

# Coastal Development and Tidal Creek Environmental Quality in the Southeastern US

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# TCP

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## Tidal Creek Project

Assess the relationship between coastal urban development and headwater tidal creek environmental quality

Headwater or first order – intertidally dominated – <10 m wide

Comparative watershed approach (forested, suburban, urban)

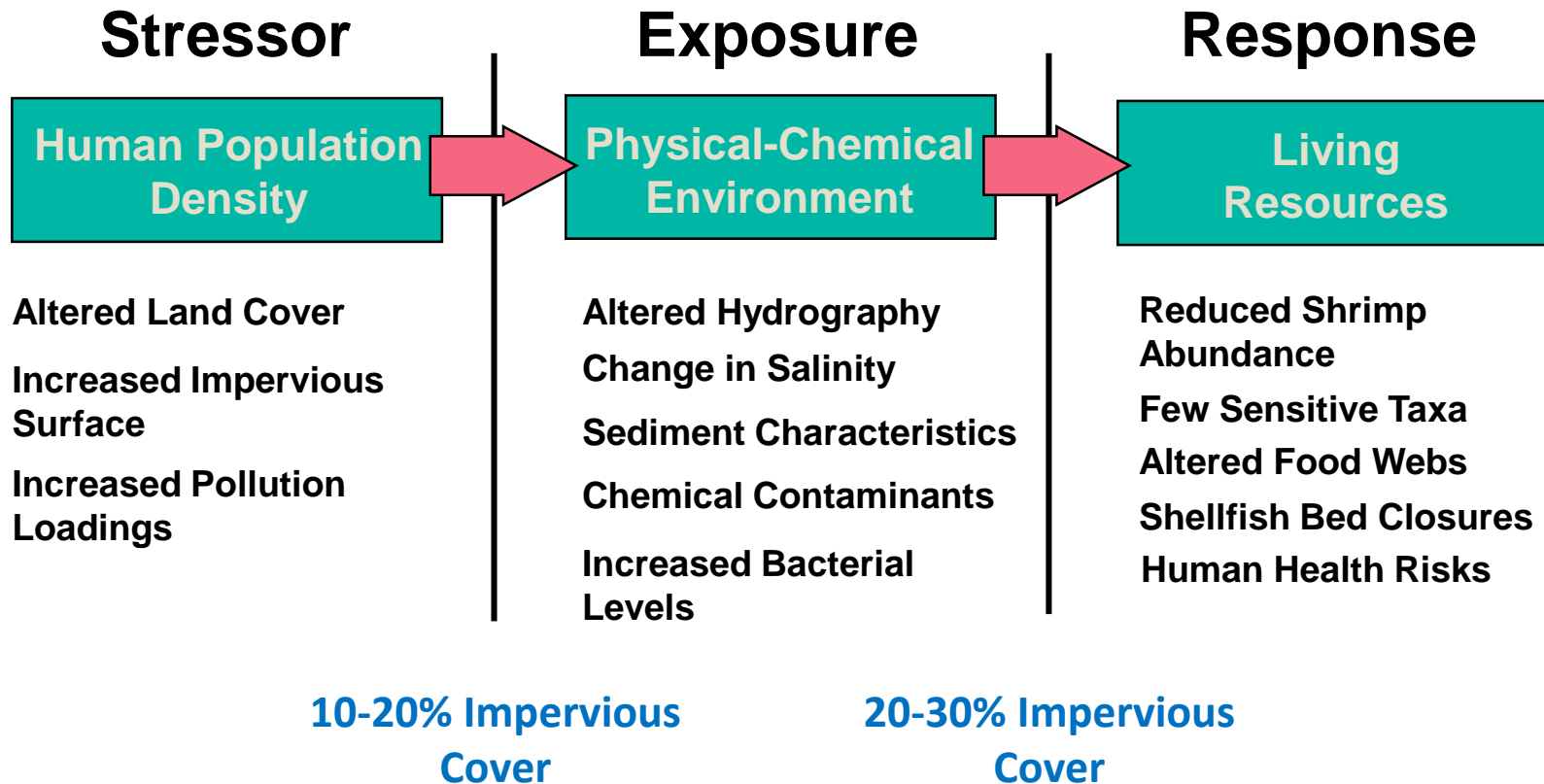
Comprehensive ecosystem study – 1994 to 2015

Spatial, Temporal, Ecological, Ecotoxicological

% watershed impervious cover = indicator of coastal development



# Headwater Conceptual Model



# SCECAP

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## **South Carolina Estuarine and Coastal Assessment Program**

Similar to National Coastal Condition Assessment

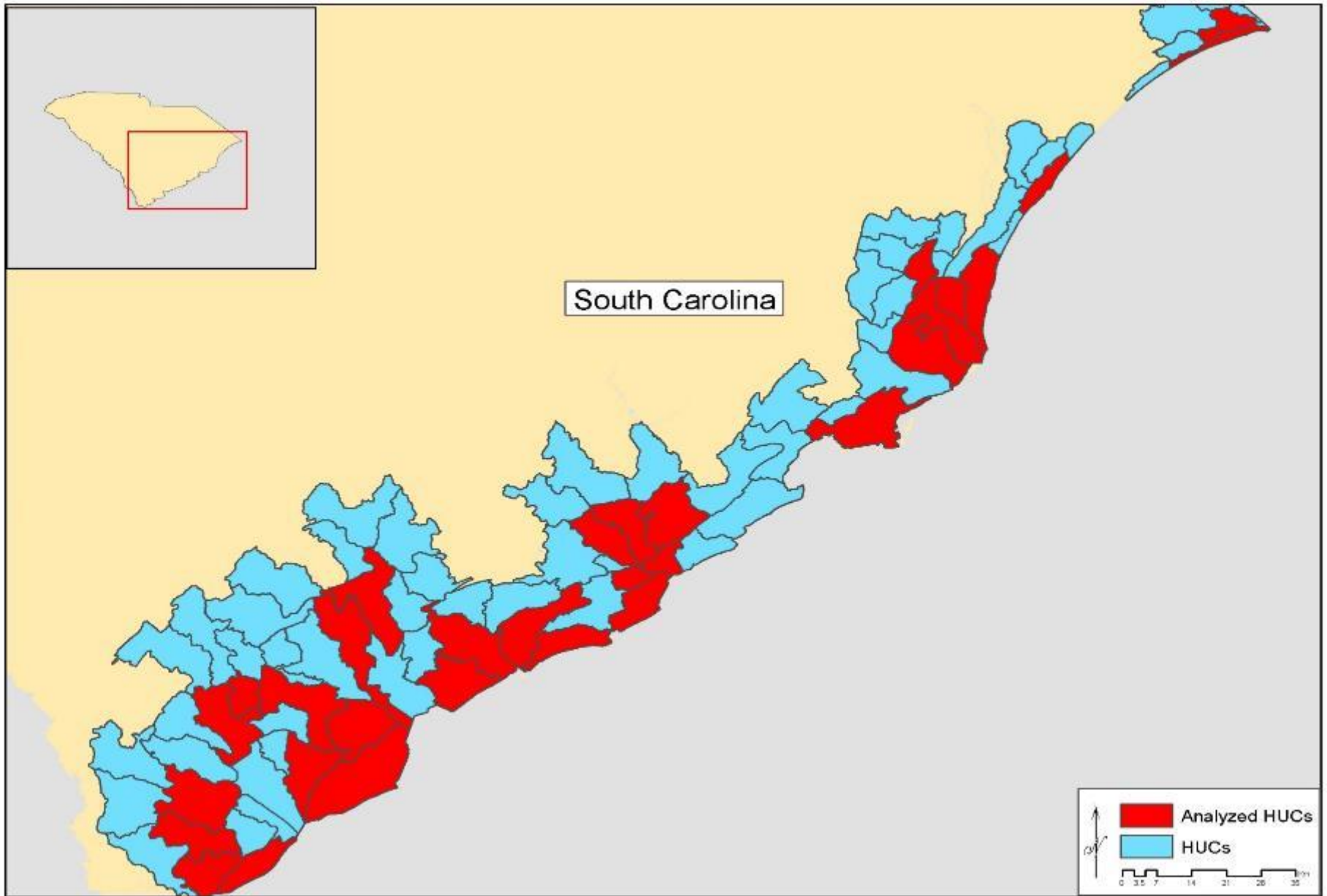
Initiated by Bob Van Dolah in 1999 and continues today

