



The Impacts of Coastal Development on Tidal Creek Ecosystem Health

Denise Sanger
S.C. Sea Grant Consortium
and
Center of Excellence in Oceans and Human Health
at Hollings Marine Laboratory



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Partners

- NOAA/NOS, Hollings Marine Laboratory, Center for Coastal Environmental Health and Biomolecular Research Charleston, SC
- SC Department of Natural Resources, Charleston, SC
- National Estuarine Research Reserves - Grand Bay, Weeks Bay, Sapelo Island, North Carolina, ACE Basin, NI-WB
- College of Charleston
- The Citadel
- University of South Carolina
- SC Sea Grant Consortium
- US Geological Survey
- Dauphin Island Sea Lab
- University of Arkansas- Pine Bluff
- Among many others



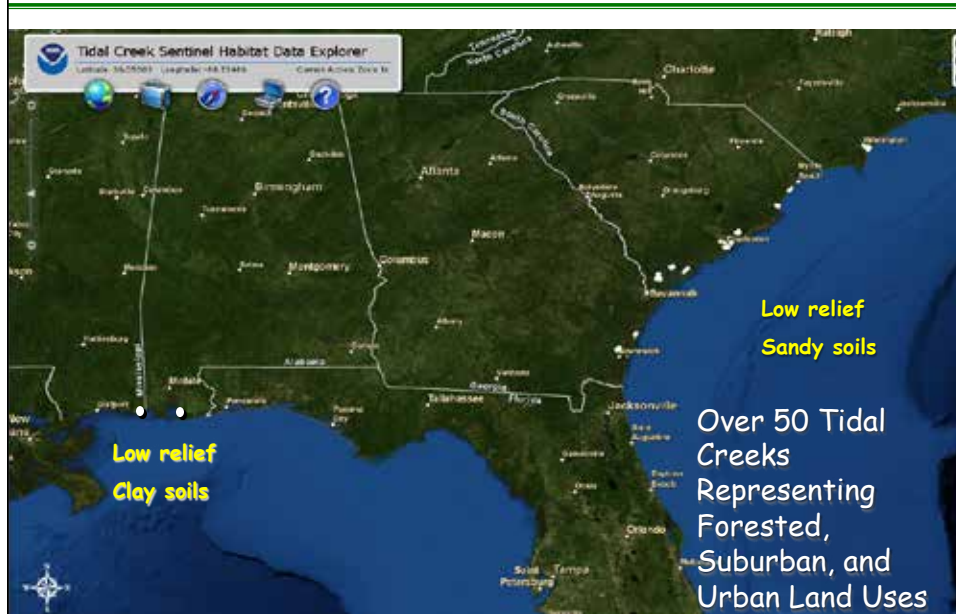
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Objectives of Presentation

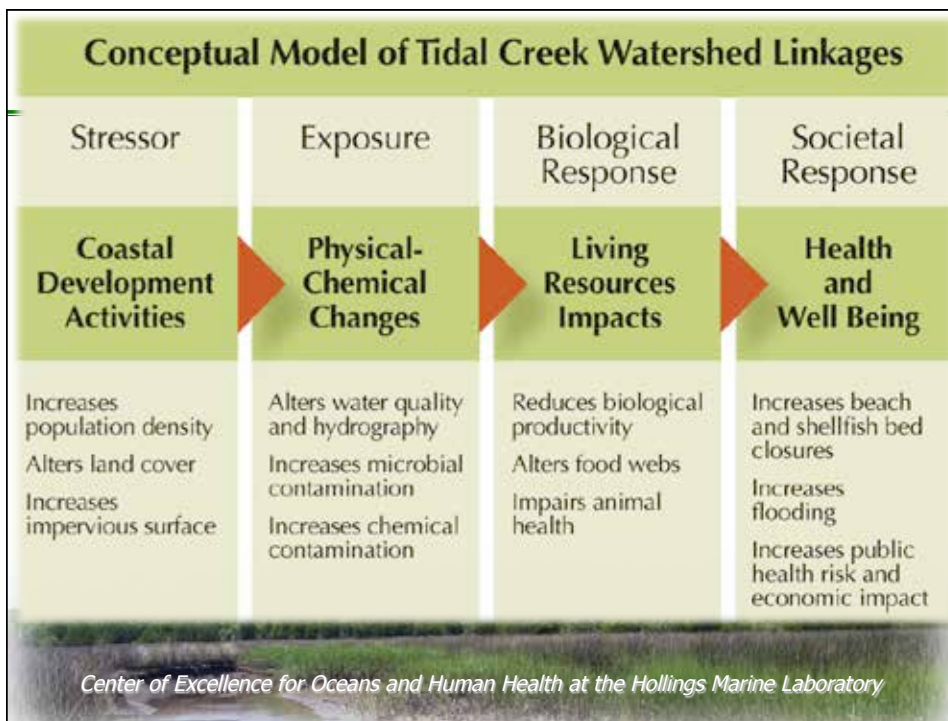
- Provide a synthesis of the impacts coastal development, or sprawl, has on coastal ecosystems and the humans that live in them.
- Demonstrate that tidal creek networks are **sentinel ecosystems** in the SE that provide early warning of the consequences of uncontrolled development on the Coastal Zone.



