

Linkages Between Land Cover and the Environmental Conditions of Tidal Creek

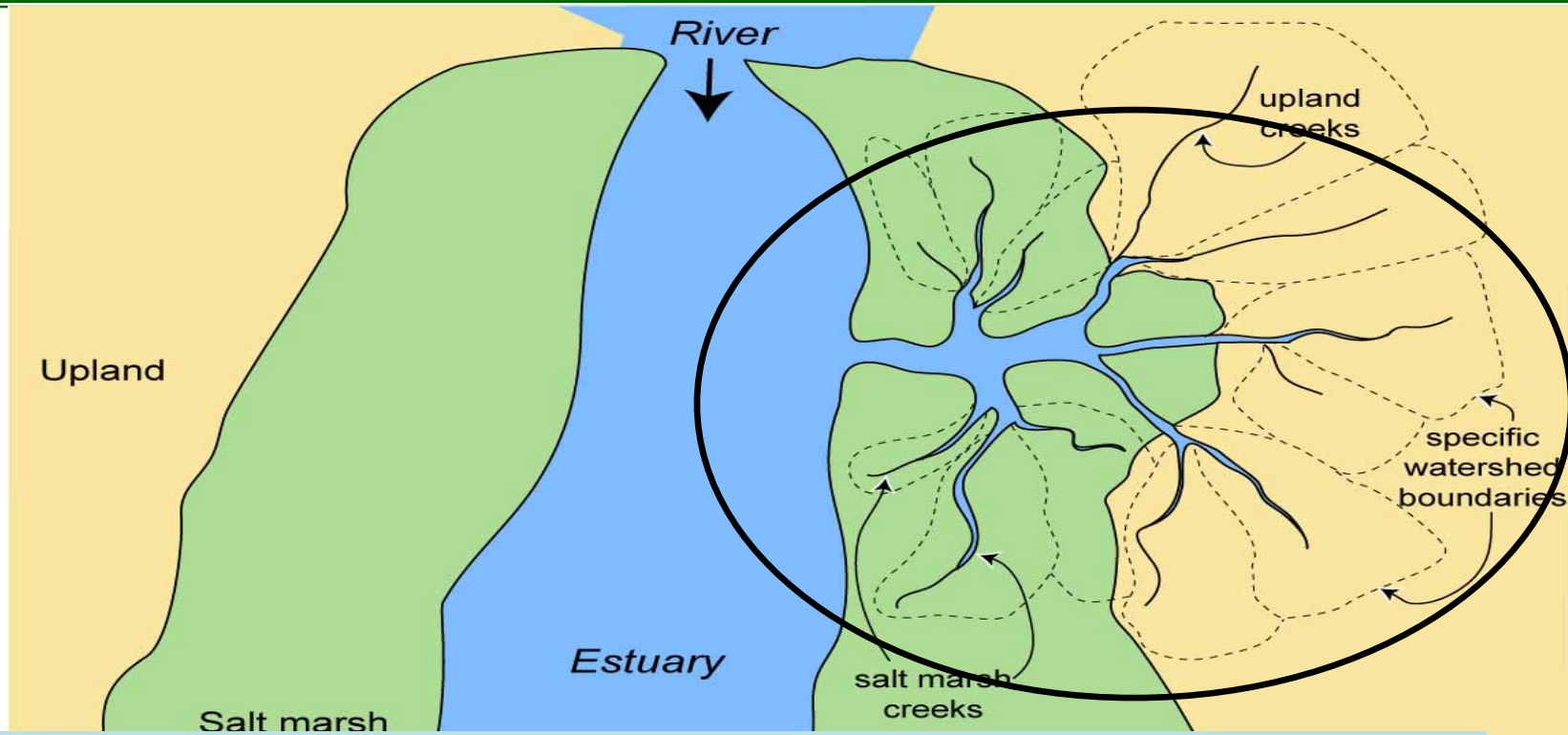
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What are tidal creeks?



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





Why Are They Important?

- Primary hydrologic link to uplands
- Preferred sites for development
- Refuge and nursery habitat for fisheries



- Complex ecosystems & human interface

Health at the Hollings Marine Laboratory

Charleston Urban Growth - Allen & Lu



Temporal Series Maps

Urban Area
70
Miles²

Urban Area
250
Miles²

Tidal creeks are being converted to ditches and conduits of non-point source runoff

Urban Area
868
Miles²

Urban Area
607
Miles²

 Urban

2030

Mapped at 5:1 ratio
for year 2015 and 2030

2015

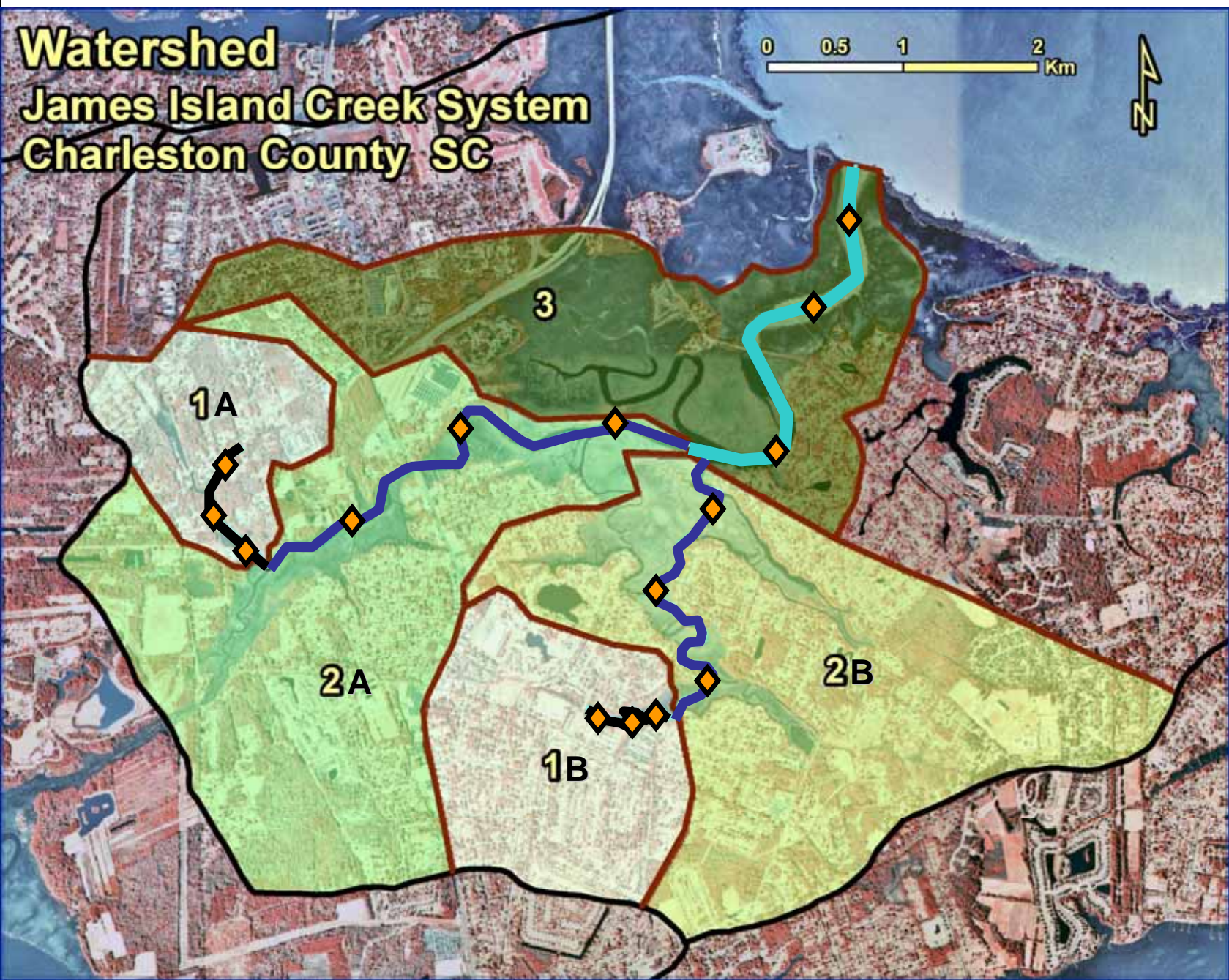


Research Questions

- What are the impacts of changing land use on tidal creeks?
 - Comparative Approach
- How do these impacts change along the longitudinal gradient of tidal creeks (i.e., headwaters to larger tidal rivers)?
 - Creek Classification



