

Tidal creeks as sentinel habitats: a conceptual model for describing the effects of land use change on coastal ecosystems

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***SC Sea Grant Consortium**

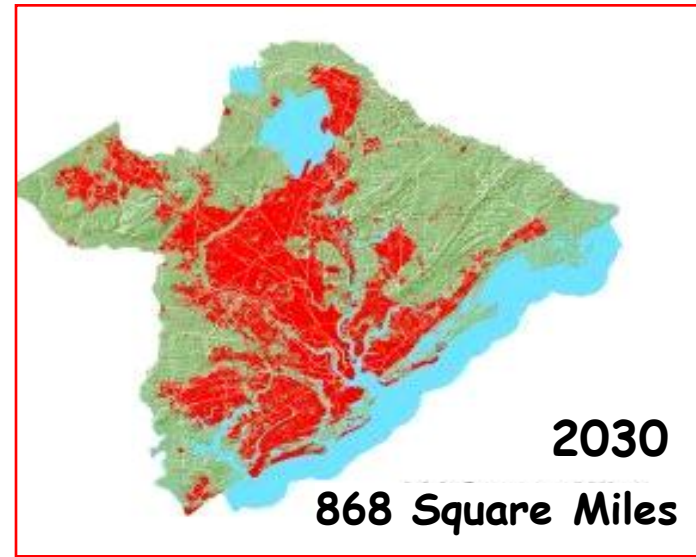
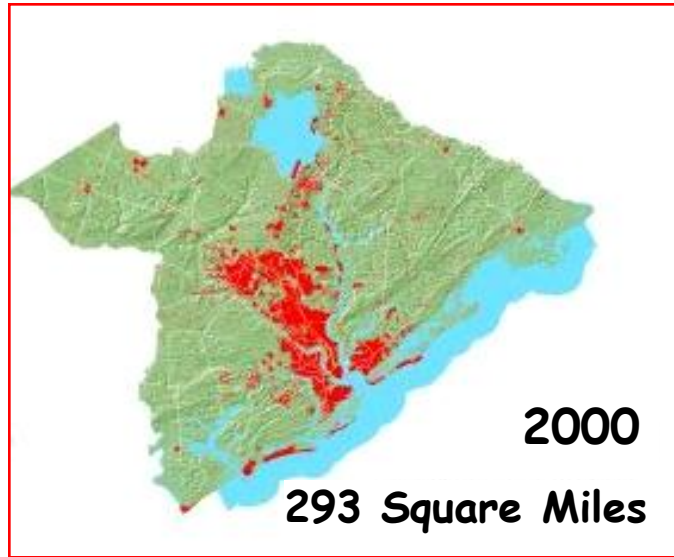


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Problem

Area of urban land is projected to triple between 2000 and 2030

Charleston SC area



Urban Non-urban Water

Allen and Lu (2003)

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Question

Primary Research Question

- How do coastal development practices impact the ecological character of coastal habitats?
- In the southeastern US, we ask how coastal development practices impact **tidal creeks**. Why?