Tidal Creeks Sampled



Creek Continuum




Stressor


Coastal
Development
Activities


Increases
population density

Alters land cover

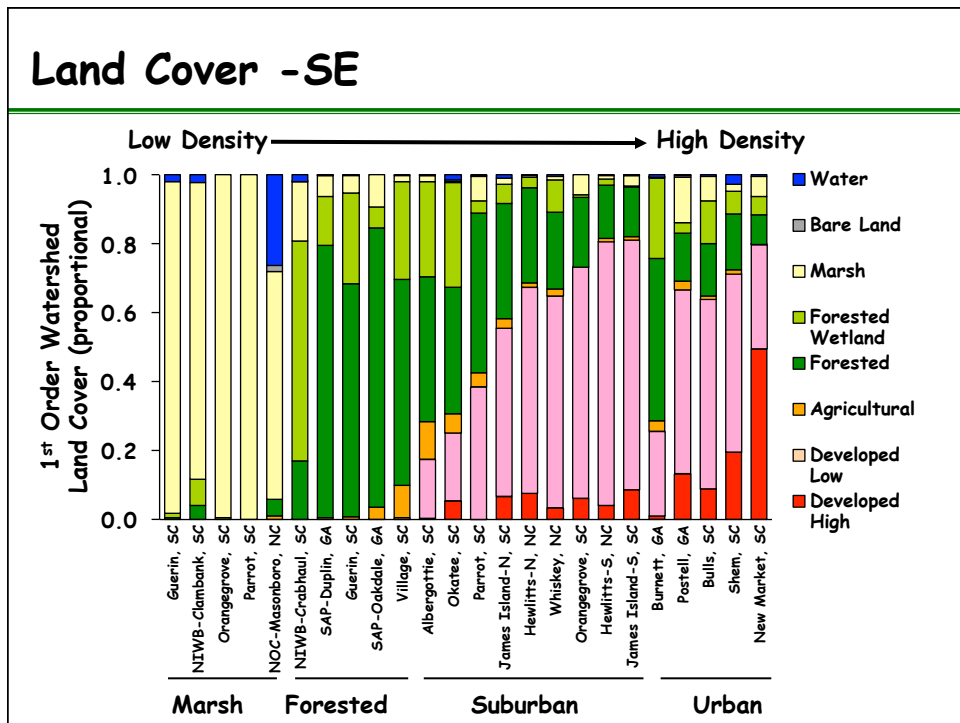
Increases
impervious surface



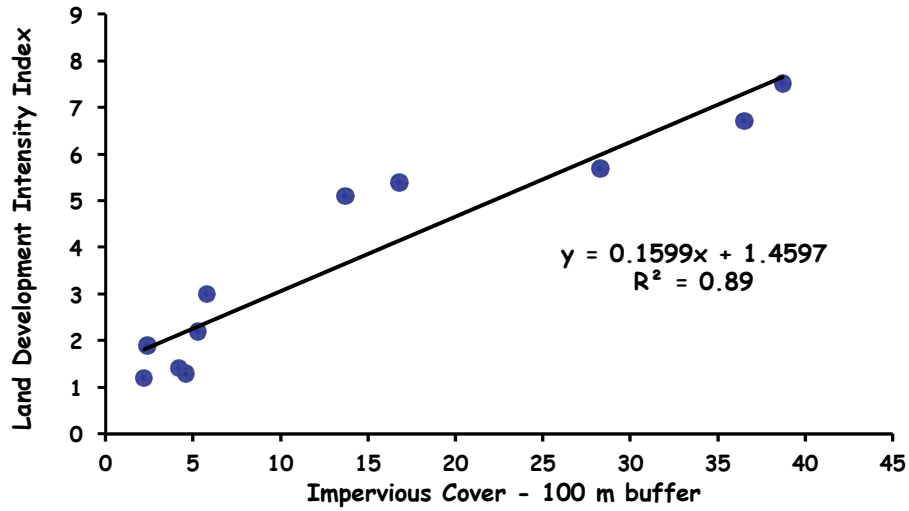




Land Use Planning in Montana



Land Cover - Tampa Bay



Data from Krebs et al. in prep

Exposure

Physical-Chemical Changes

Alters water quality and hydrography

Increases microbial contamination

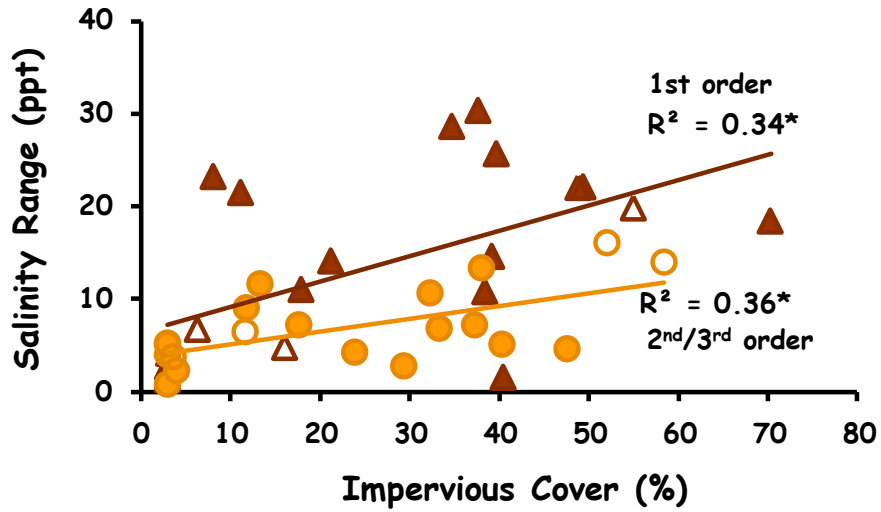
Increases chemical contamination



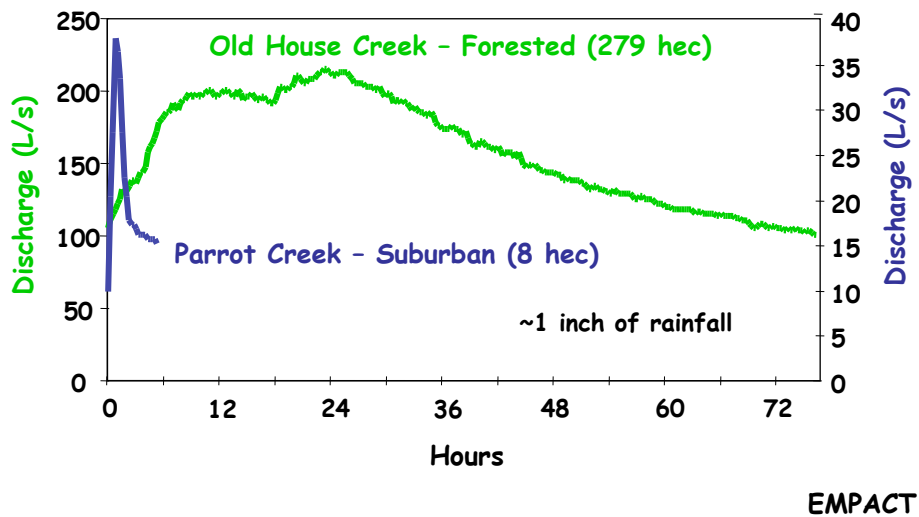
Post and Courier

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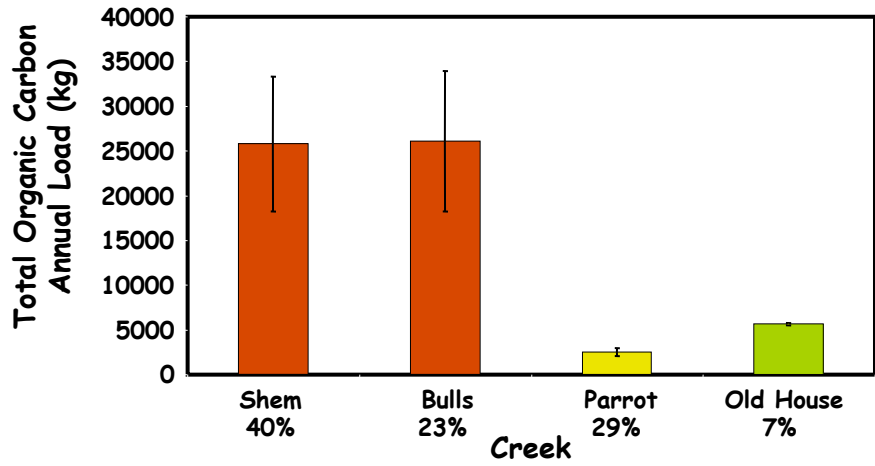
Salinity Distributions - SE/GoM