Creek Gradient

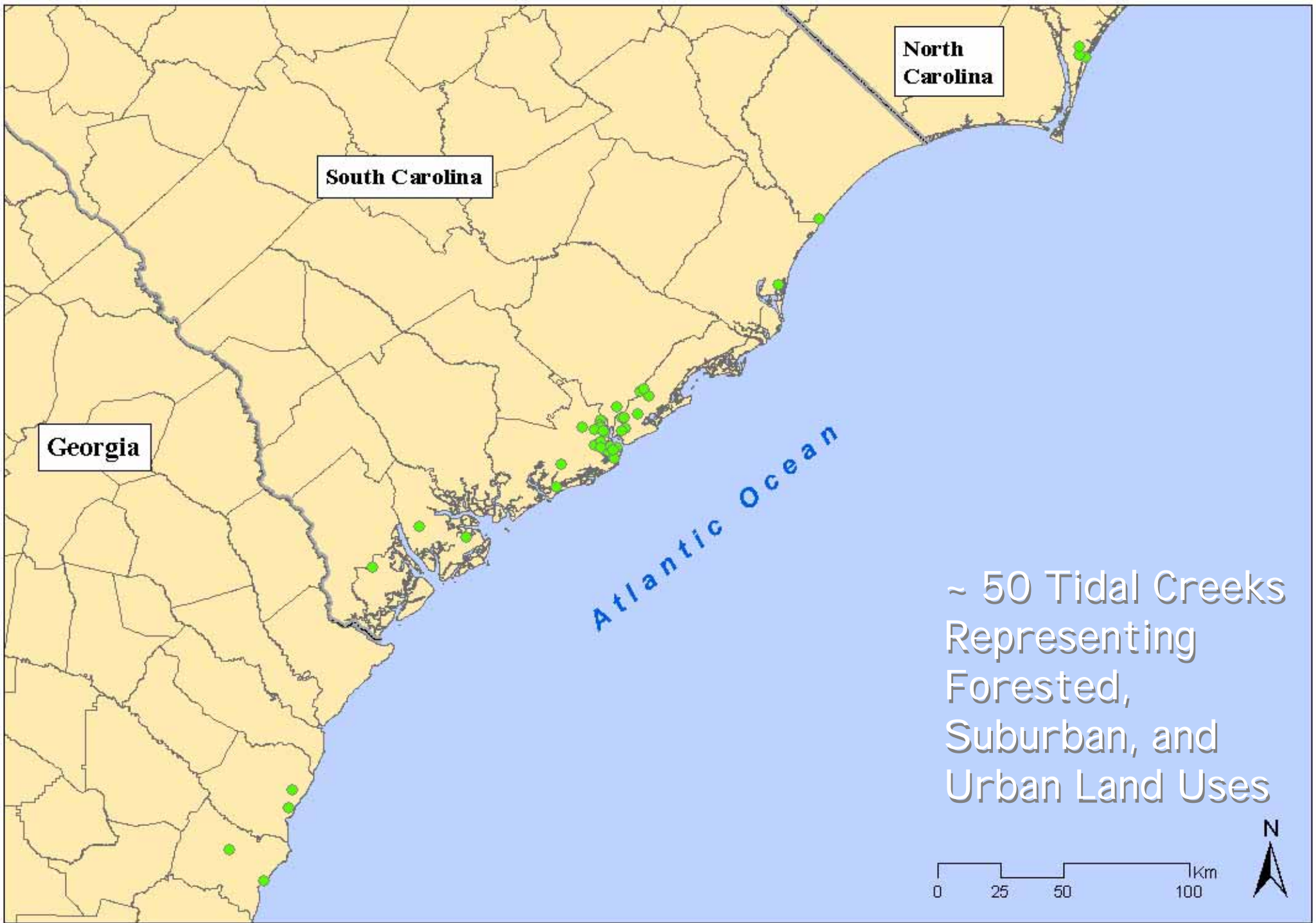


- Creek Lengths
- 1A - 850 m
 - 1B - 850 m
 - 2A - 6400 m
 - 2B - 4600 m
 - 3 - 5800 m



Sampling Design

- Sampled down the gradient—1st to 3rd order
 - Water Quality -- 1 logger deployed/order
 - Pathogens -- 1 grab sample/order
 - Nutrients -- 3 grab samples/order
 - Sediment Contaminants - 1 sample/order
 - Biological Community - 3-9 samples/order
- Evaluated creeks showing a gradient of increasing impervious cover (i.e., increasing urbanization)
- Sampled in Summer, 2005
- Sampled on ebbing tide