Evaluate the overall health of the state's estuarine habitats

Assess relationships with coastal development

Tidal creeks (<100m wide and >10m wide)  
and open water (>100m wide)





# Land Cover vs. Estuarine Quality

## Pearson Correlation Analysis Results

Land Cover Category	Sediment Contaminants					Water
	ERM-Q	PAHs	PCBs	Pest.*	Metals	Fecals
Scrub shrub & forested wetlands	+	-	-	-	+	-
Bare land**	-	-	-	-	-	-
Grassland & pasture & scrub shrub	-	-	-	-	-	-
Deciduous & mixed forest**	-	-	-	-	-	-
Evergreen forest	-	-	-	-	-	-
Cultivated land	-	-	-	-	-	-
Urban low density	+	+	+	+	+	+
Urban high density	+	+	+	+	+	+
Urban combined	+	+	+	+	+	+
Percent impervious surface	+	+	+	+	+	+

\*\*Spearman rank correlation

 P < 0.05

 P < 0.10

Van Dolah et.al. 2008. Estuarine habitat quality reflects urbanization at large spatial scales in South Carolina's coastal zone. Science of the Total Environment 390:142-154.

# OHHI MAP

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## Oceans and Human Health Initiative Monitoring and Assessment Program

Combined TCP and SCECAP

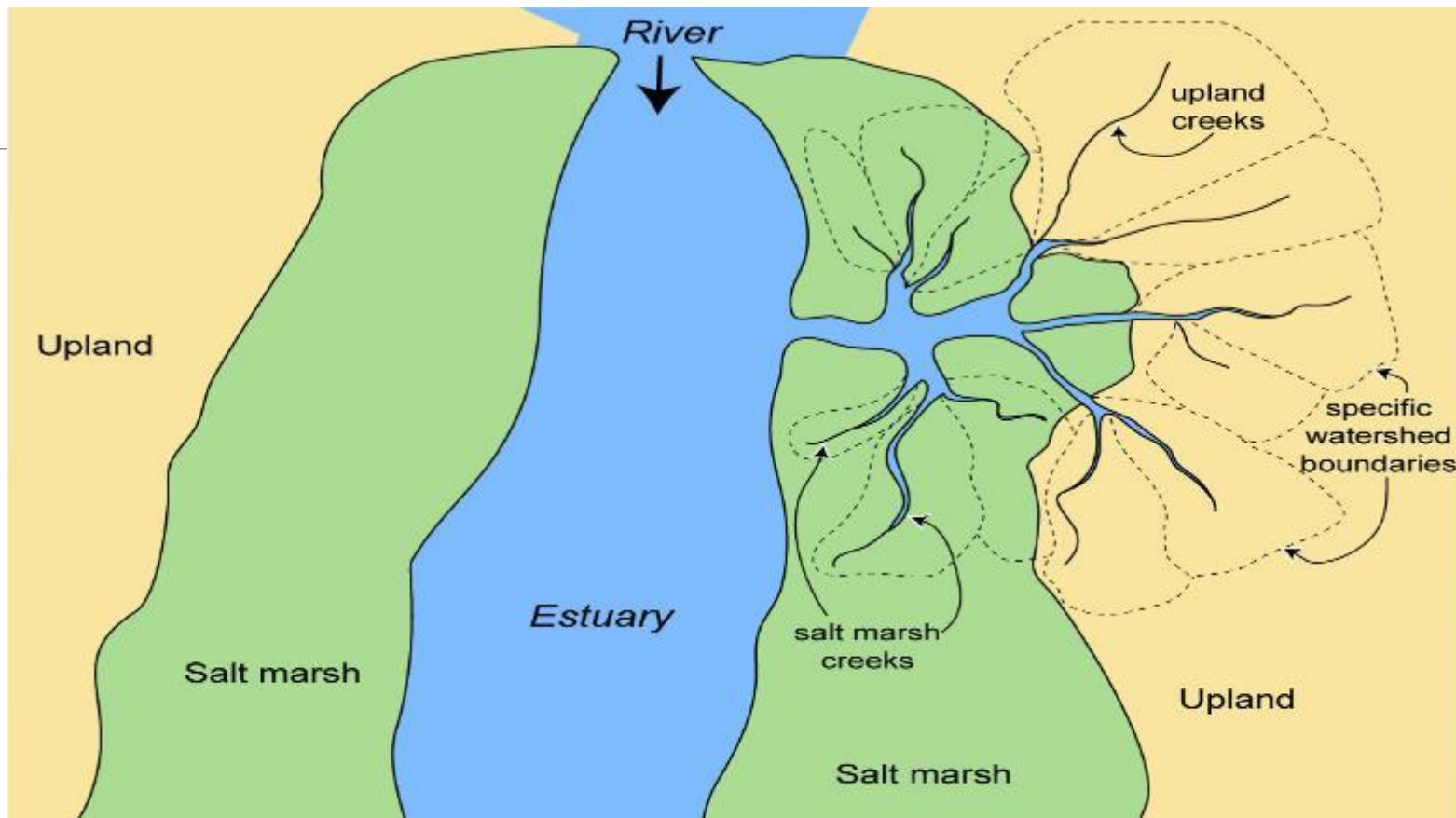
2005 and 2006

How do these impacts change along the longitudinal gradient of tidal creeks (i.e., headwaters to larger tidal creeks)?