Rate of Runoff - Charleston, SC



TOC Annual Loads - Charleston, SC

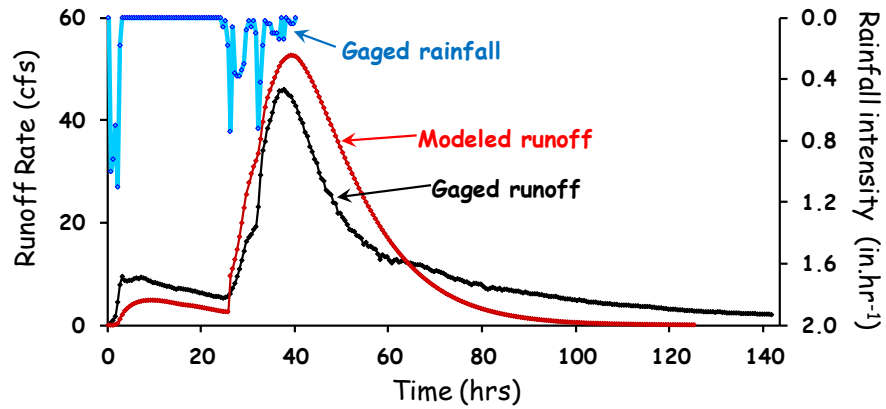


EMPACT

Runoff Model Validation - SE

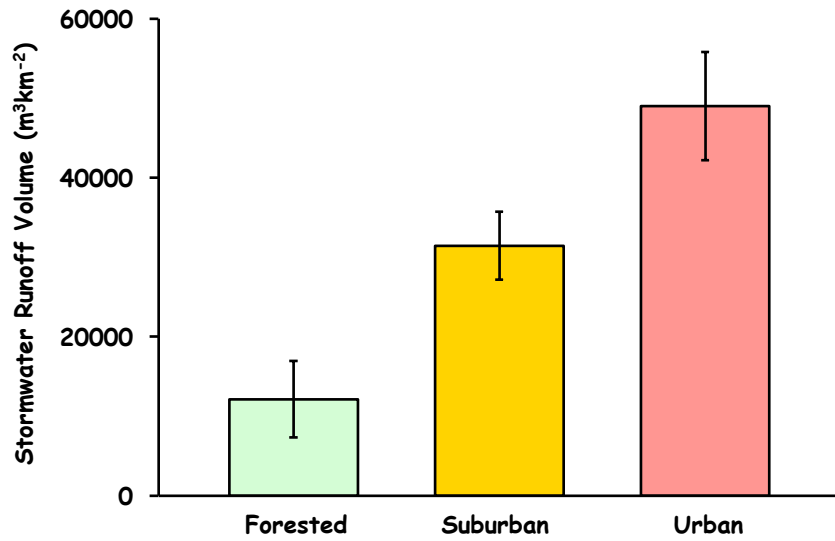
USDA- Natural Resource Conservation Service Calibrated Model

