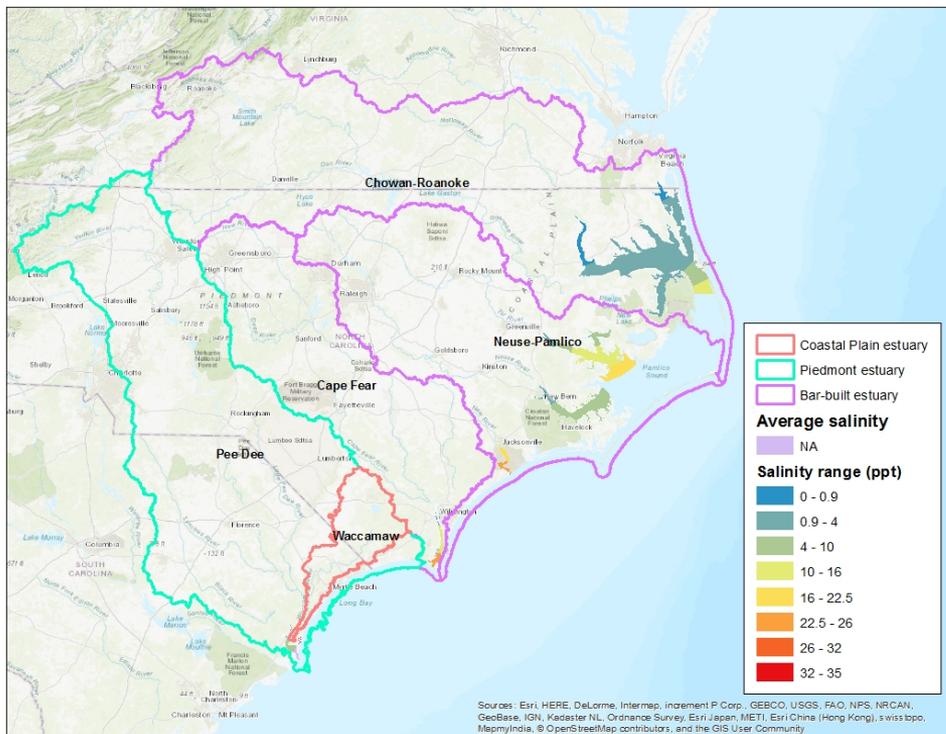
U.S. Drought Monitor
Southeast
December 25, 2007



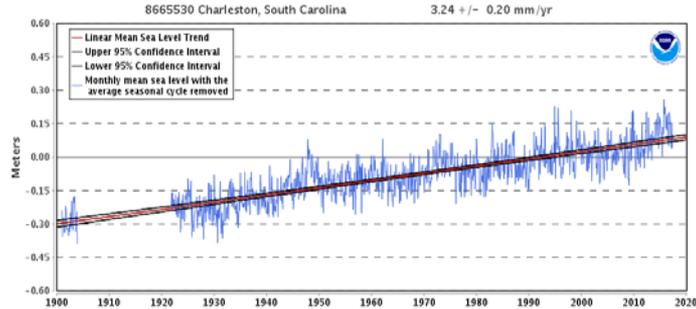
U.S. Drought Monitor
Southeast
February 7, 2012