North
Carolina

South Carolina

Georgia

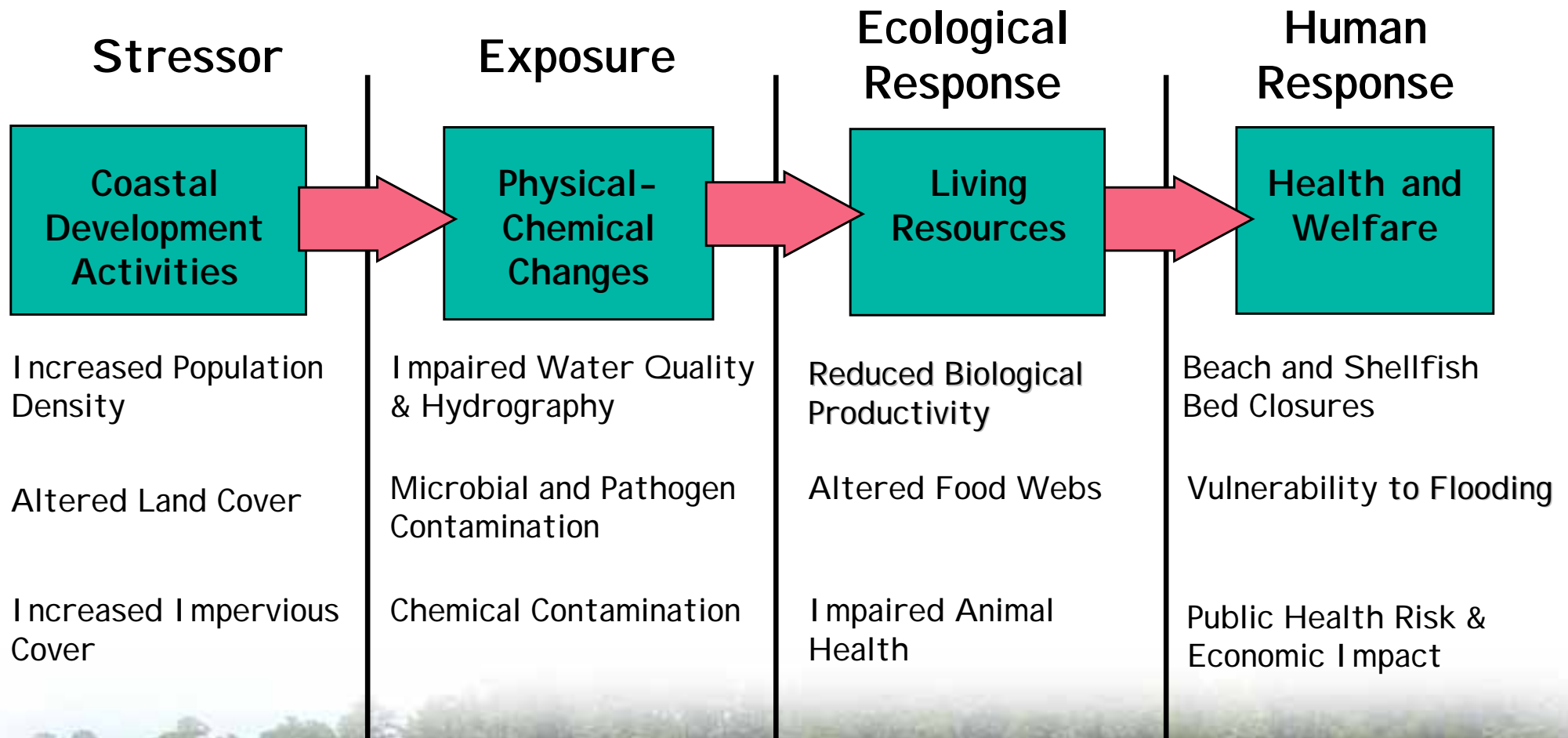
Atlantic Ocean

~ 50 Tidal Creeks
Representing
Forested,
Suburban, and
Urban Land Uses

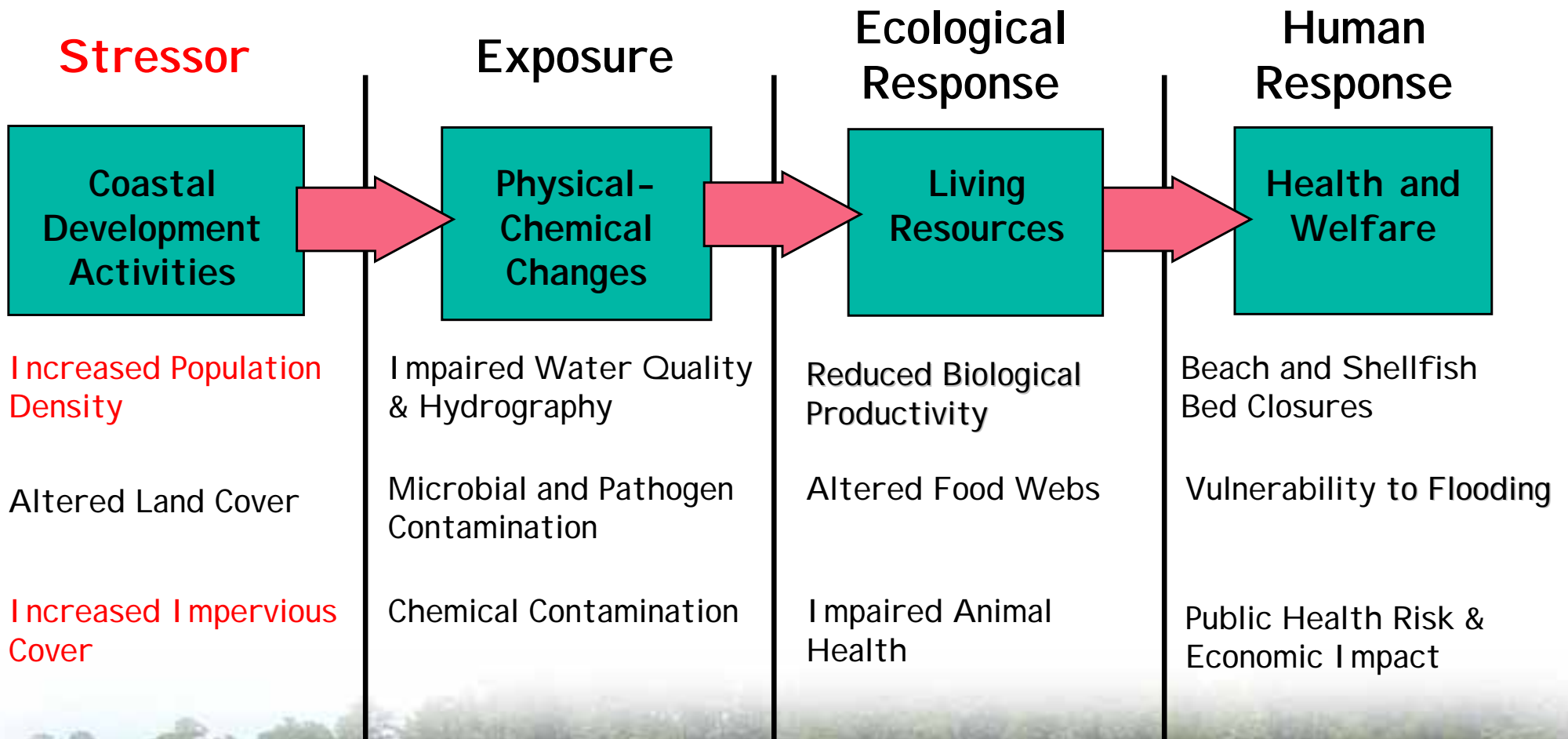
0 25 50 100 km



Conceptual Model of Creek Watershed Linkages

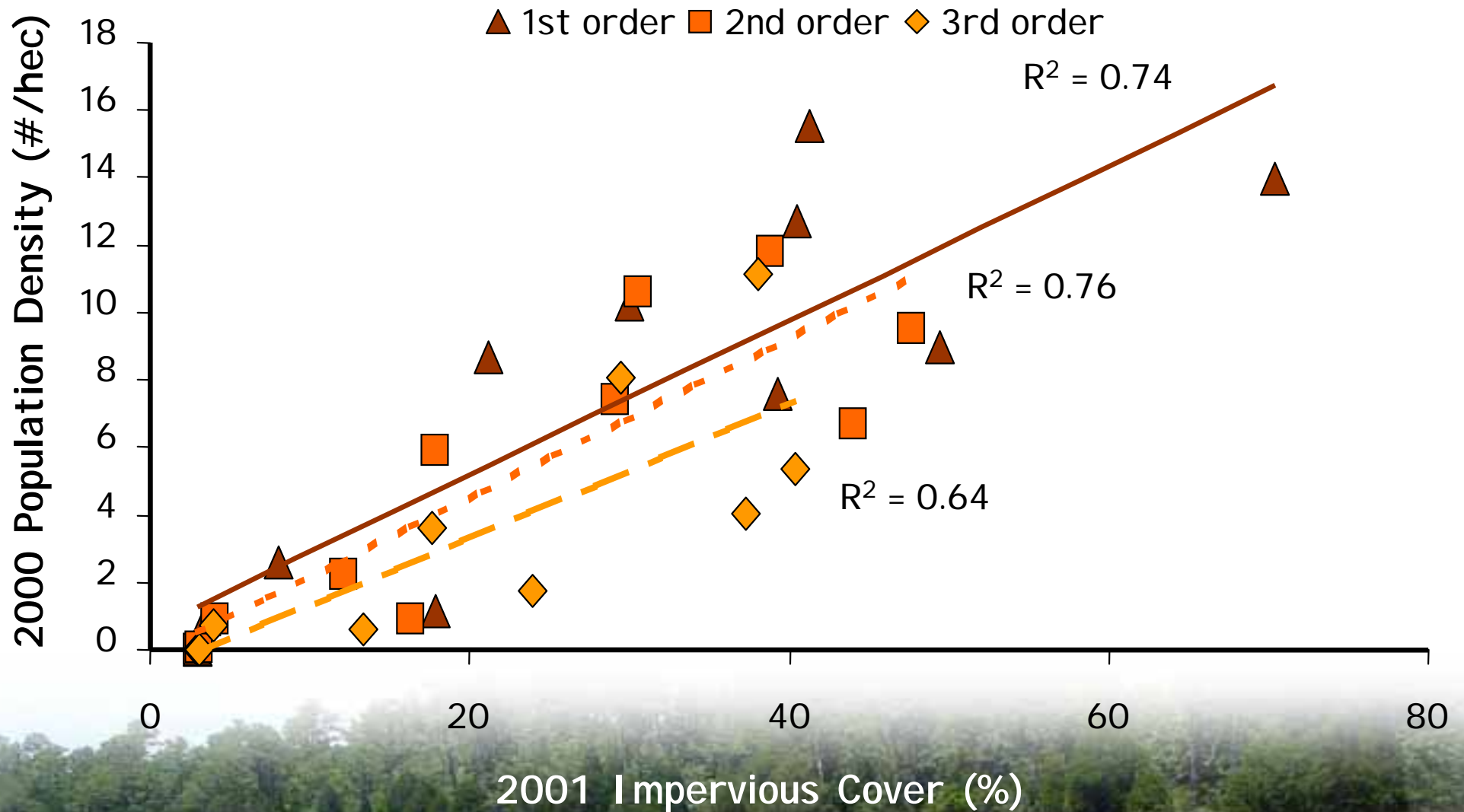