Old House Creek - 4/2003 4.6 inch storm event

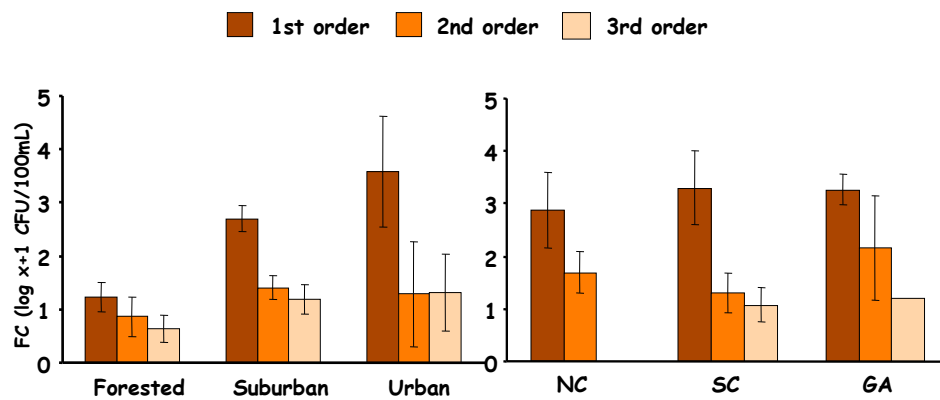


Blair et al. in prep

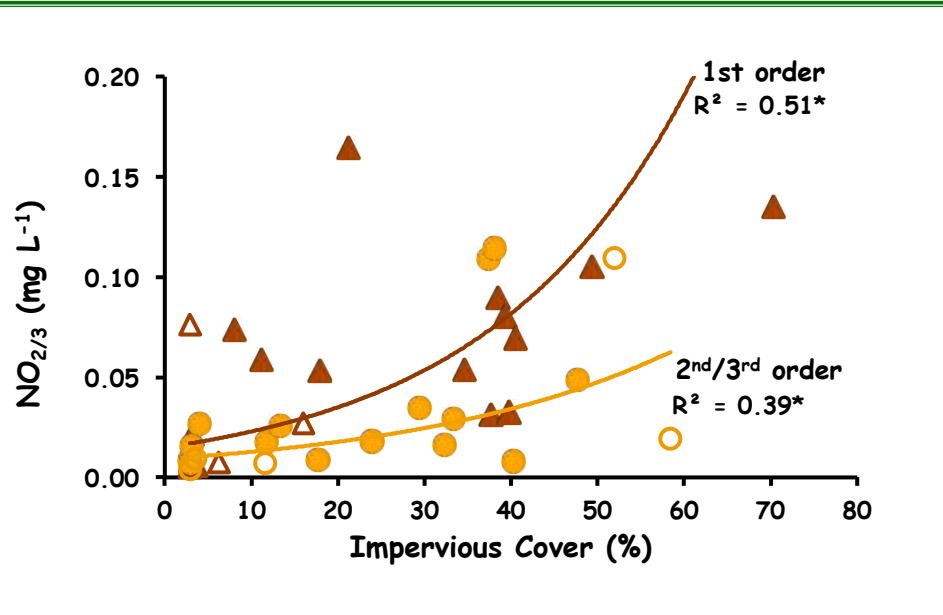
Modeled Runoff Headwaters - SE



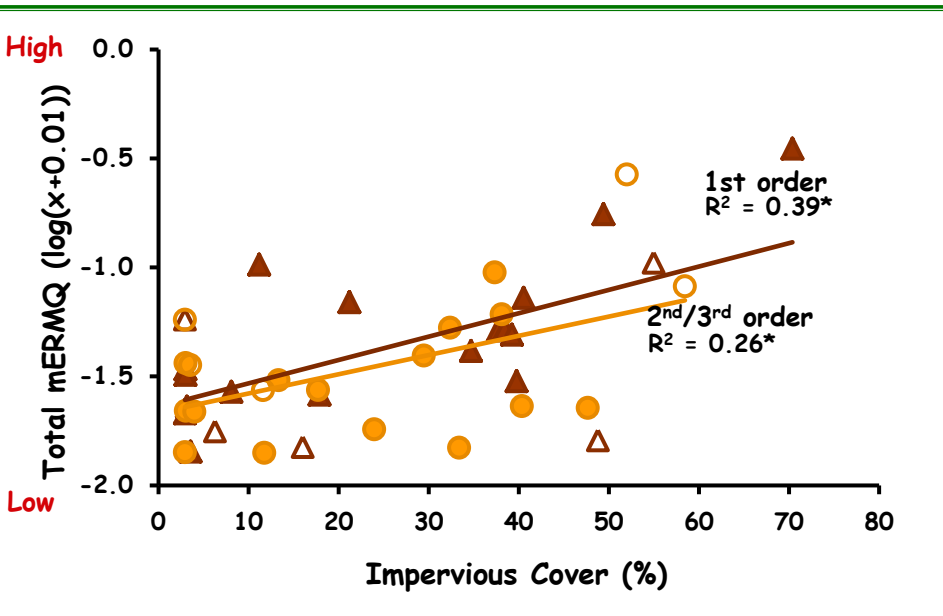
Fecal Coliforms - SE



Nitrate/Nitrite - SE/GoM



Chemical Contamination - SE/GoM



Chemical Contamination - SCECAP SC

	Tidal Creek (2nd/3rd order)	Open Water
Urban Area	0.51*	-0.31
Impervious Cover	0.51*	-0.30
Correlations - R		