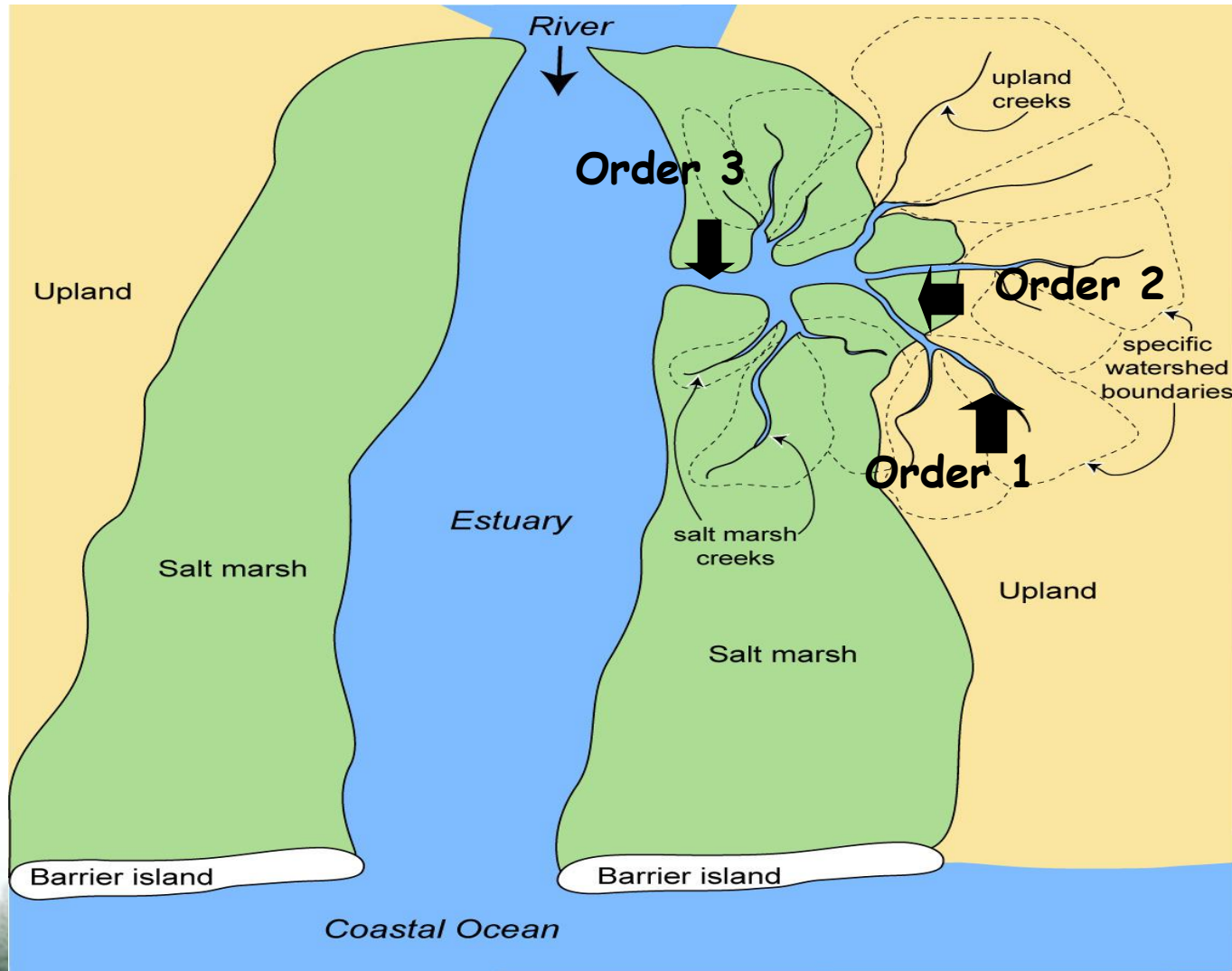
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Tidal creeks have ecological and economic value