Conceptual Model of Creek Watershed Linkages

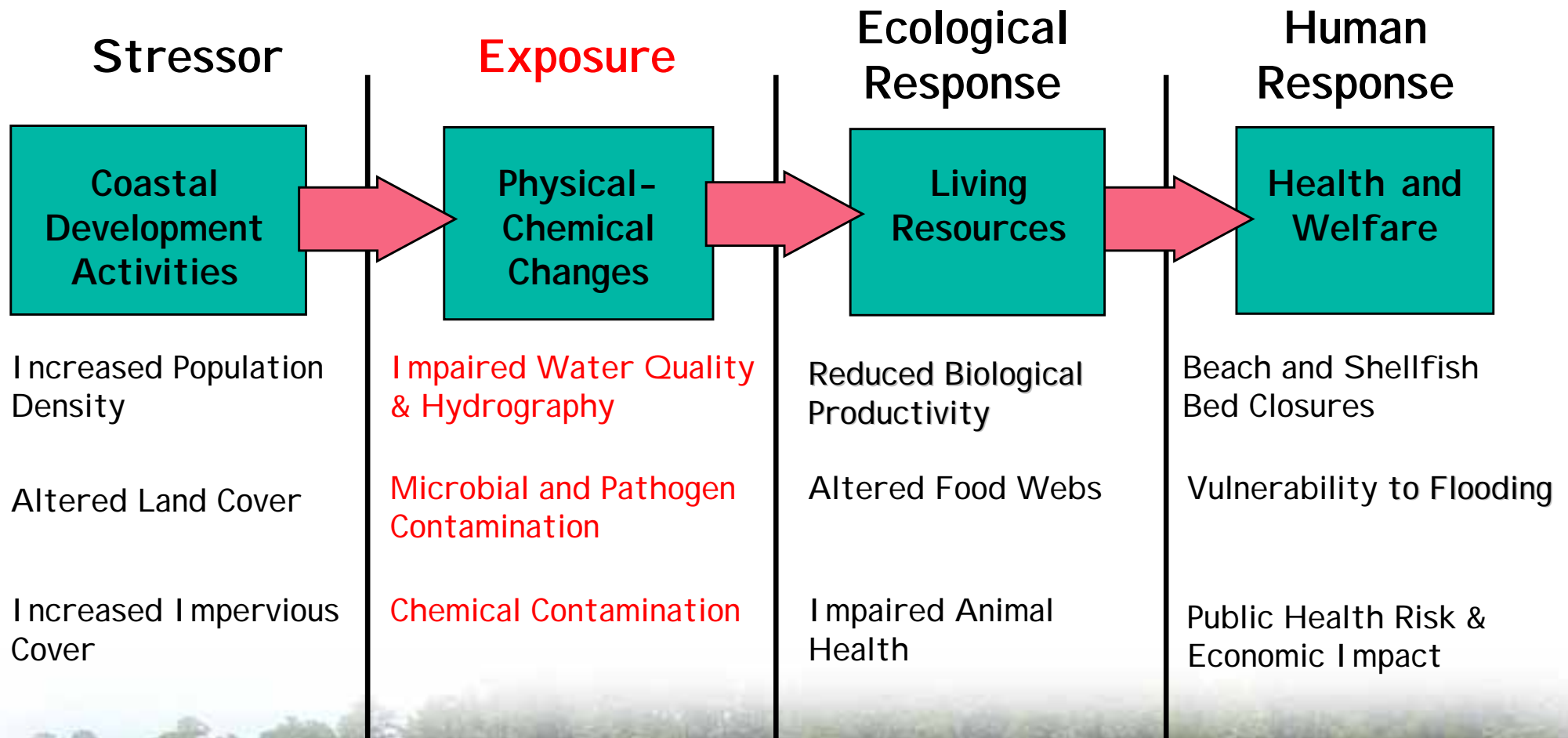




Population Density vs Impervious Cover

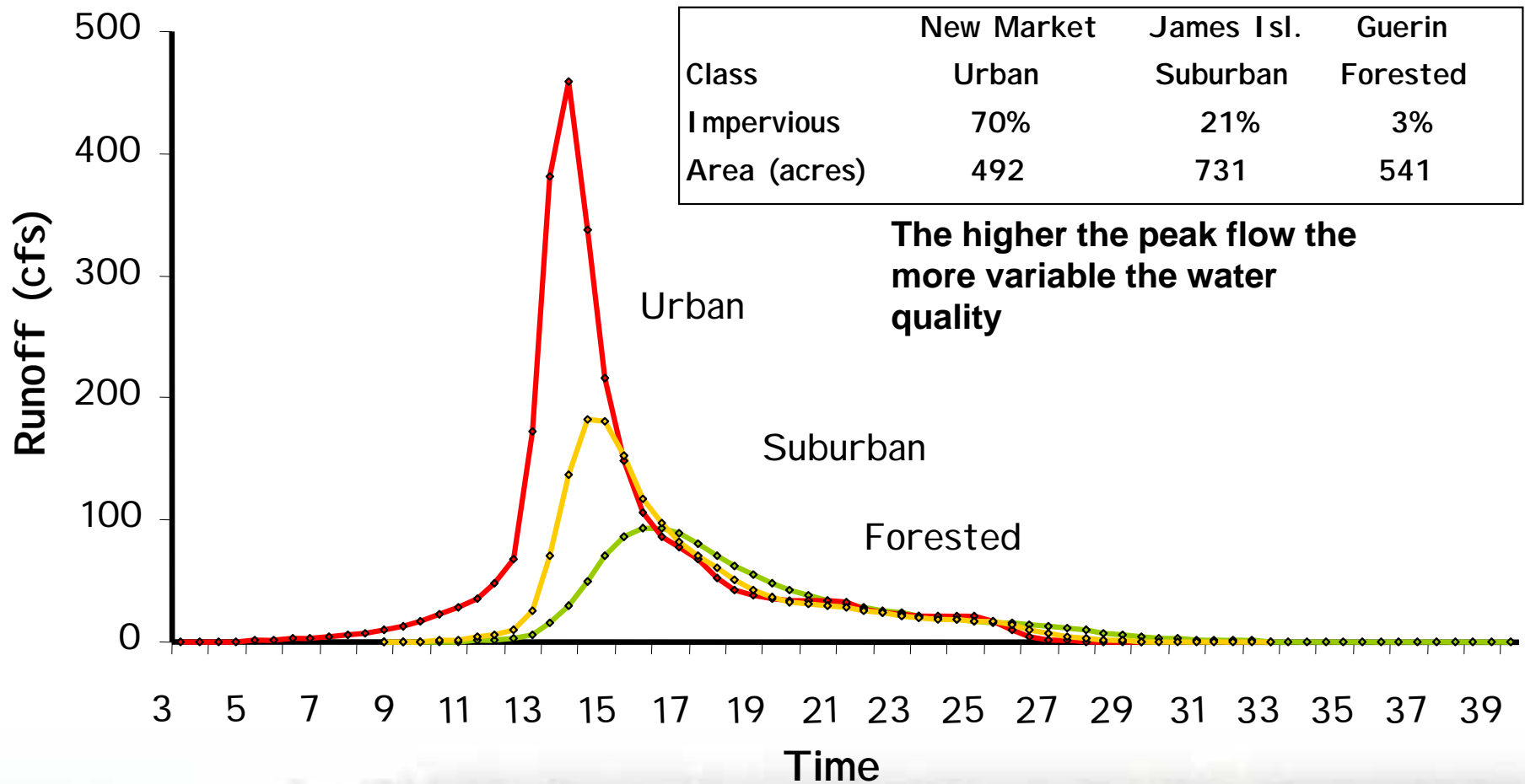


Conceptual Model of Creek Watershed Linkages





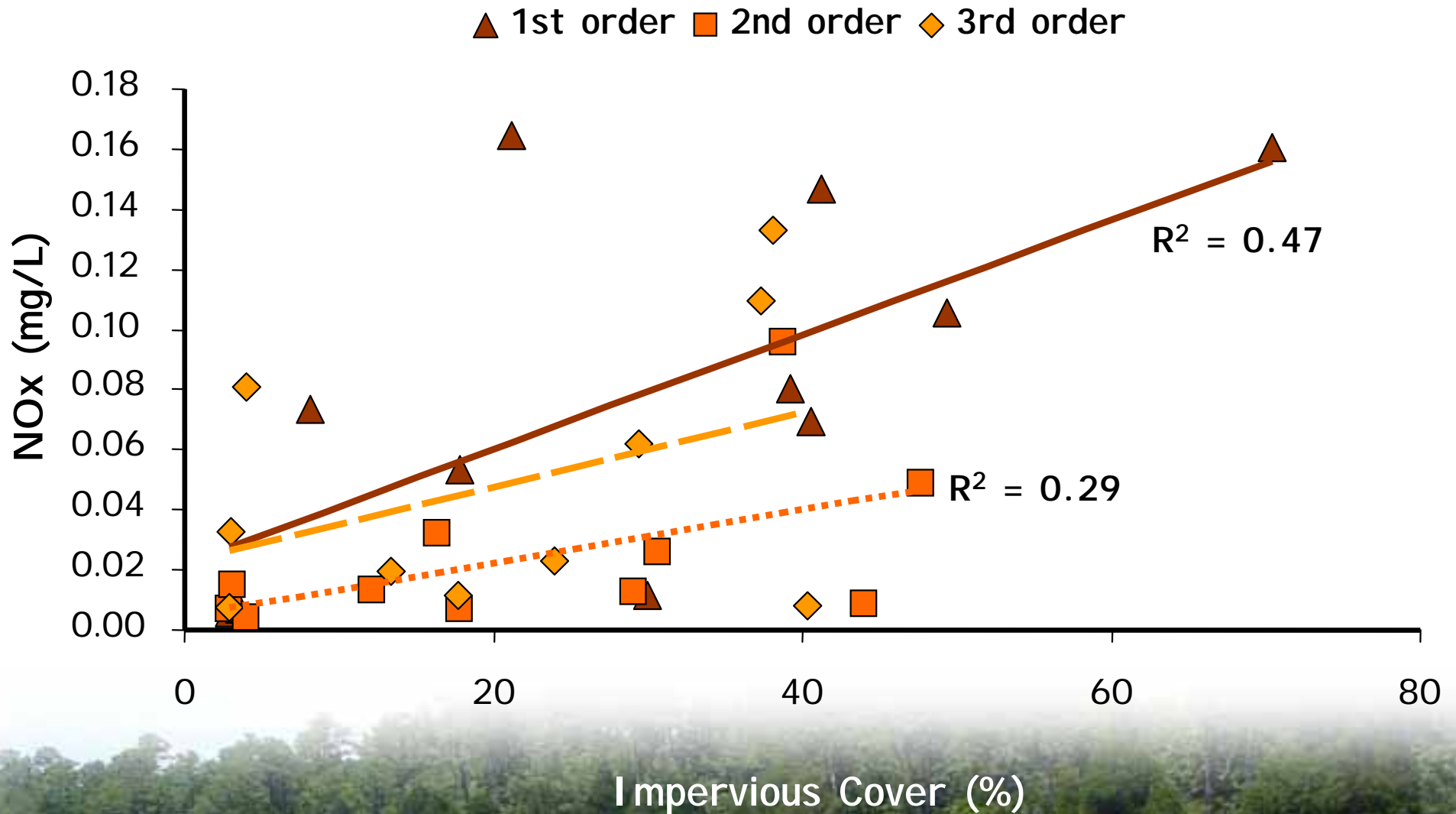
Amount and Rate of Runoff



Watershed Runoff (2-year 24-hour storm -- 4.5-inch rainfall)