Van Dolah et al. 2007

Biological Response

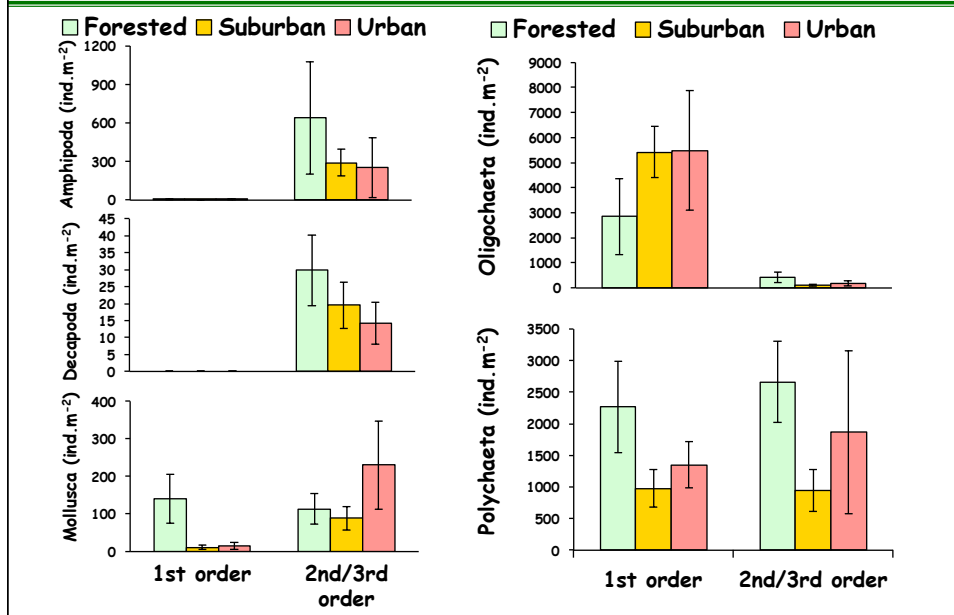
Living Resources Impacts

Reduces biological
productivity
Alters food webs
Impairs animal
health

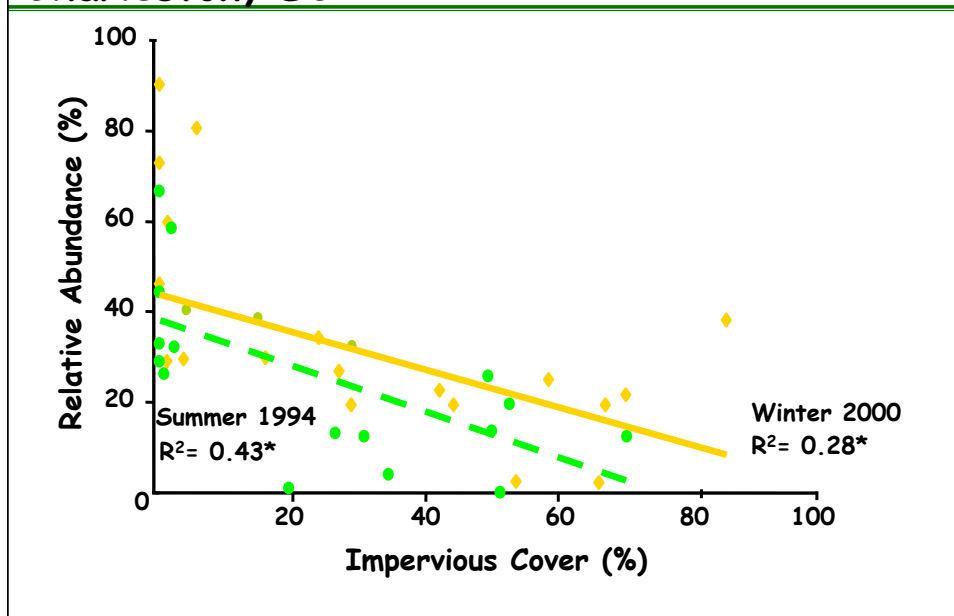


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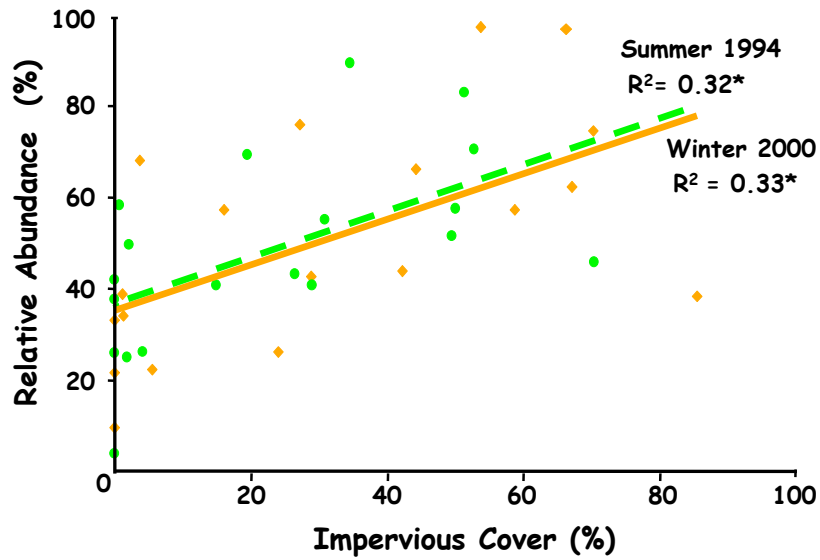
Macrobenthic Abundance - SE



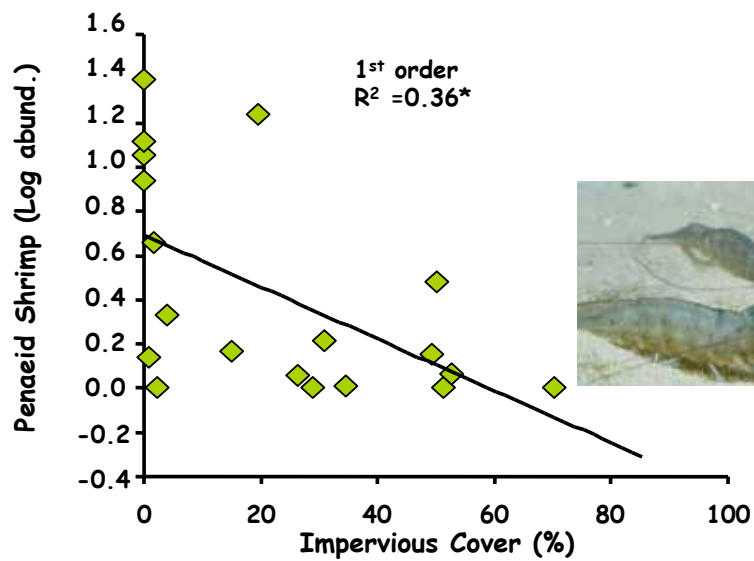