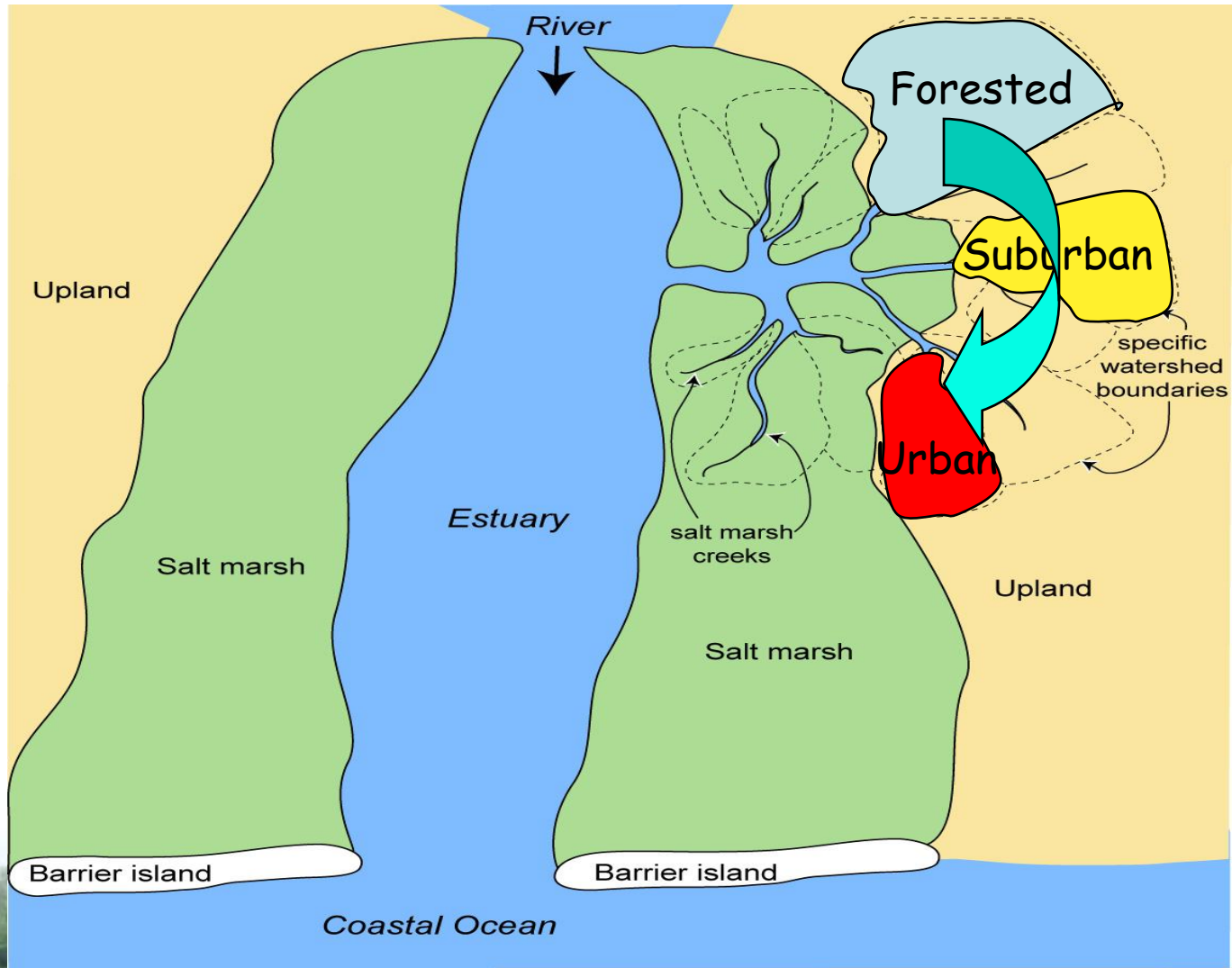
- Refuge and nursery habitat for fisheries
- Primary hydrologic link to uplands
- Preferred sites for development



Tidal creek networks



Development of tidal creek watersheds



Coastal development and impervious surface

Impervious cover can be used to represent the degree of development

Forested



Suburban



Urban



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Conceptual model

People are moving to the coasts! People=pavement?