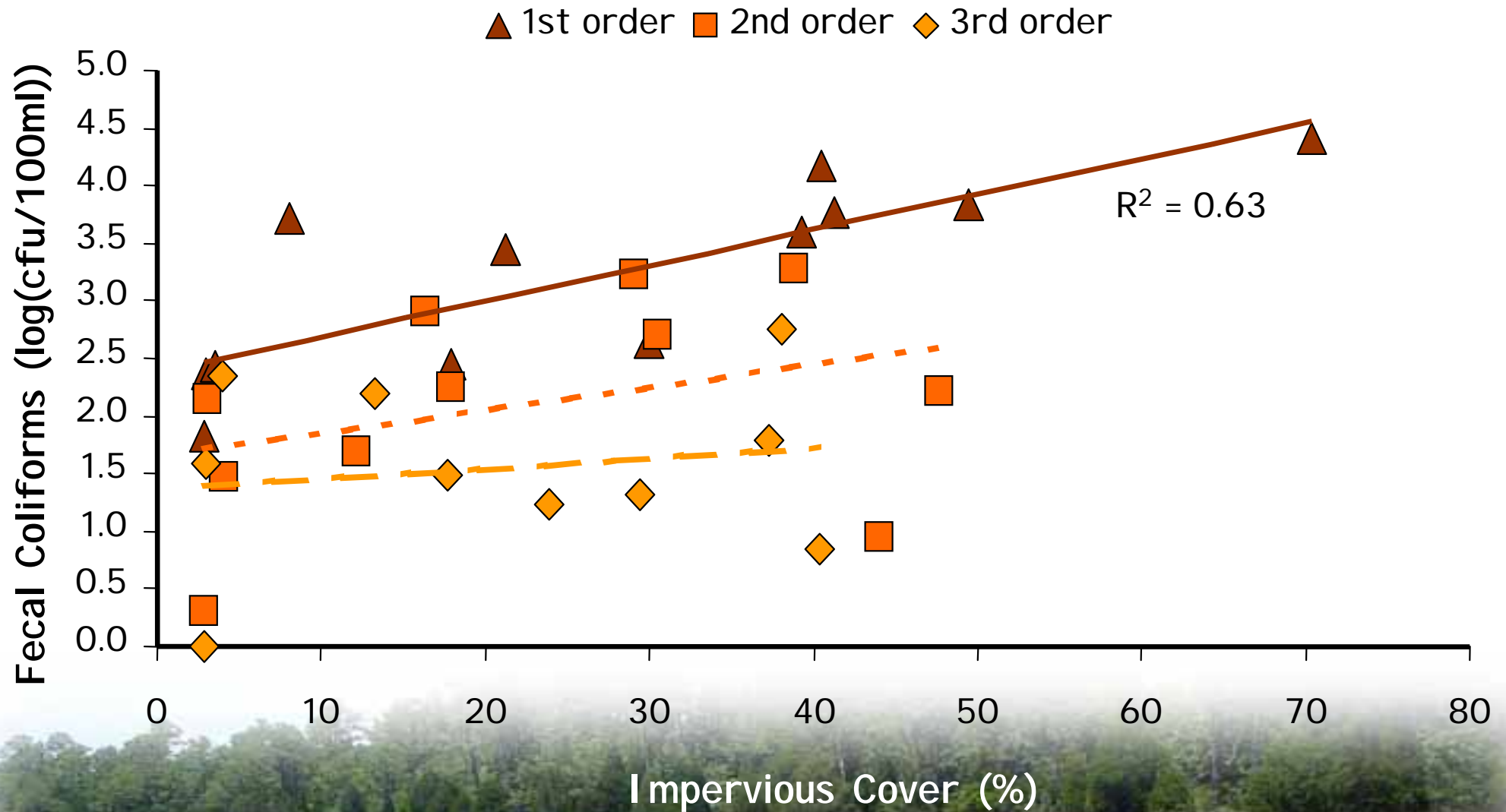


Nutrients vs Impervious Cover

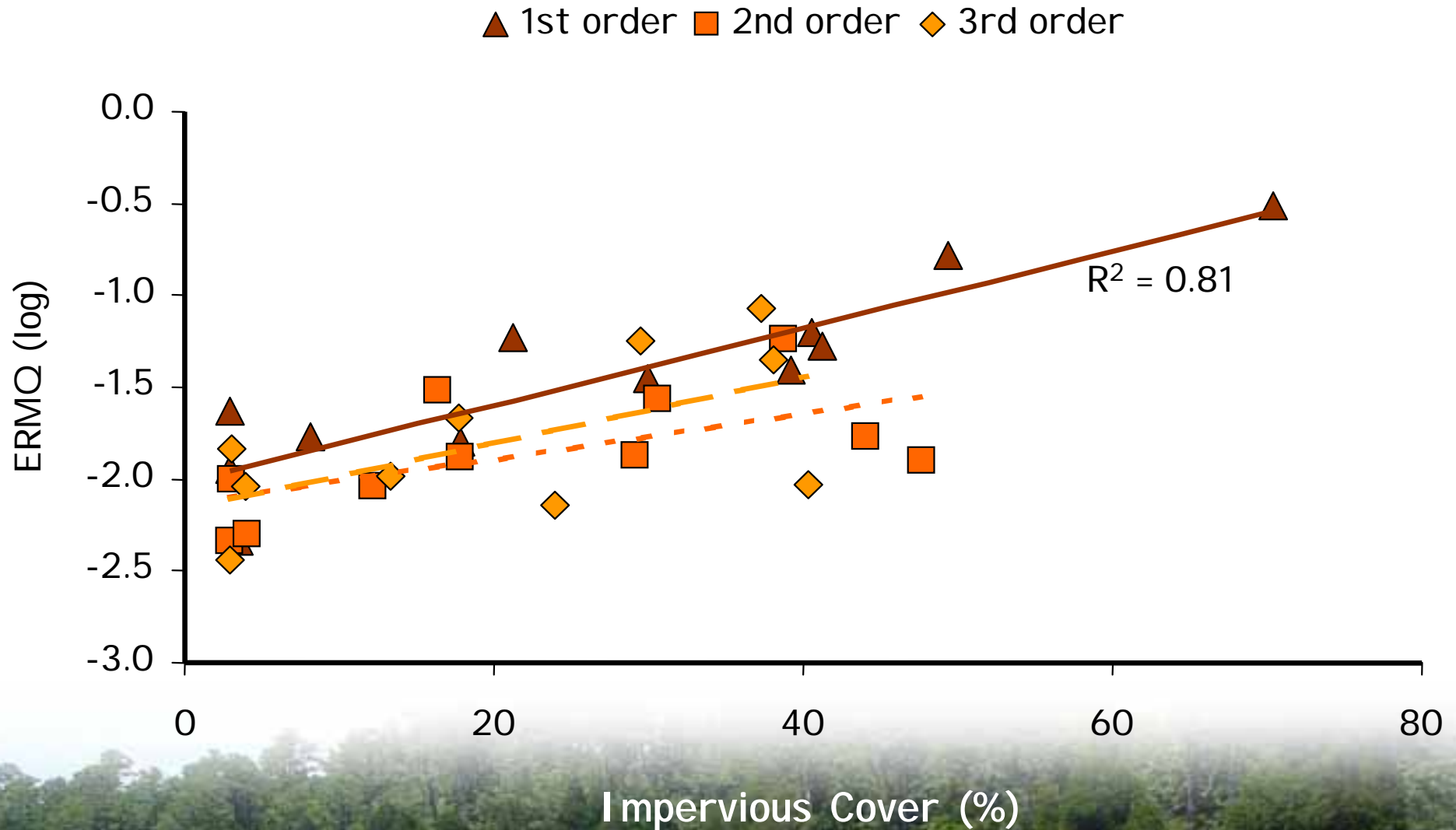




Fecal Coliform vs Impervious Cover

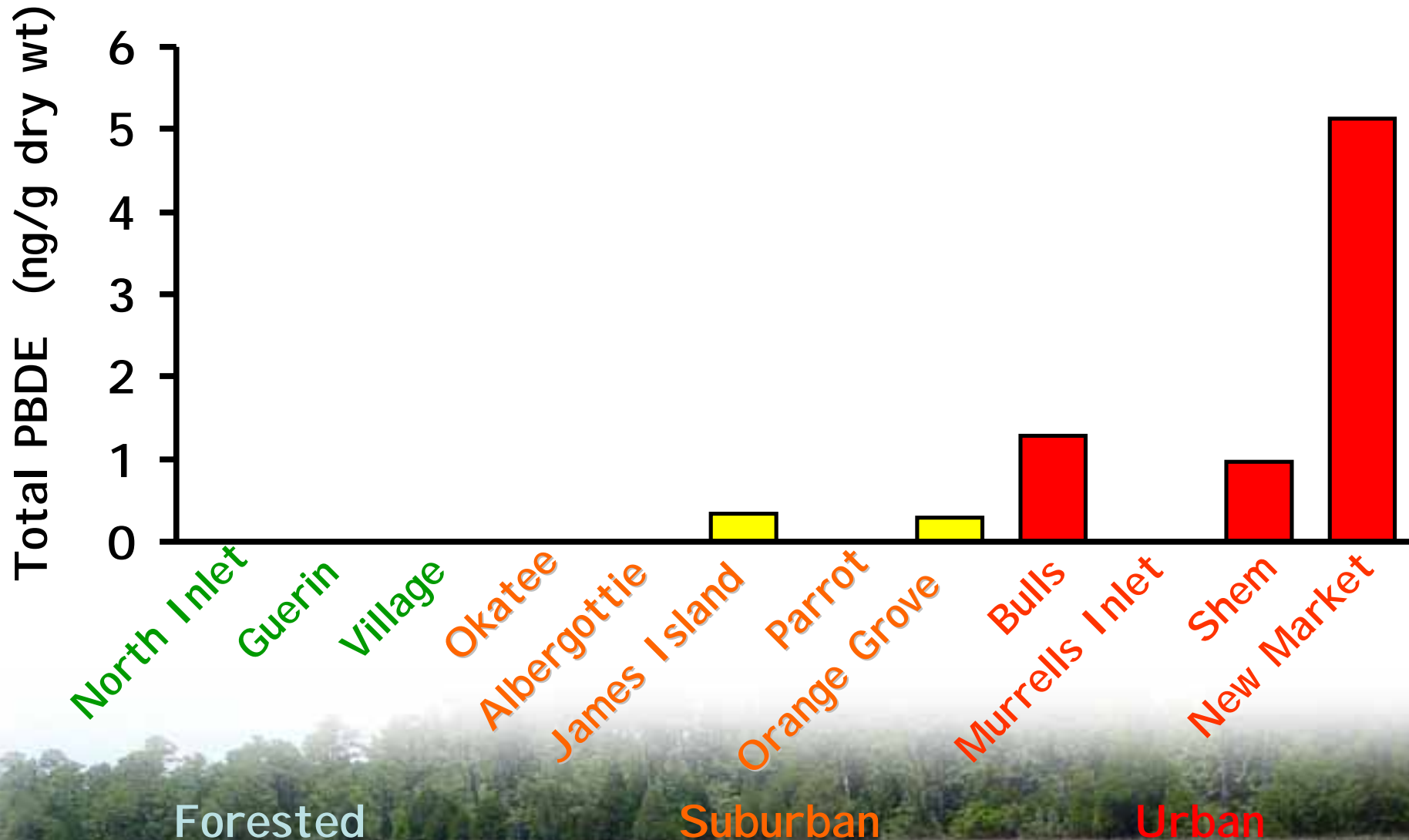


Chemical Contamination vs Impervious Cover