Exposure: landscape characteristics



Sea-level rise

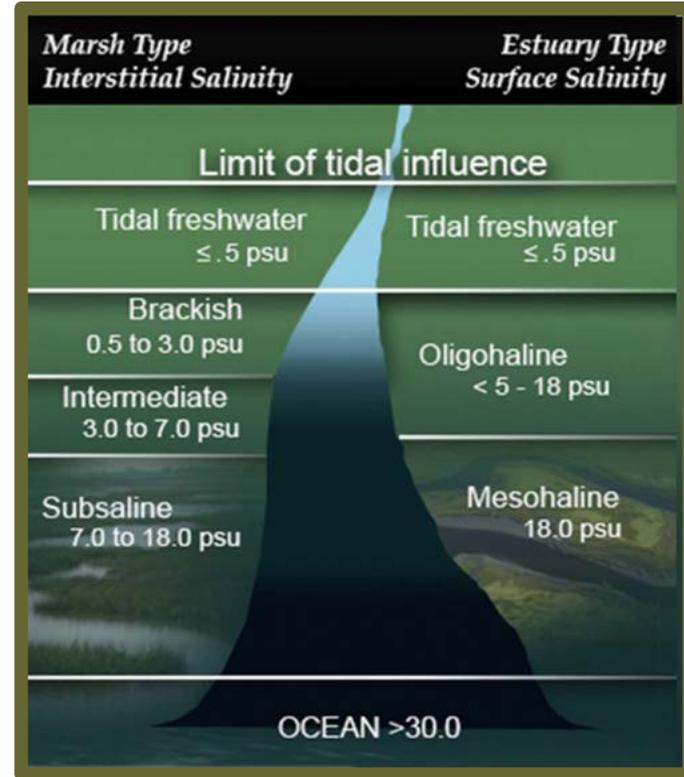
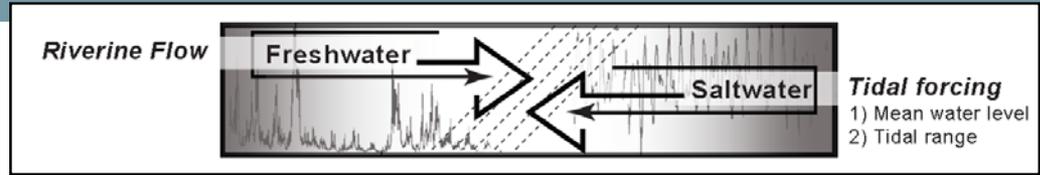