Macrobentos Stress Sensitive - Charleston, SC



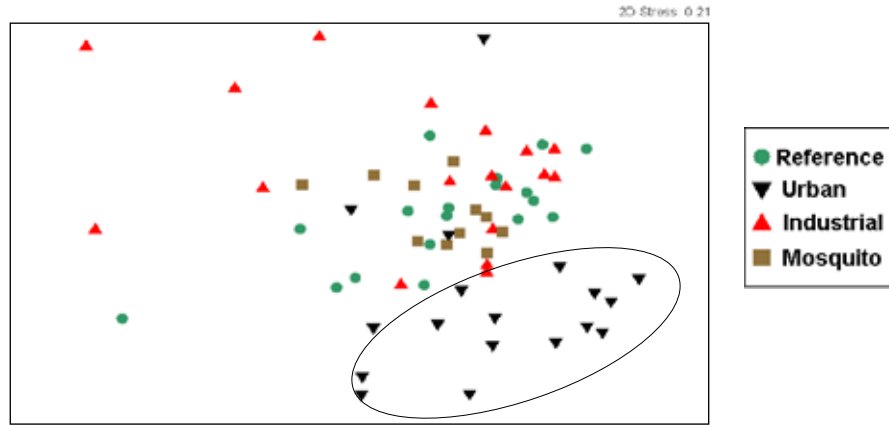
Macrobentos Stress Indicative - Charleston, SC



Penaeid Shrimp - Charleston, SC



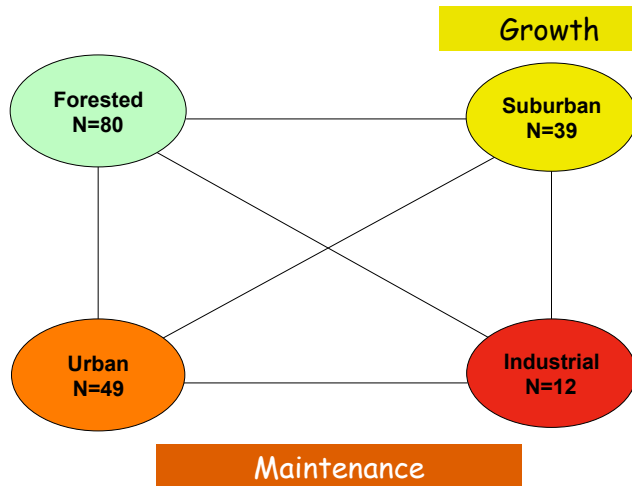
Nekton Community Structure - Tampa Bay



Nekton community differed between urban creeks and non-urban tributaries ($P < 0.005$, ANOSIM), but not among non-urban tribs ($P > 0.30$)