- Creek Classification

Multiple strata (First, Second, Third Orders)

# What are tidal creeks?



Tidal creeks and associated salt marsh = 50-65% of Southeastern estuarine area



# Example Classification



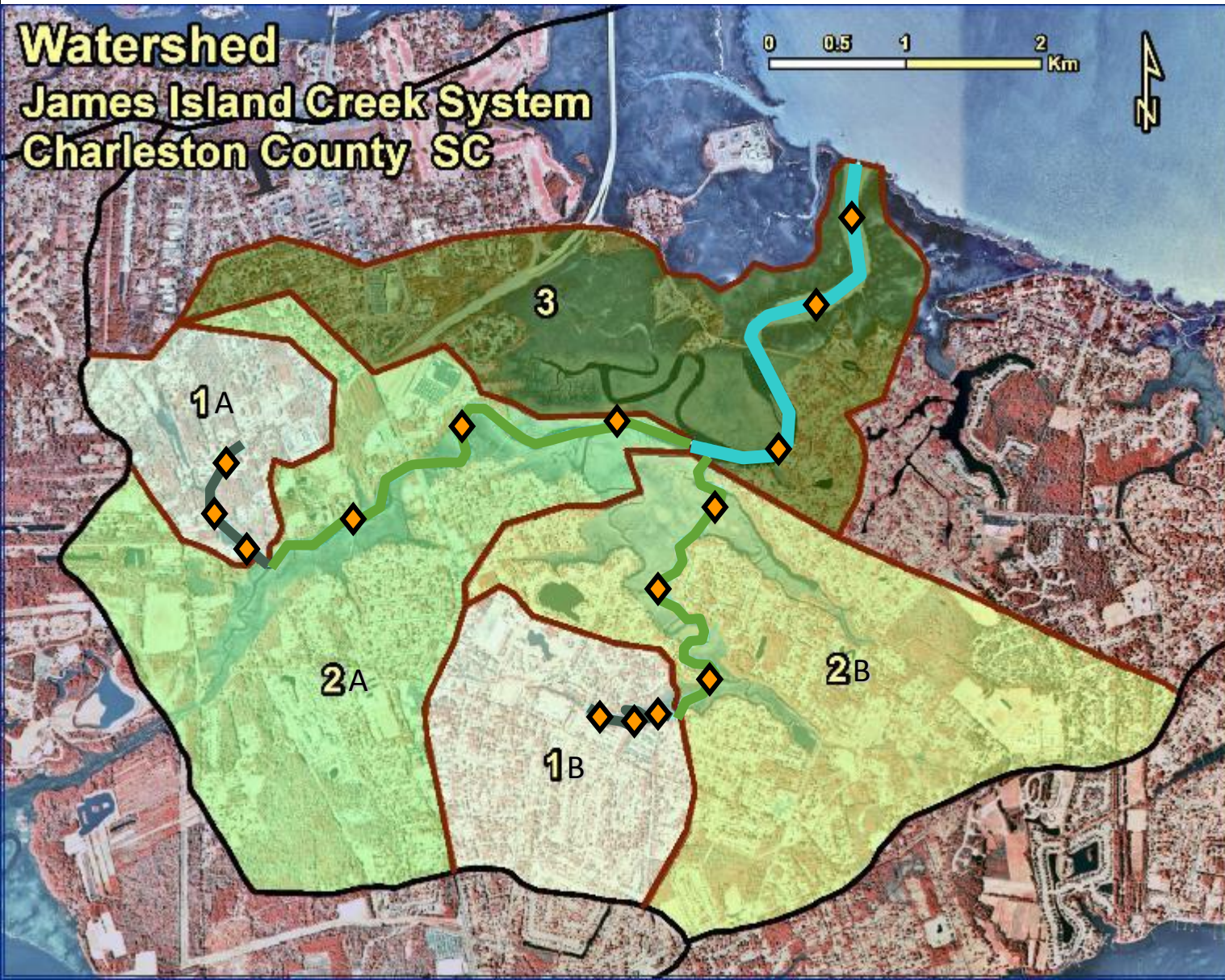
Rivulets

# Unified Classification Framework

## Characteristics of NC/SC/GA upland & salt marsh creeks by stream order

Stream Order	Upland Creeks		Marsh Creeks		Comments
	Drainage Basin (ha)	Stream Width (m)	Drainage Basin (ha)	Stream Width (m)	
<b>Rivulet</b>	<1	<1-2	<1	<1-2	Drains completely at low tide
<b>First</b>	62-2,425 Median = 377	1-10	15-30 Median = 27	1-10	~75% of vol. drains at low tide
<b>Second</b>	322-5,501 Median= 1,650	10-100	50-300 Median = 167	10-50	~ 50% of vol. drains at low tide
<b>Third/ Tidal River</b>	>5,000	>100	>300	50-100	~25% of vol. drains at low tide