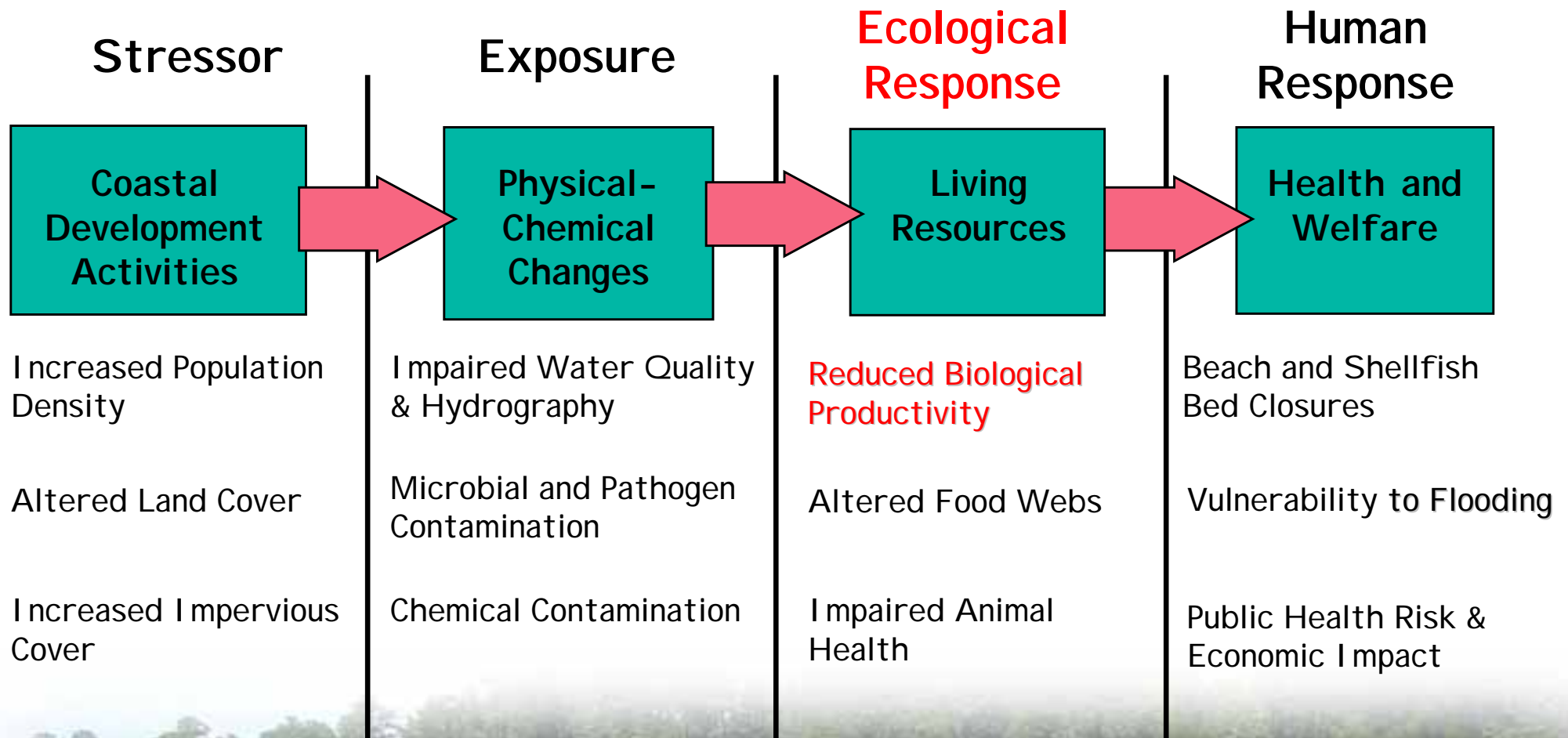


Flame Retardant Contamination



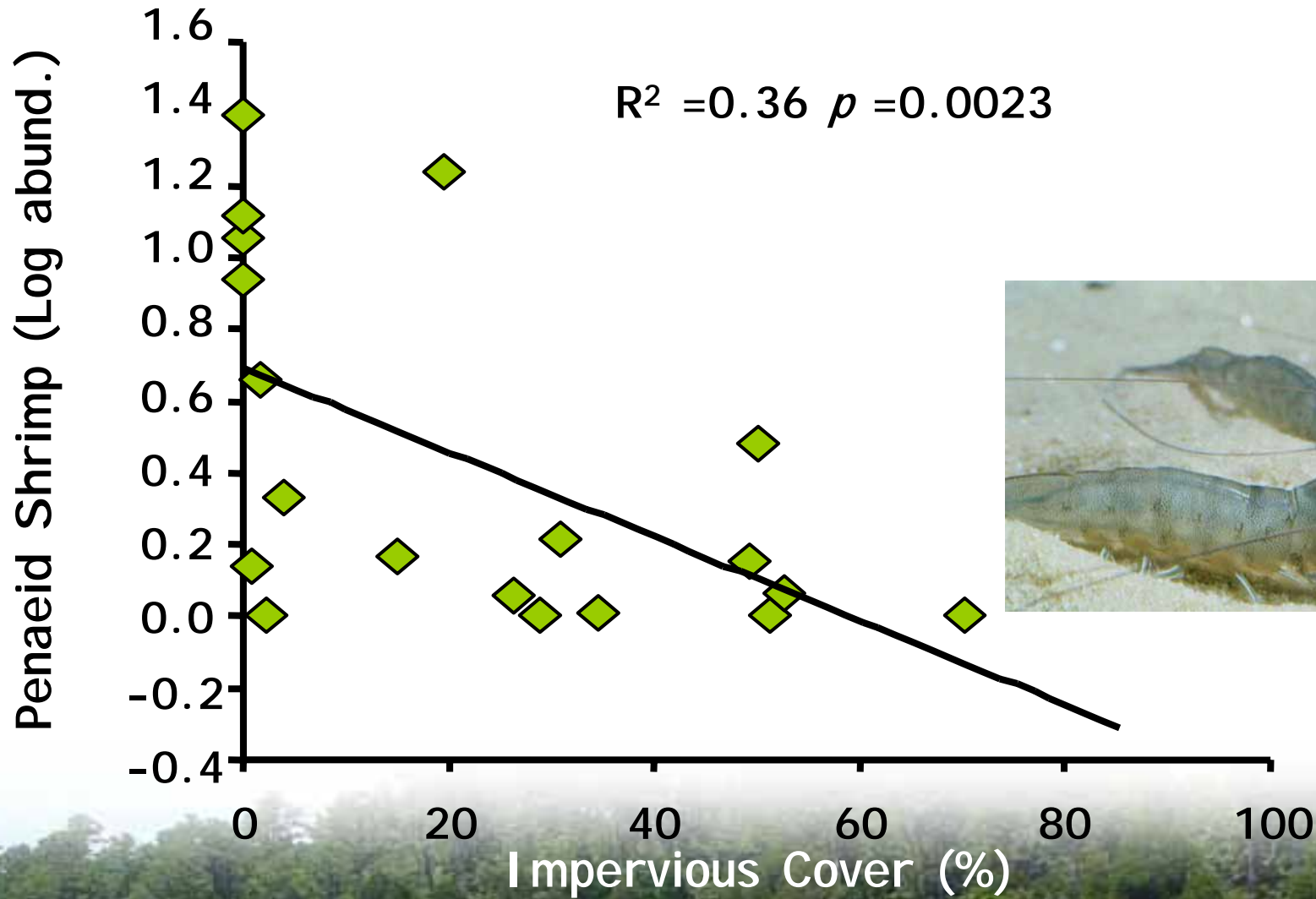
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Conceptual Model of Creek Watershed Linkages