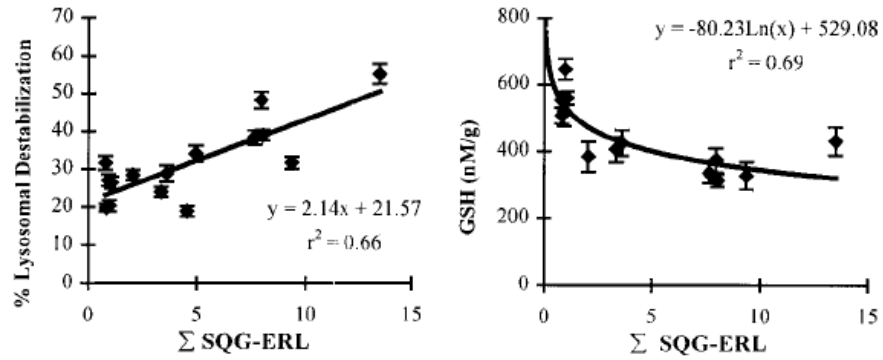
Krebs et al. in prep

Oyster Gene Regulation - SE



Chapman et al. 2010 and 2011

Cellular Impacts - Charleston, SC



Ringwood et al. 1999

Societal Response

Health and Well Being

Increases beach and shellfish bed closures

Increases flooding

Increases public health risk and economic impact



Oce

Hollings Marine Laboratory

Shellfish Bed Closures - NC

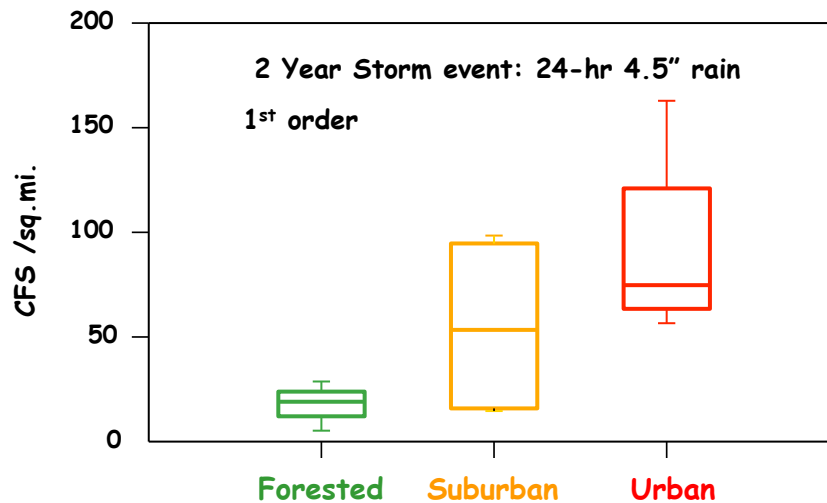
Carteret County

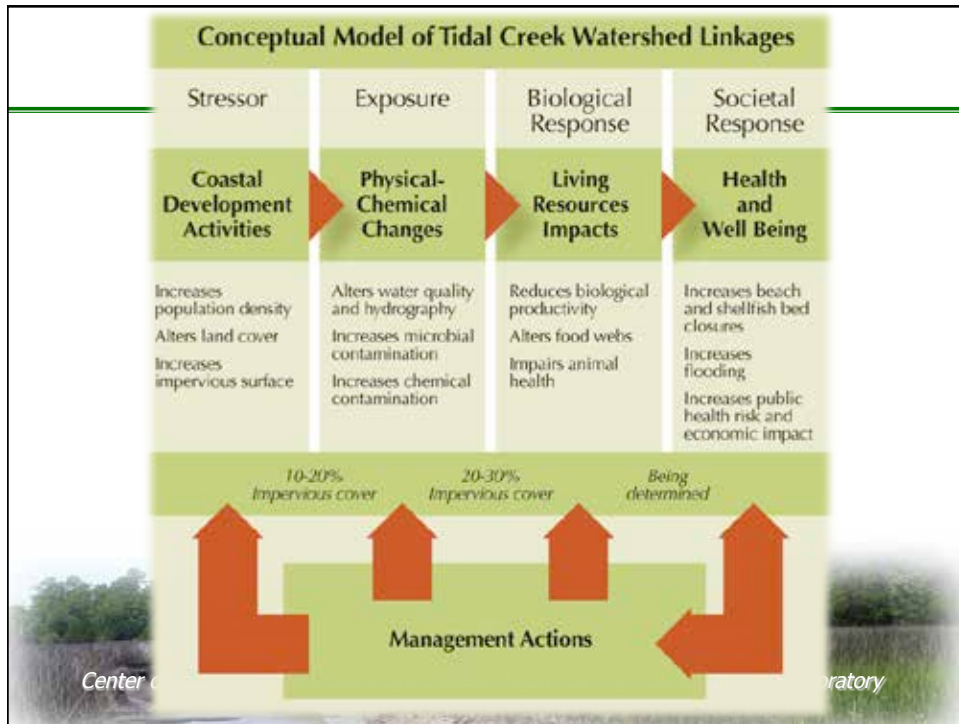
	Population	Closings	Landings	Value
Population		0.24*	(-)0.55*	(-)0.20*
Closings	0.77*		(-)0.43*	(-)0.31*
Landings	(-)0.11	(-)0.23*		0.78*
Value	(-)0.00	(-)0.01	0.77*	