# Creek Gradient



## Creek Lengths

1A - 850 m

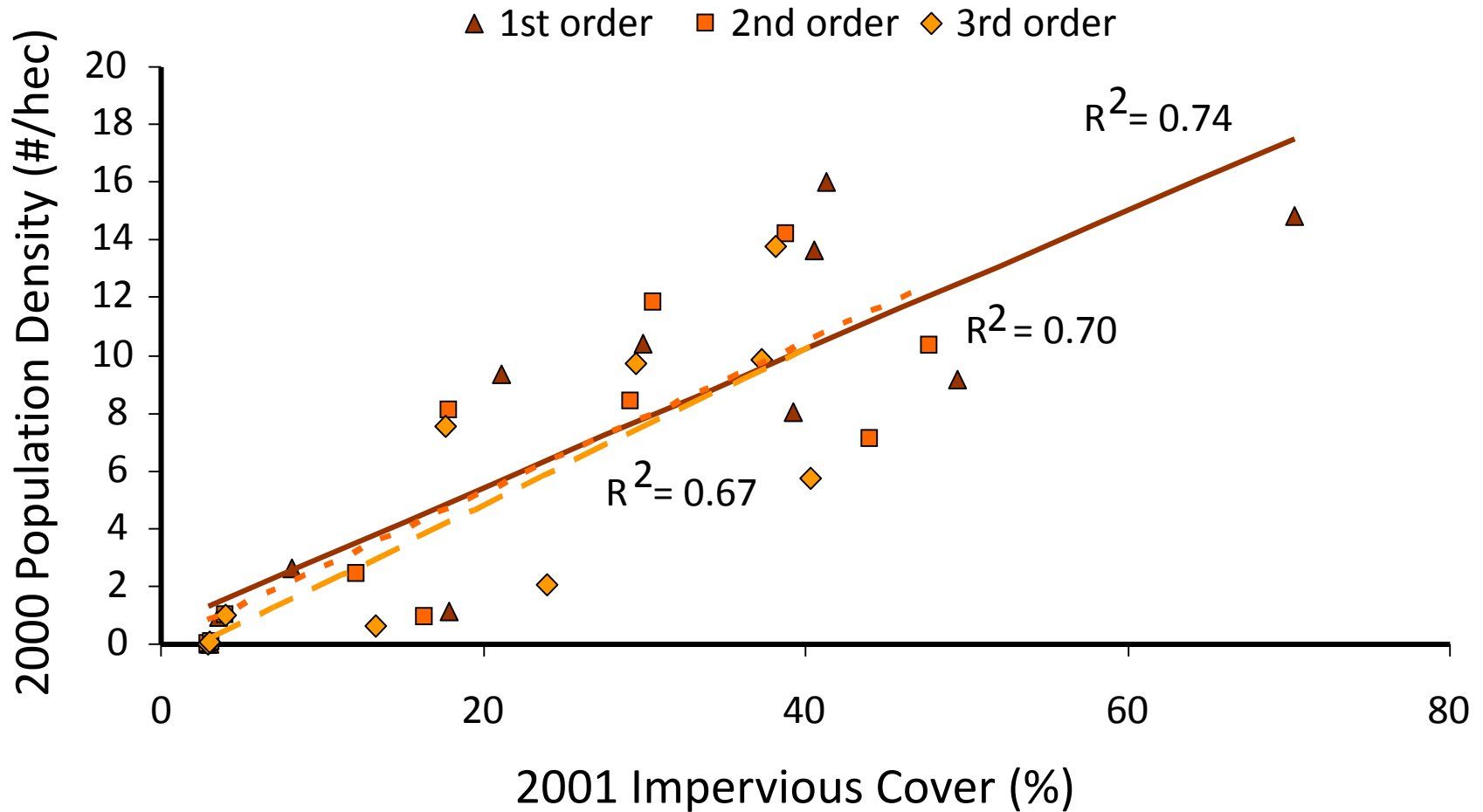
1B - 850 m

2A - 6400 m

2B - 4600 m

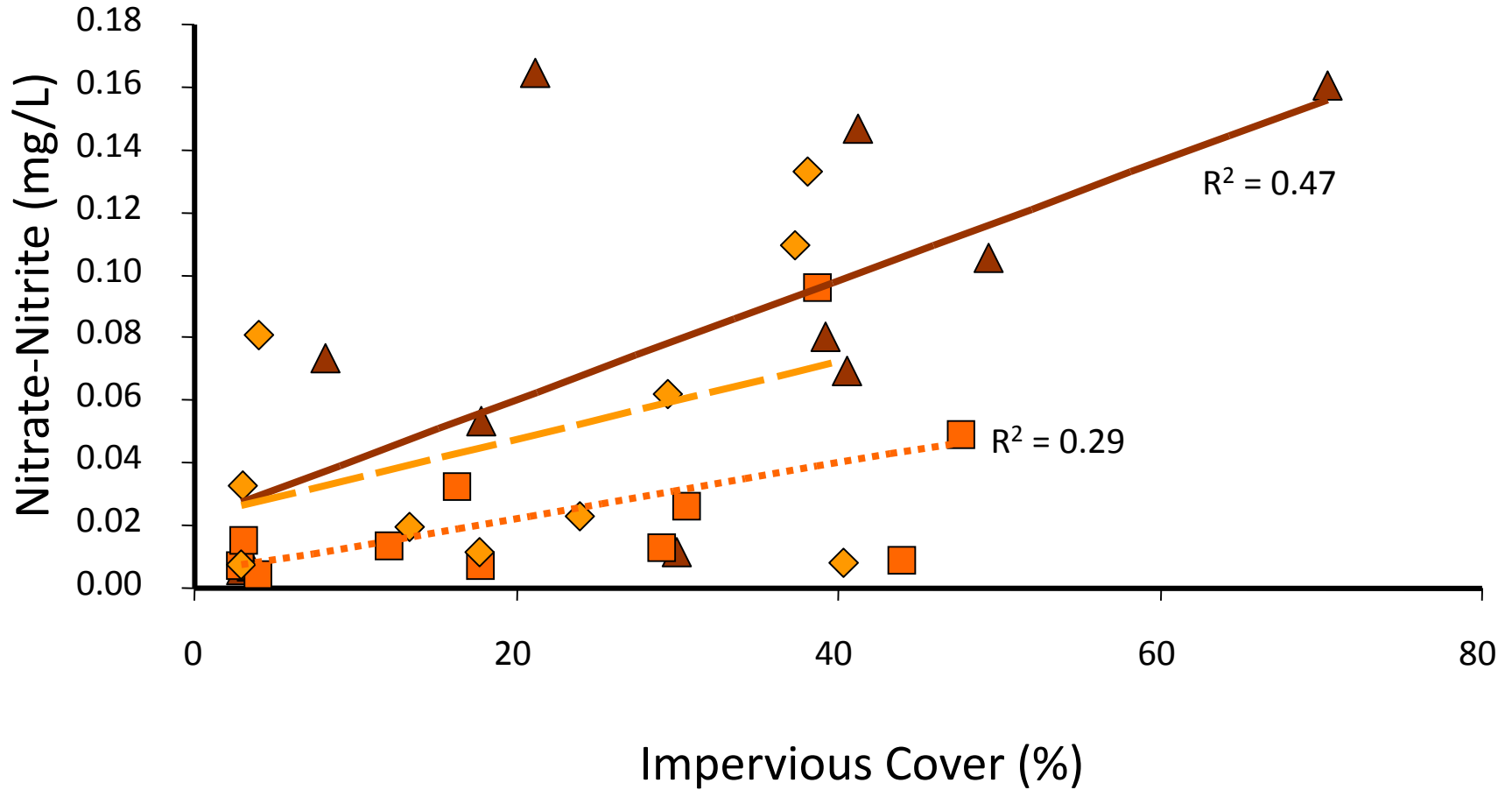
3 - 5800 m