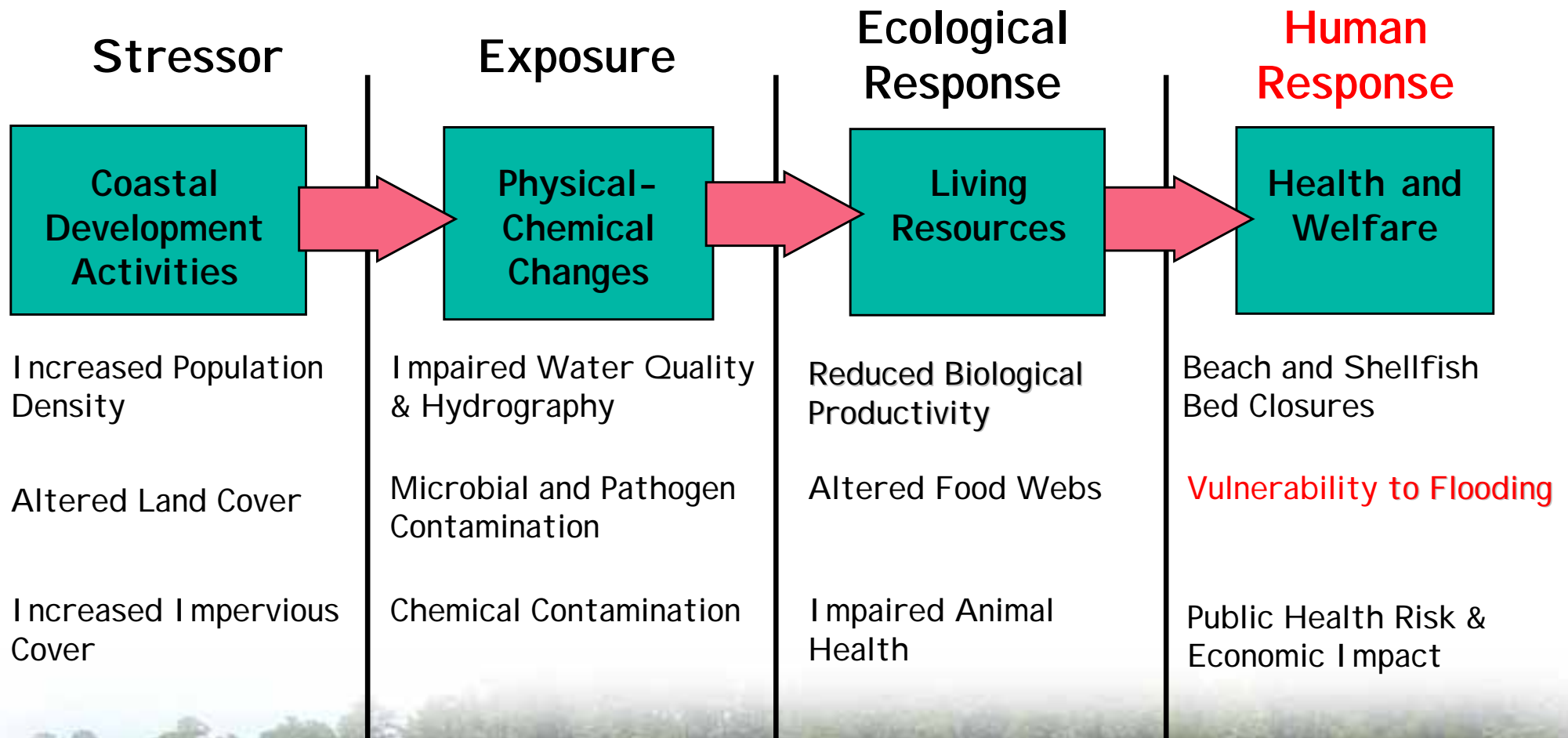




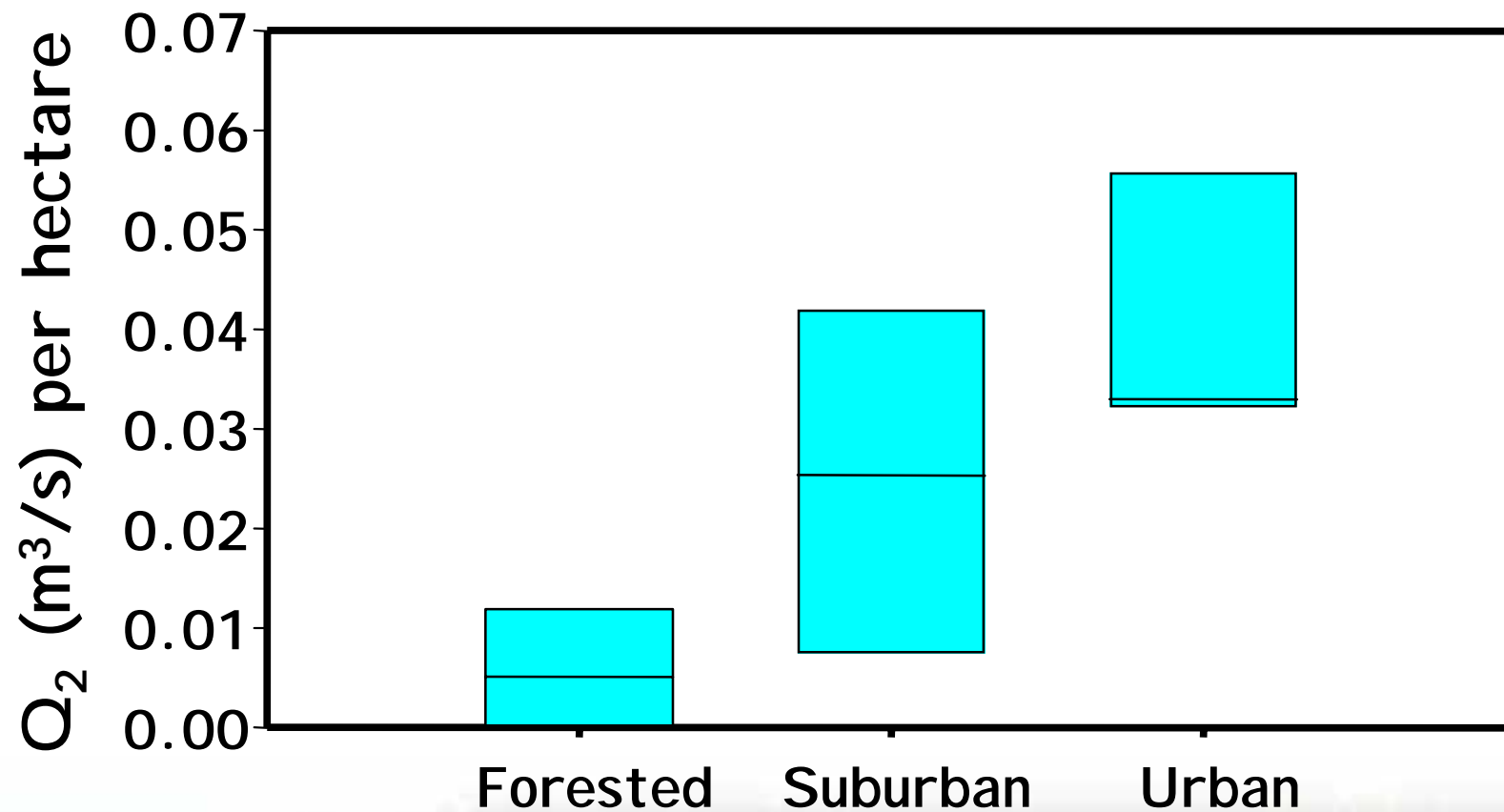
Ecological Response - Penaeid Shrimp



Conceptual Model of Creek Watershed Linkages



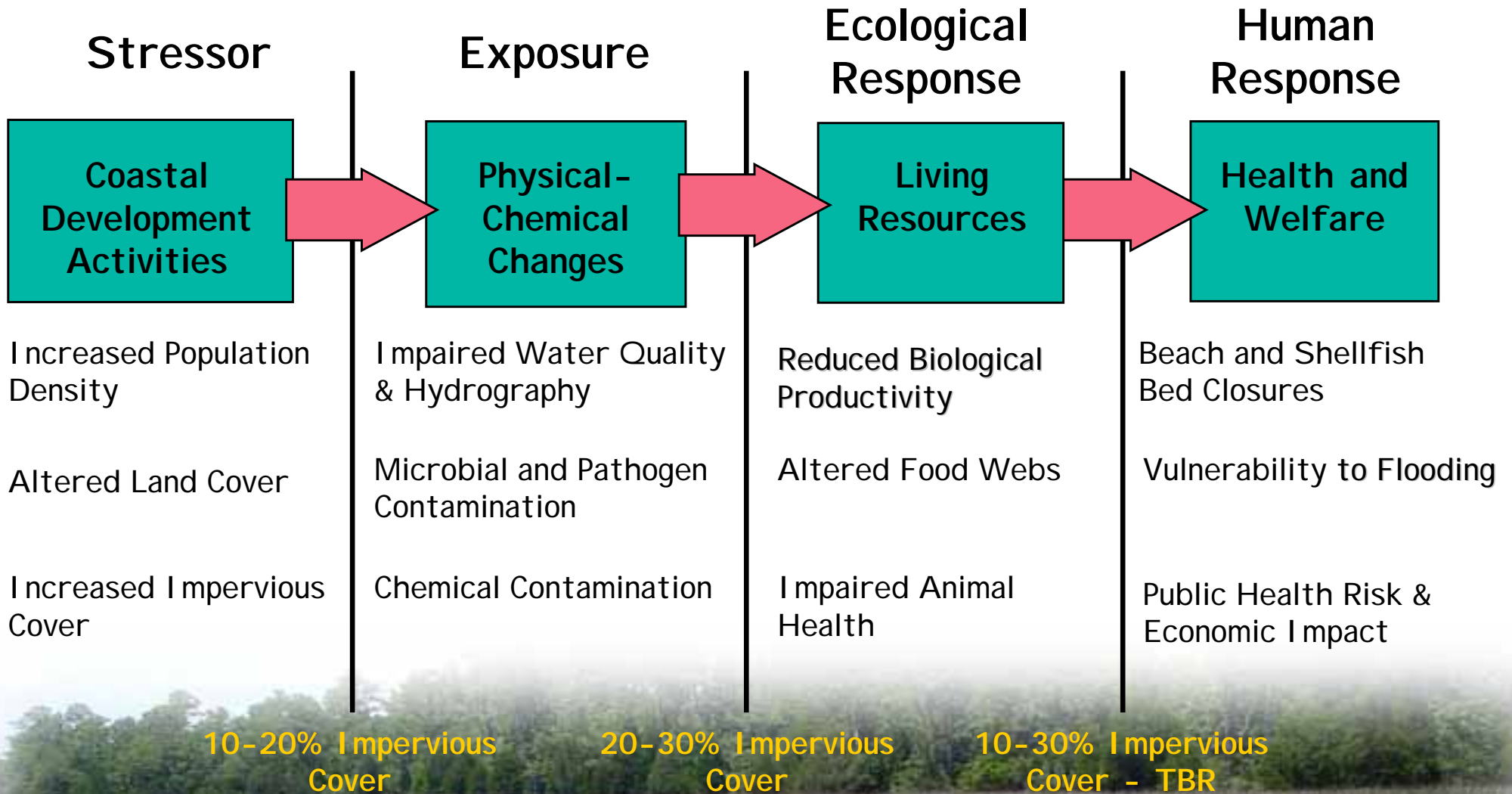
Predicted two year peak flow based on watershed properties