Stressor

Coastal
Development
Activities

Increased Population
Density

Altered Land
Cover

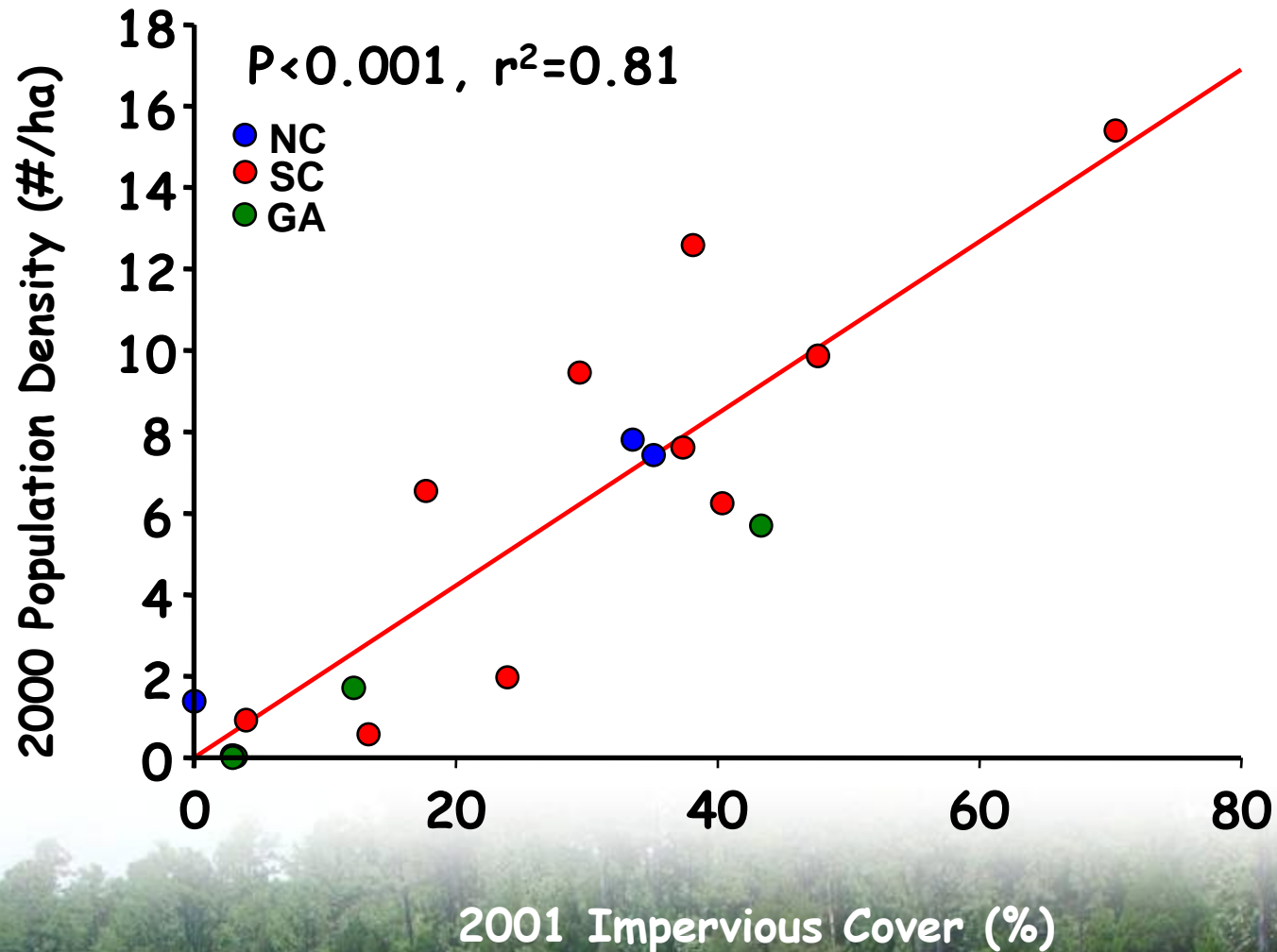