# Population Density vs Impervious Cover

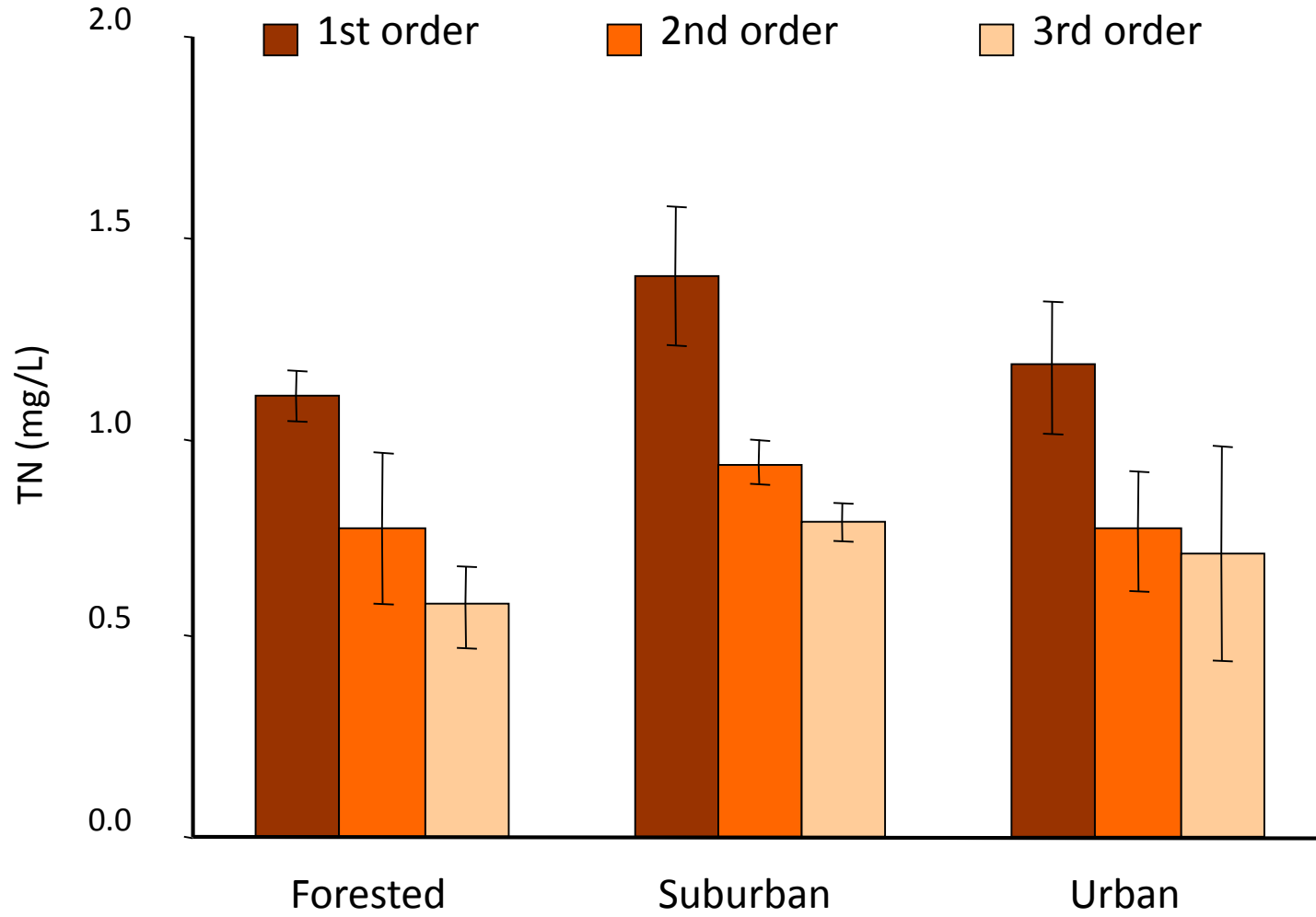


# Nitrate-Nitrite vs Impervious Cover

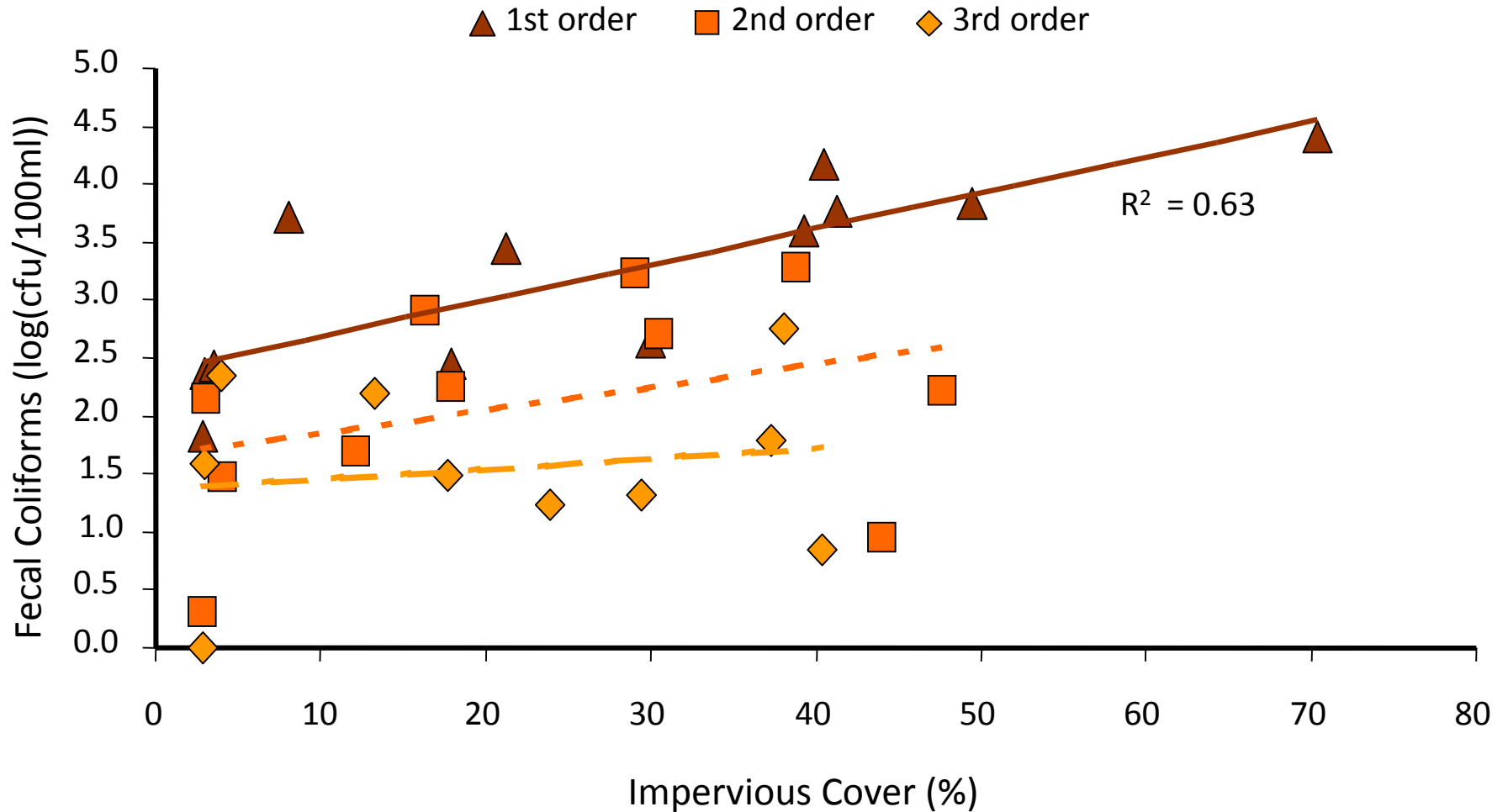
▲ 1st order    ■ 2nd order    ◆ 3rd order