Vulnerability to Flooding



Conceptual Model of Creek Watershed Linkages



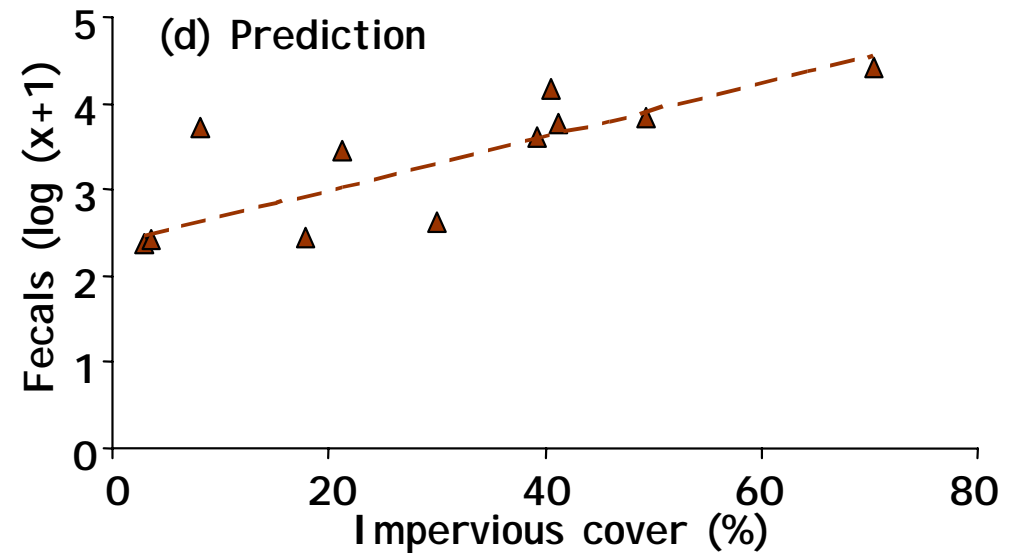
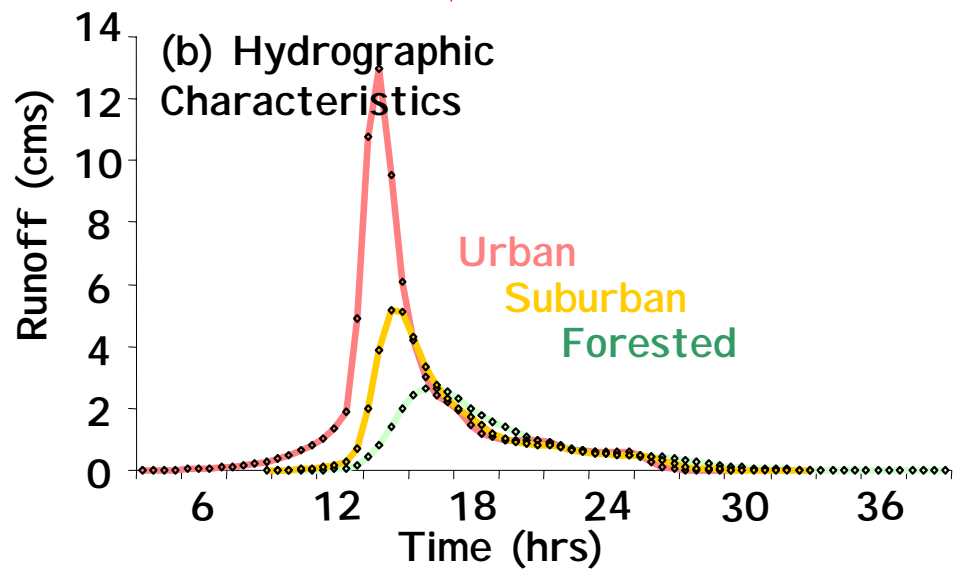
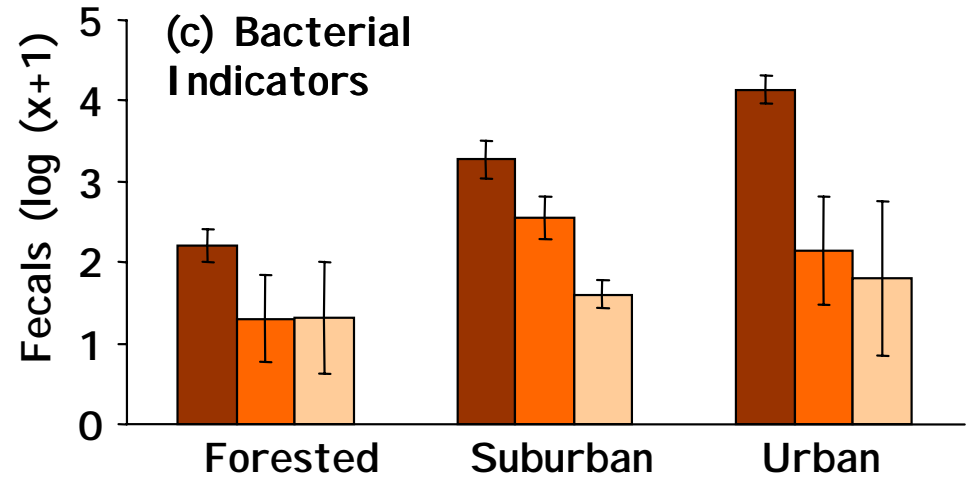
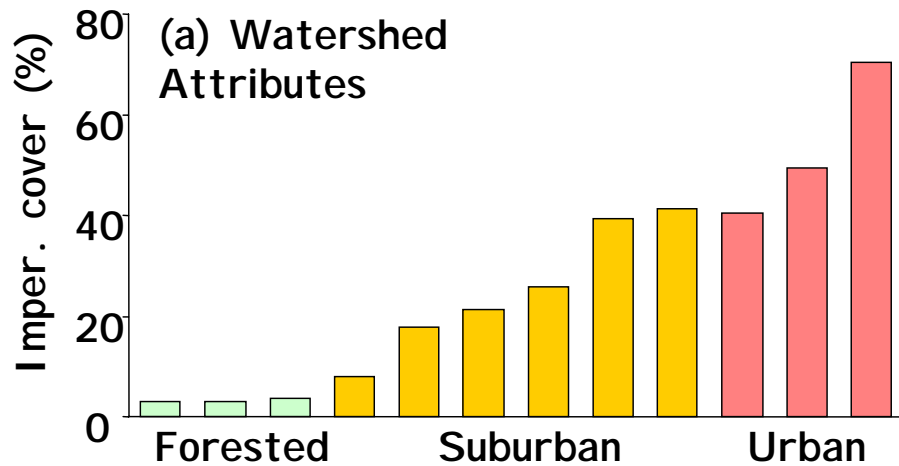


Next Steps

- Develop potential to forecast or predict potential impacts from various levels of development
- Expand results to SE region and other areas
 - Currently testing in GA and NC with NERRs as regional references
- Continue to refine the model and add additional information
- Sentinel habitats for evaluating coastal development



Forecasting - Next Step





Characteristics of Sentinel Habitats

- Important structural components (e.g., habitat builders).
- Key functional roles (e.g., nursery habitat, materials cycling).
- High exposure and sensitive to stressors of interest
- Response patterns to stressors understood (i.e., baseline information exists)



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

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Tidal Creeks as Sentinel Habitats

Tidal creeks are
the zone of first impact—
the proverbial
“canary in the mine”—
for coastal ecosystems.

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