Increased Impervious
Cover



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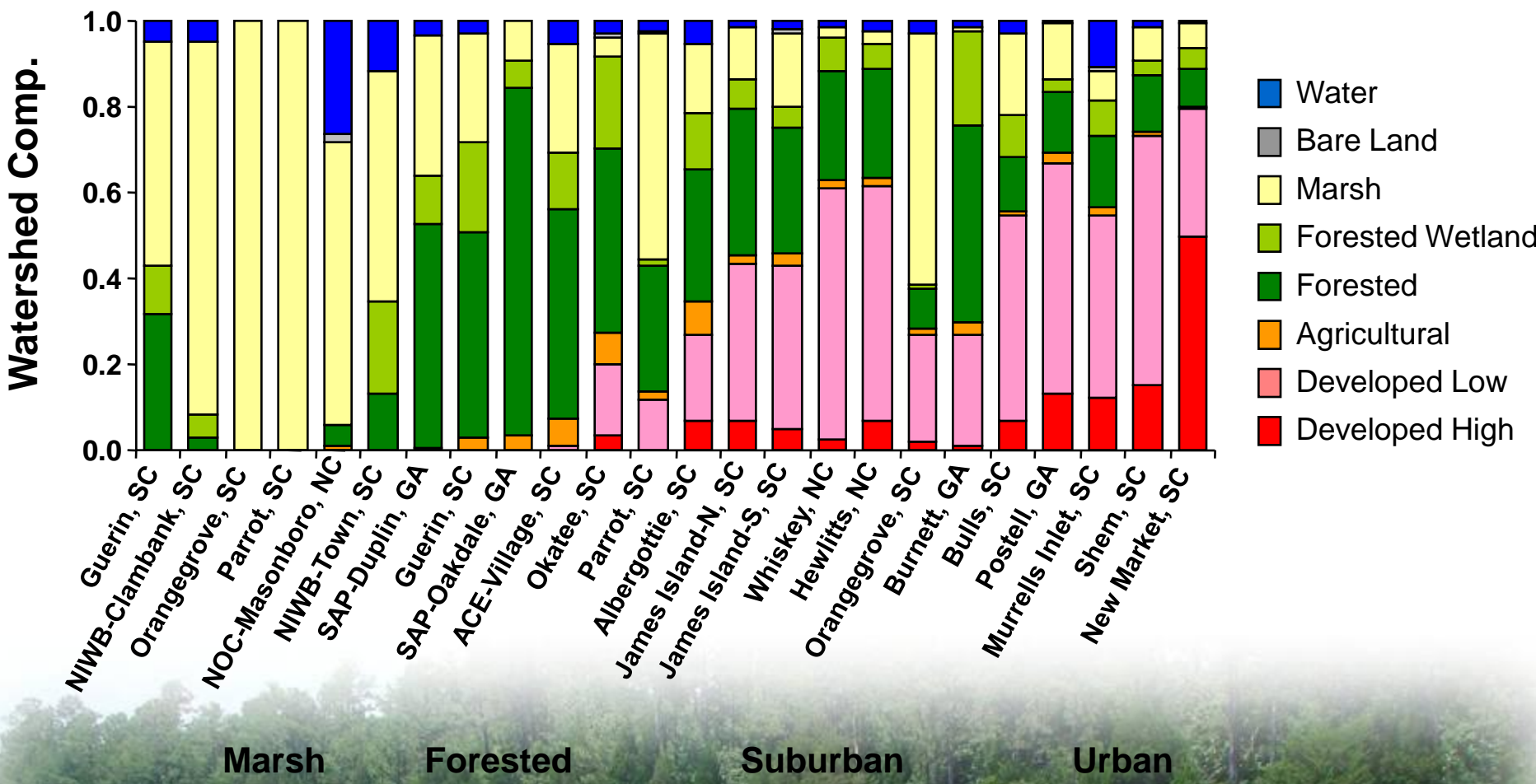
Understanding the stressor