New Hanover County

Maiolo and Tschetter 1981

Flooding Potential - SC



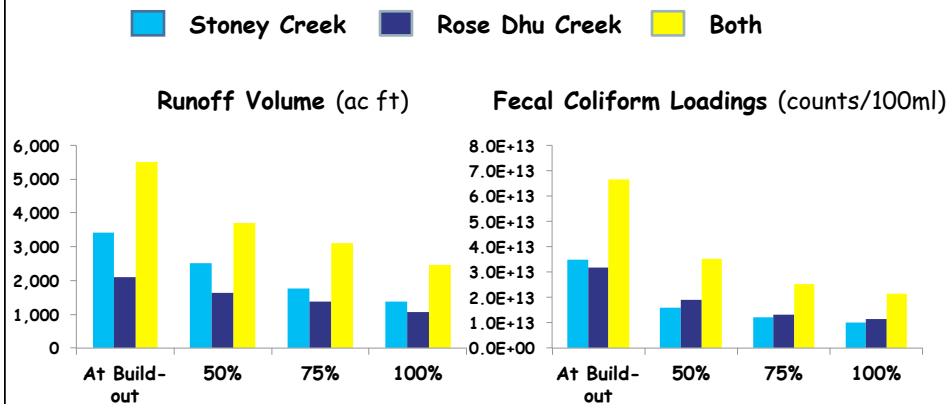


Prediction - Bluffton Case Study

- **Loadings = concentration * runoff volume**
- **Concentration FC (colonies/100 ml) = 0.0299 (% impervious cover) + 2.5147**
- **Model Runoff Volume - modified NRCS method**
- **Underestimates loadings**
 - Mortality and dilution occurred before headwaters

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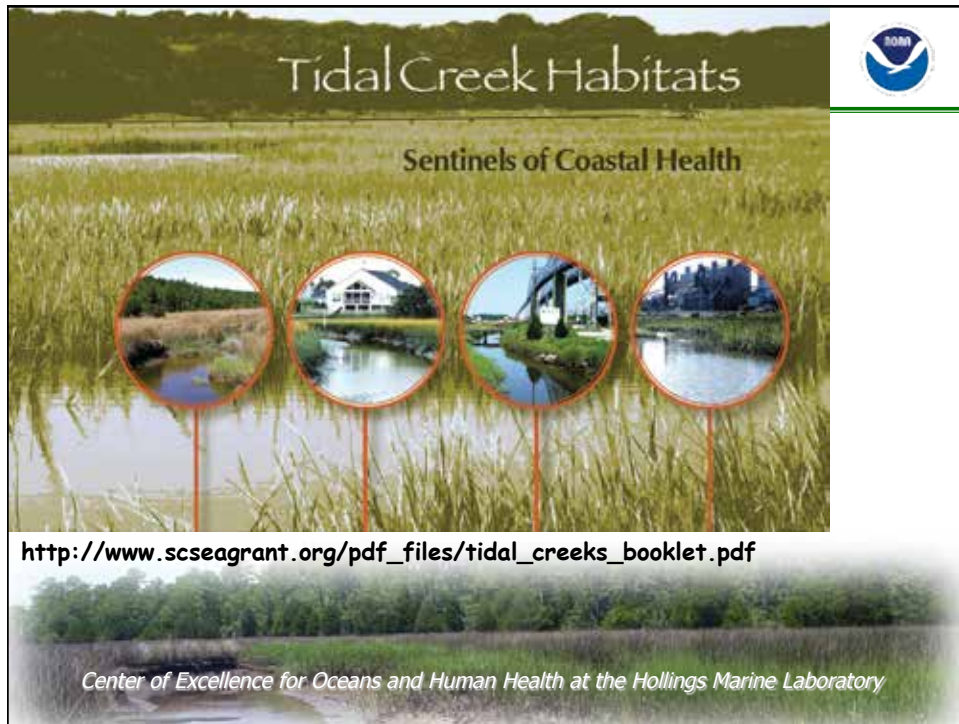
TDR Implementation Levels - Bluffton, SC



Tidal Creek Sentinel Habitats

- Important structural connection to land
- Strongest relationships in the headwater areas
- Many functional roles
 - refuge and nursery
 - pollution & materials processing
- Relationships exist between coastal development and the environmental quality of tidal creeks and resulting human health and welfare impacts
- Knowledge exists to forecast responses





Research Needs

- How many tidal creek networks are present and how diverse ecologically are they?
- What are the impacts to the natural hydrology from the addition of impervious cover and BMPs?
- How variable are the flushing times among tidal creeks, and what features most affect the flushing times?
- What boundary conditions most effectively reduce nutrient and pollutant inputs; what physical and ecological structures most effectively sequester pollutant loads?
- What are the water flows, loadings, and loading rates from upland coastal development into tidal creeks?
- How can these impacts be forecasted to improve the management decision-making process?

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