# Total Nitrogen

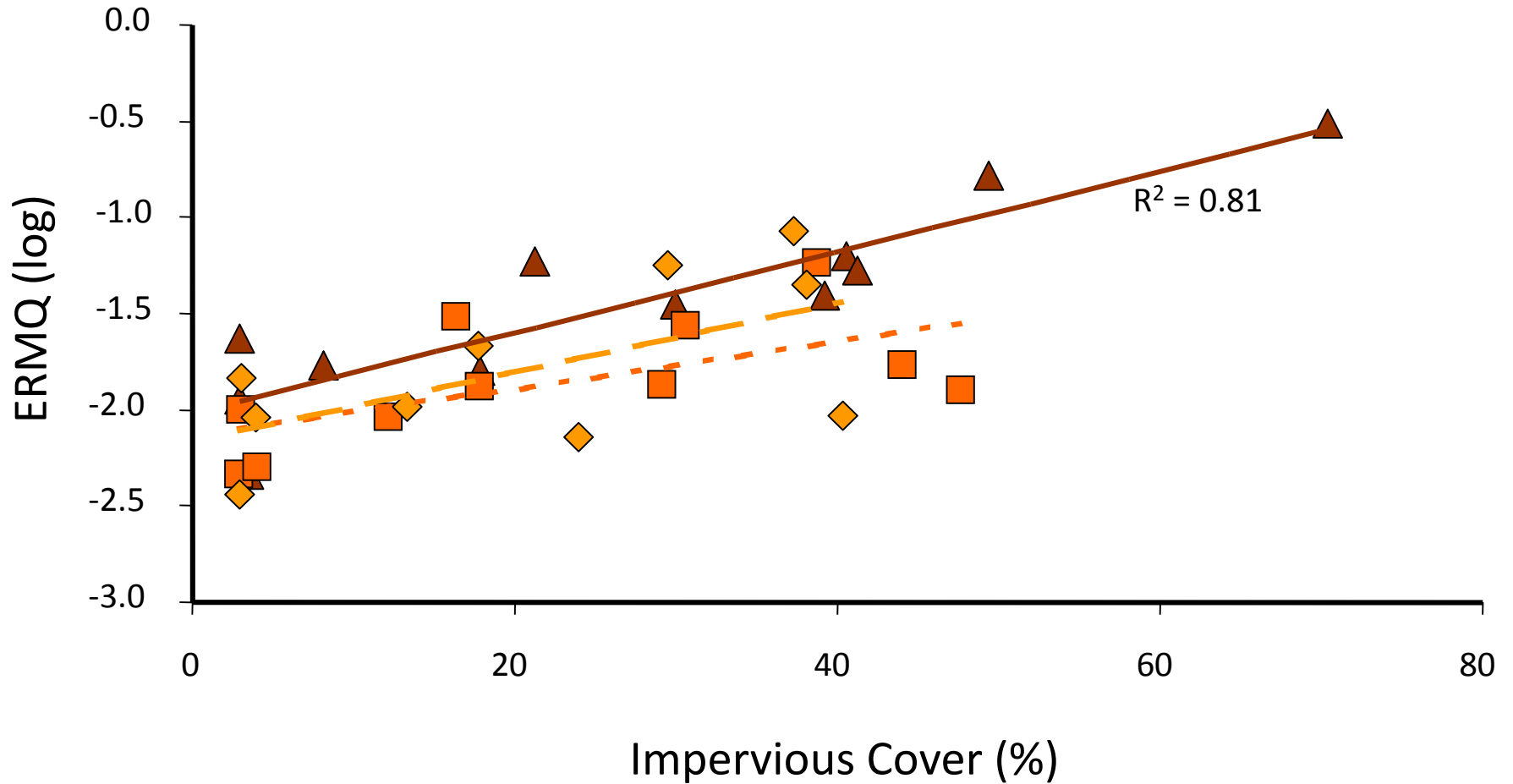


# Fecal Coliforms vs Impervious Cover



# Chemical Contaminants vs Impervious Cover

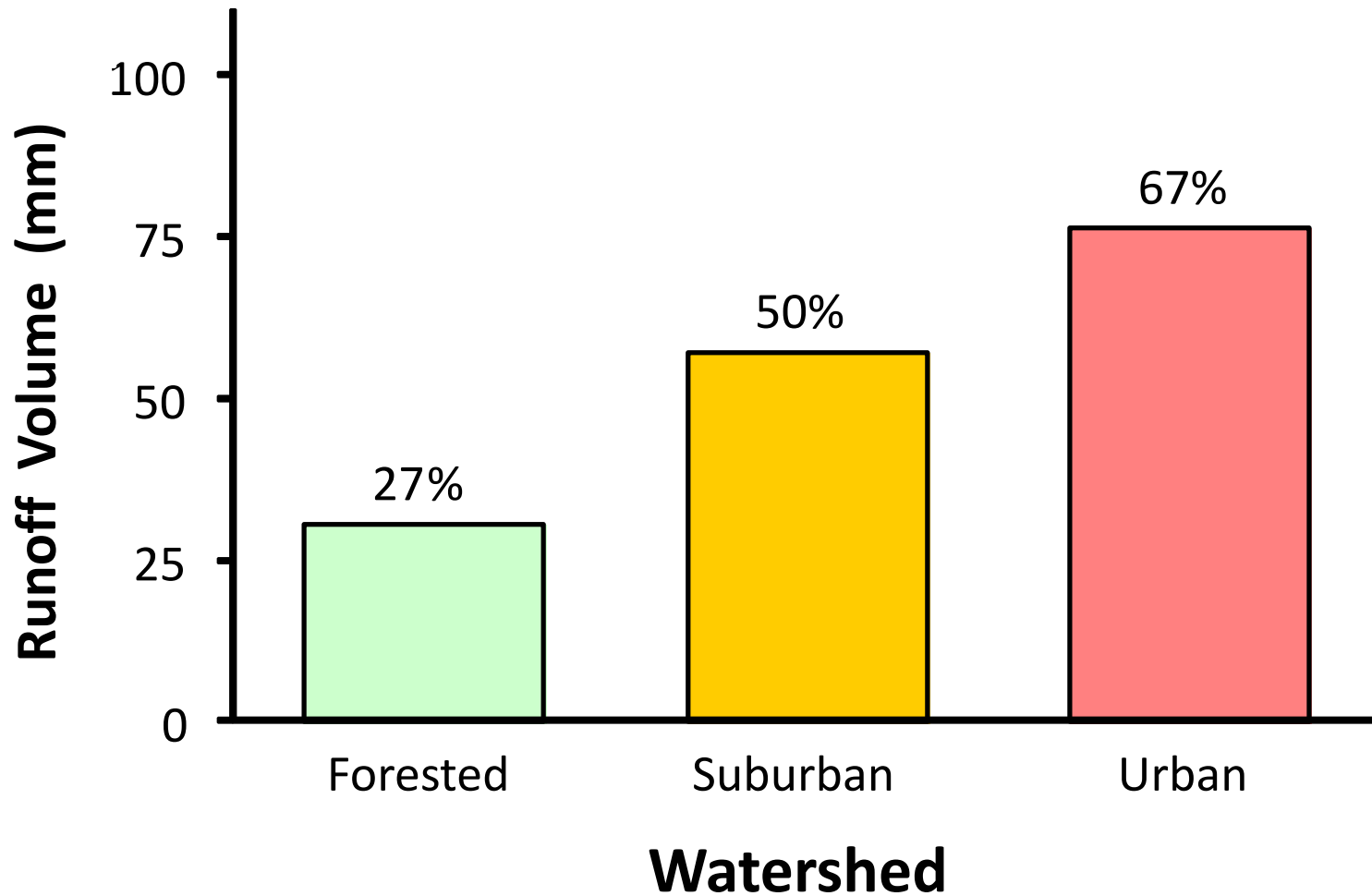
▲ 1st order    ■ 2nd order    ◆ 3rd order