Mean sea level trend, Charleston, SC
Source: NOAA/NOS

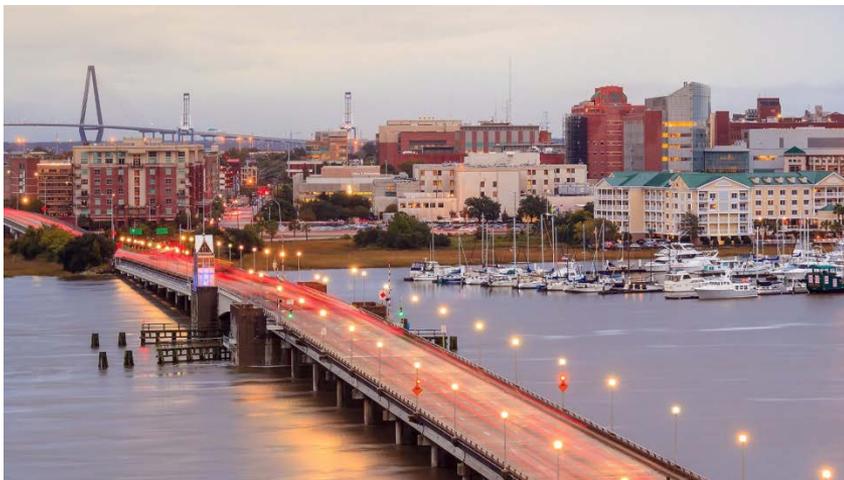


Source: NC King Tides Project
<http://nckingtides.web.unc.edu/past-photos/>

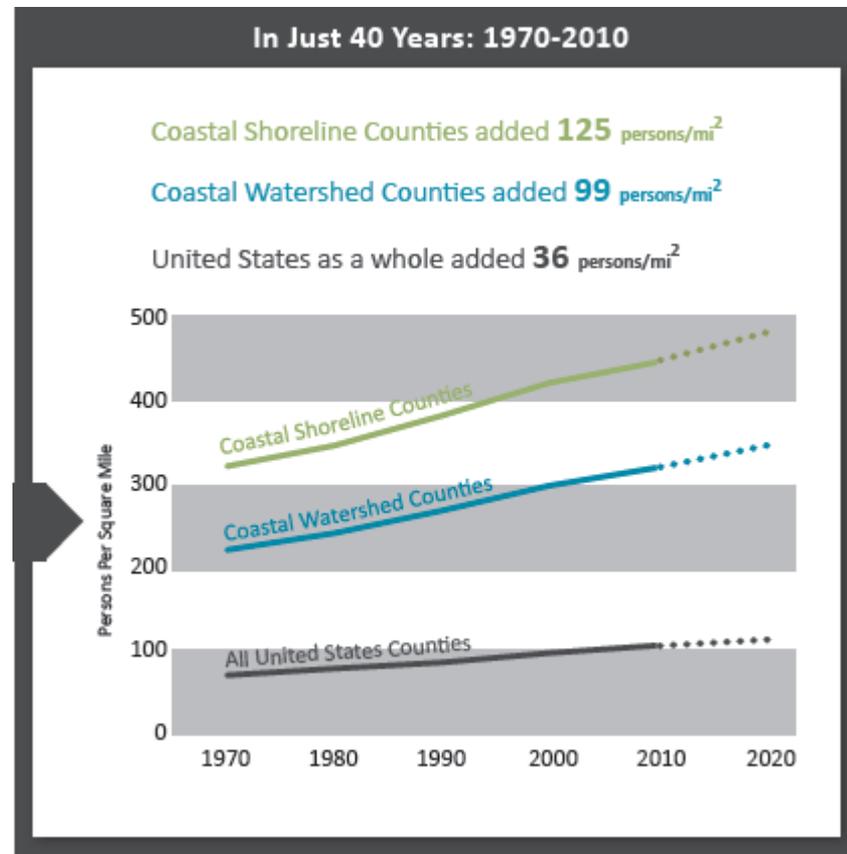
Freshwater-saltwater interface



Coastal populations and water use



Source: <http://www.charlestonresilience.net/>



Source: NOAA, *National Coastal Population Report* (2013)