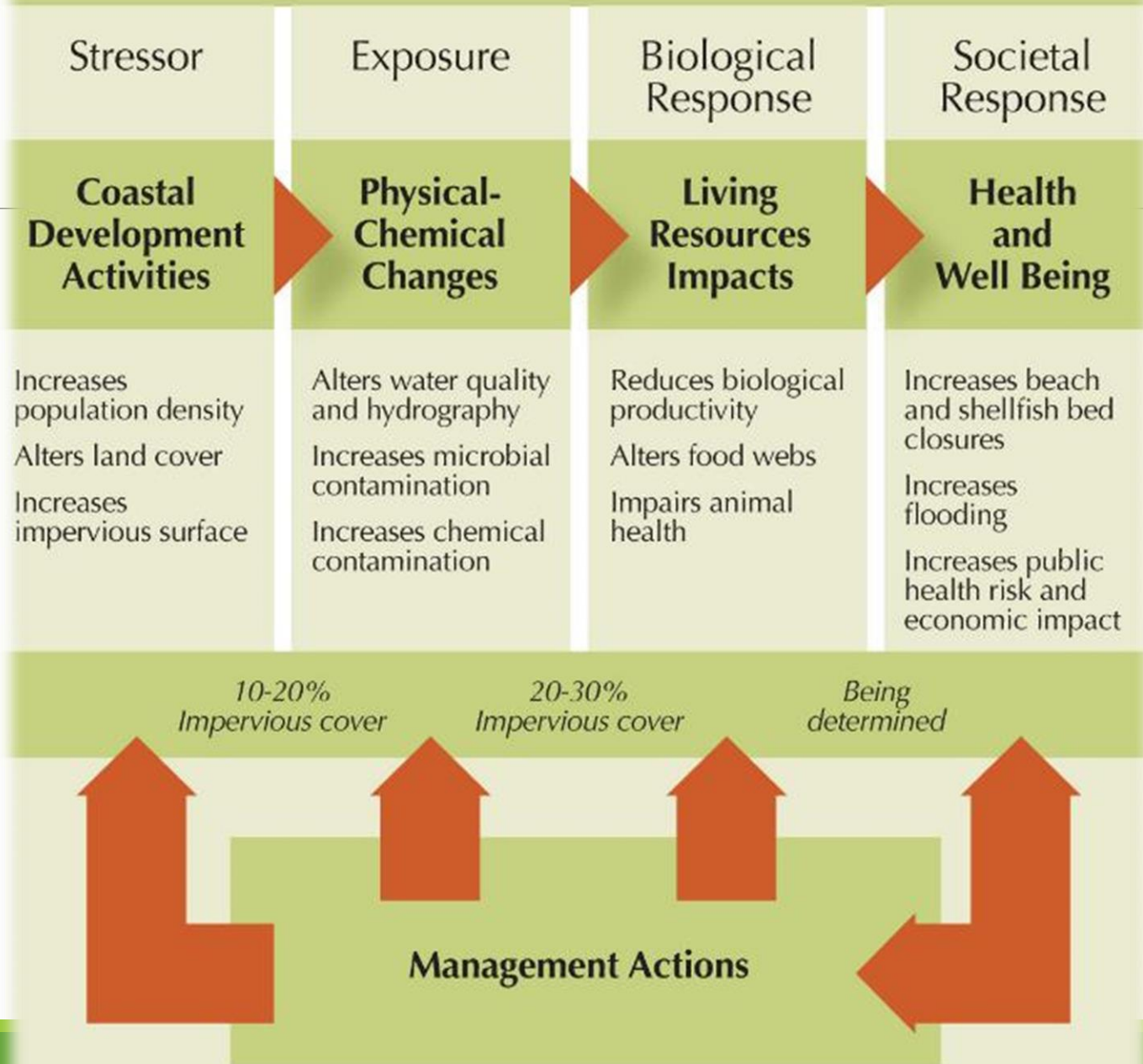
Images from the Post and Courier

# Modeled Runoff Volume



Present scenario – 24-hr 4.5-in storm event, average runoff conditions Blair et al. 2013

# Conceptual Model of Tidal Creek Watershed Linkages



# CI-DEEP

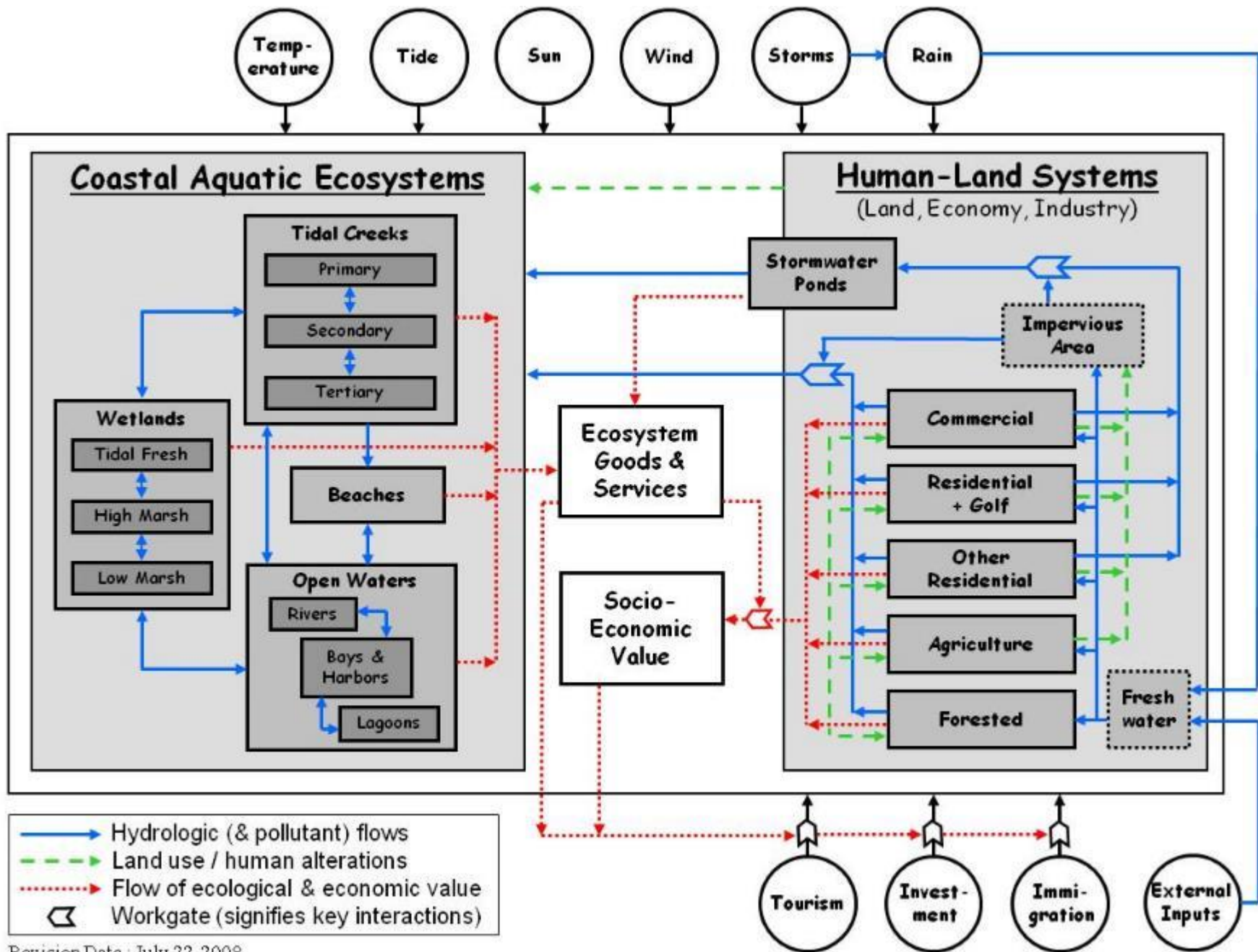
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## **Coastal Integrated – Demographic, Economic, Environmental Prediction**

Synthesis effort based on a number of previous studies in SC  
– TCP, LU-CES, USES

Developed an overall conceptual model and specific process based  
models – stormwater ponds, tidal creeks, open water, beaches

Team: Walter Boynton, Michael Kemp, Fred Holland,  
Chris Buzzelli, Erik Smith, Denise Sanger



NATURAL ENERGIES & MATERIALS

PURCHASED GOODS, SERVICES & FUELS

**COASTAL ECOSYSTEMS**  
• TIDAL CREEKS  
• WETLANDS  
• BEACHES  
• ESTUARIES

ECOSYSTEM GOODS & SERVICES

SOCIO-ECONOMIC VALUES

**HUMAN SYSTEMS**  
• COMMERCIAL  
• RESIDENTIAL  
• AGRICULTURAL  
• FORESTED

STRESS  
LOSES

POLLUTANTS



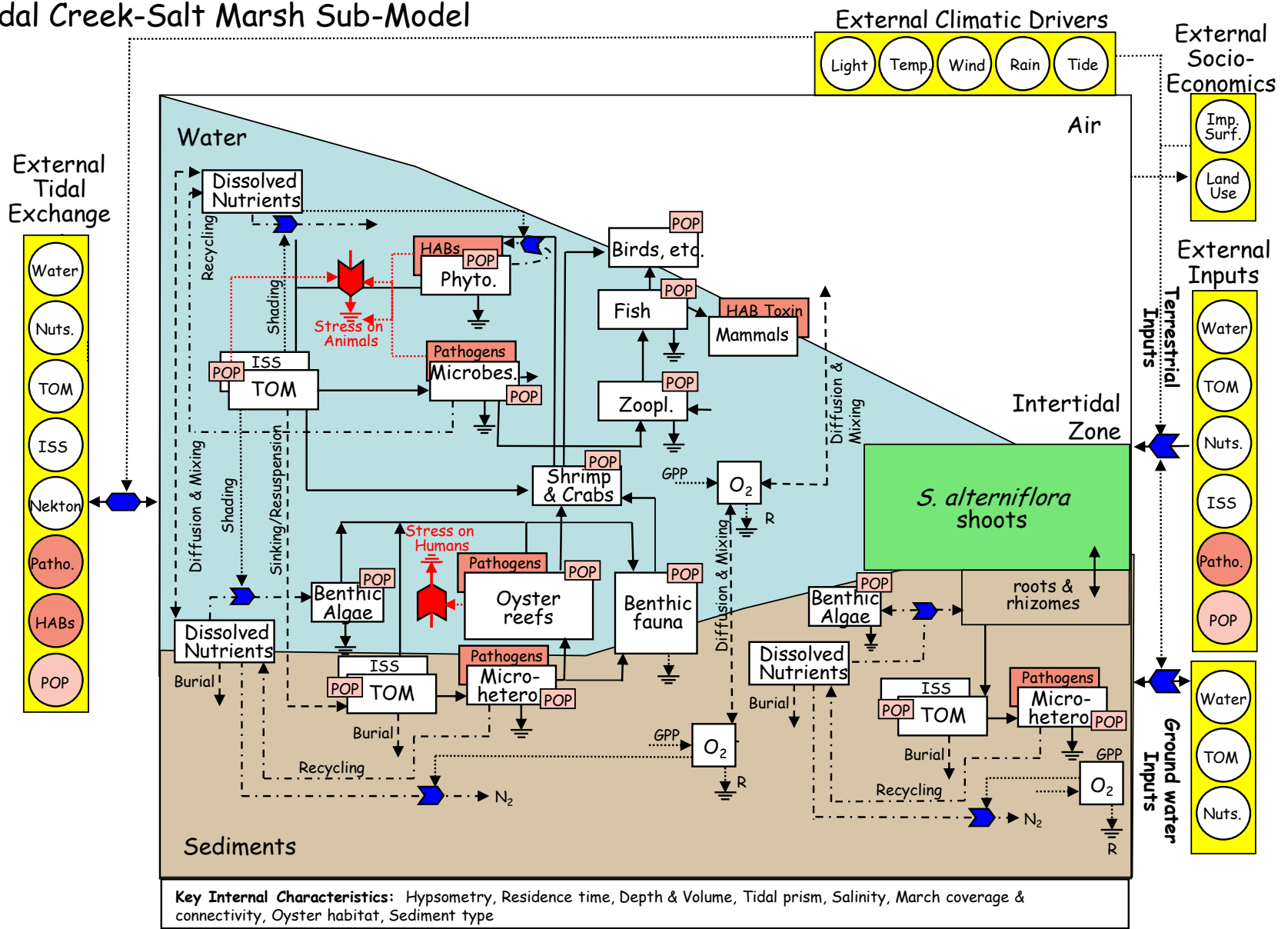
**STATUS**

*Coastal Carolina*



**TRENDS**

# Tidal Creek-Salt Marsh Sub-Model



- Chemical/Biological Transformations - - - - -
  - Feeding Fluxes —————
  - Transport - - - - -
  - Influences ·······
- ↓
- Interacting processes