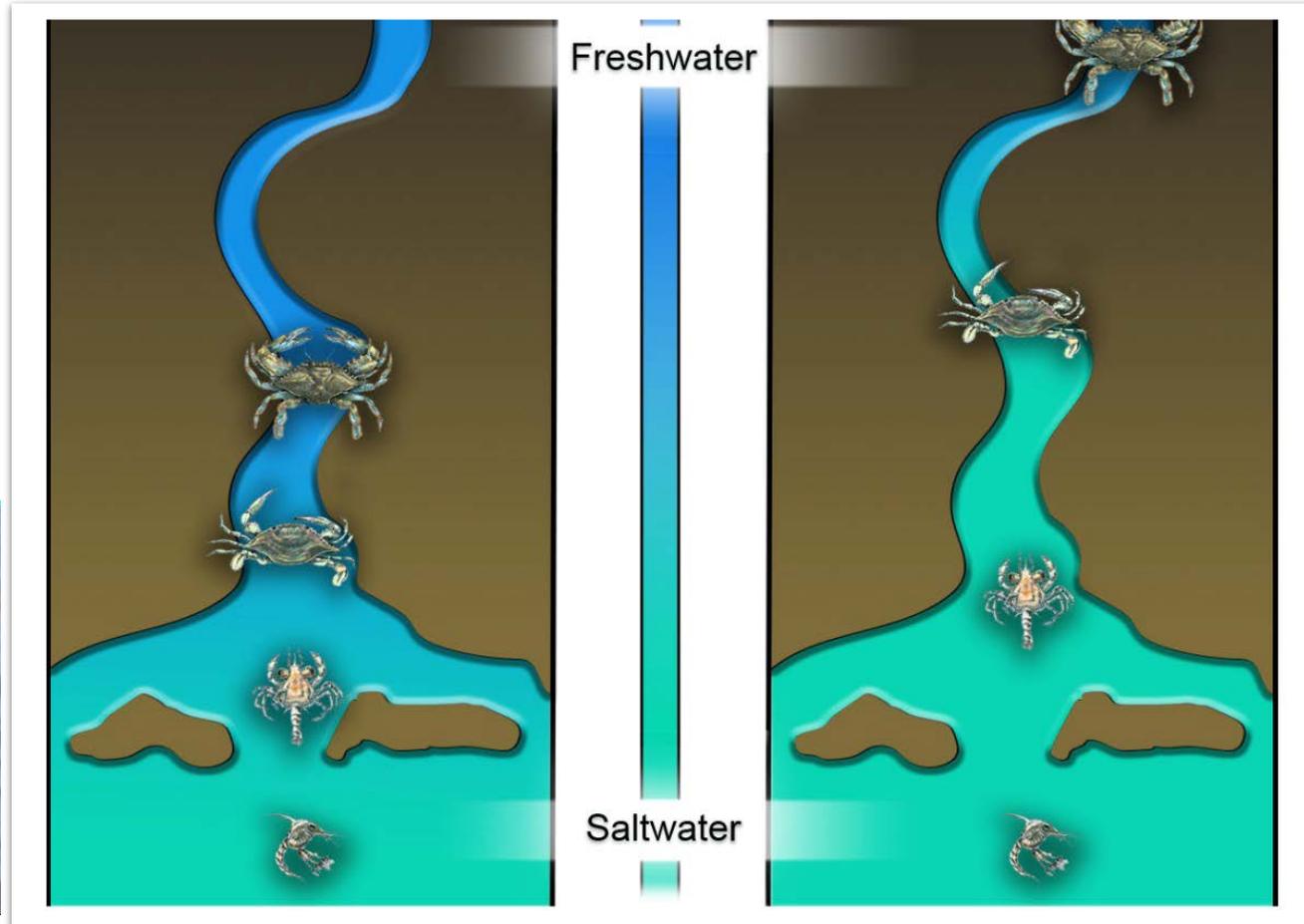
Salt Marsh



Tidal Freshwater Wetlands



Blue crab response



Upstream water regulation



Lake Tillery Dam, NC

Source: USGS South Atlantic Water Science Center-NC Office

Impoundments



Source: Dan Tufford

Salt marsh dieback

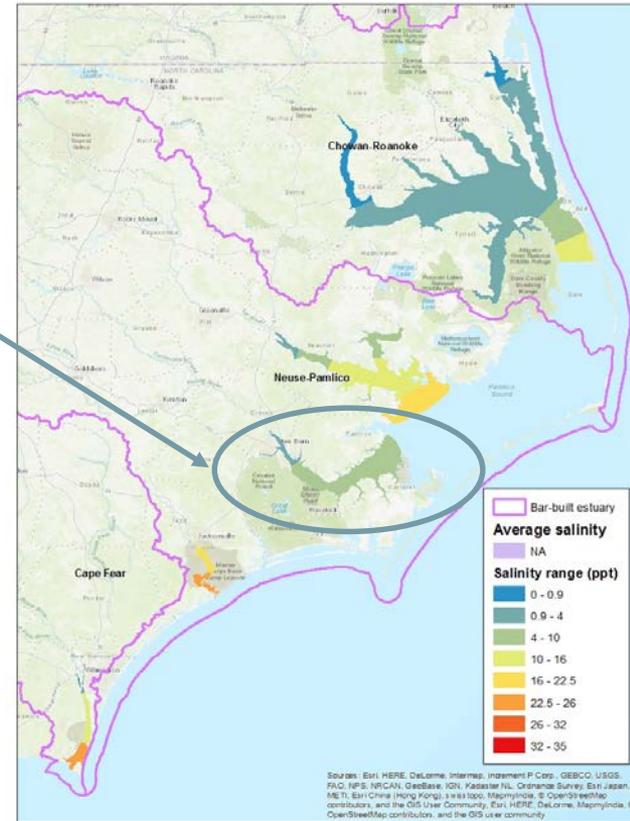


Source: Georgia Coastal Ecosystems LTER

Neuse River Estuary

Significant phytoplankton blooms and fish kills develop in upper estuary, 2008-2009 (Wetz et al., 2011)

Reduced presence of *Vibrio vulnificus* in oysters with increased salinities (Wetz et al., 2014; Froelich et al., 2012)



Susceptibility to disease



Black gill

Source:
<https://gacoast.uga.edu/research/major-projects/black-gill/>



Hematodinium perezii

Source: Michael
Childress

Business impacts and losses



Drought and coastal ecosystems: recap

“Can a unique index be developed to characterize coastal drought?”

- *Drought matters!*
 - One component of the weather-climate continuum
 - Extremes, flooding, “drought busters”
- *Impacts*
 - Salinity is a key stressor
- *Information needs*
 - Limited use of existing drought information and tools by ecosystem managers
 - Limited use of ecological/coastal information in drought monitoring systems

For more information

Carolinas Integrated Sciences & Assessments (CISA)

http://cisa.sc.edu/projects_salinity.html

Contact Kirsten Lackstrom at lackstro@mailbox.sc.edu

Coastal Estuaries and Lagoons: The Delicate Balance at the Edge of the Sea

<https://pubs.usgs.gov/fs/2018/3022/fs20183022.pdf>

USGS South Atlantic Water Science Center

https://www.usgs.gov/centers/sa-water/science/development-a-coastal-salinity-index?qt-science_center_objects=0#qt-science_center_objects