Population increase relates to development level



Understanding the stressor

Growth of urban areas and loss of forests in SE watersheds



Marsh

Forested

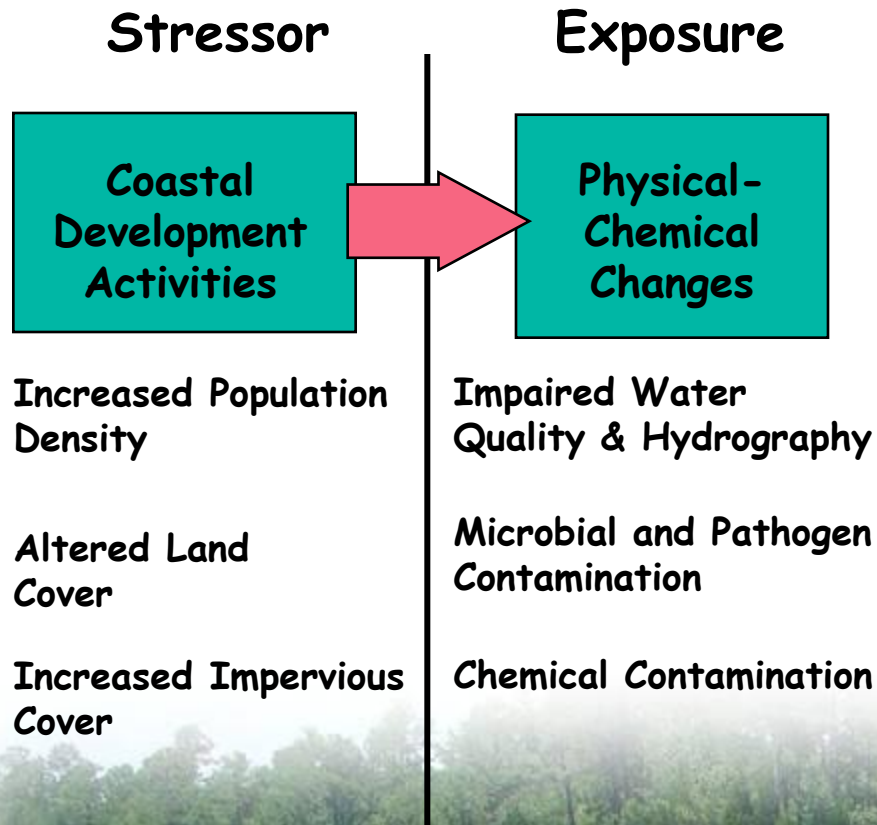
Suburban

Urban

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Conceptual model

Coastal development impacts the creek environment



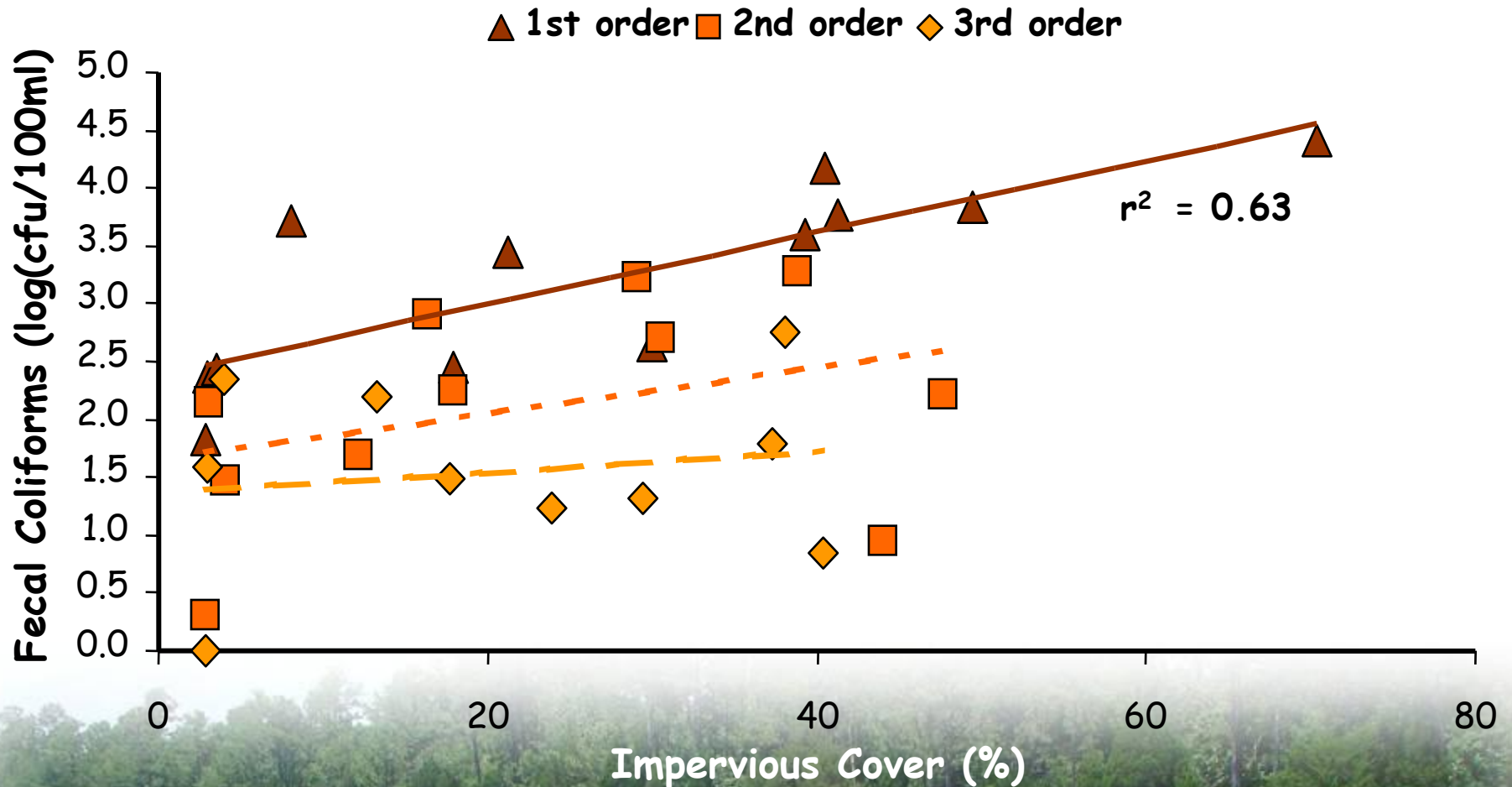
Physical-chemical changes

Nutrients increase with development



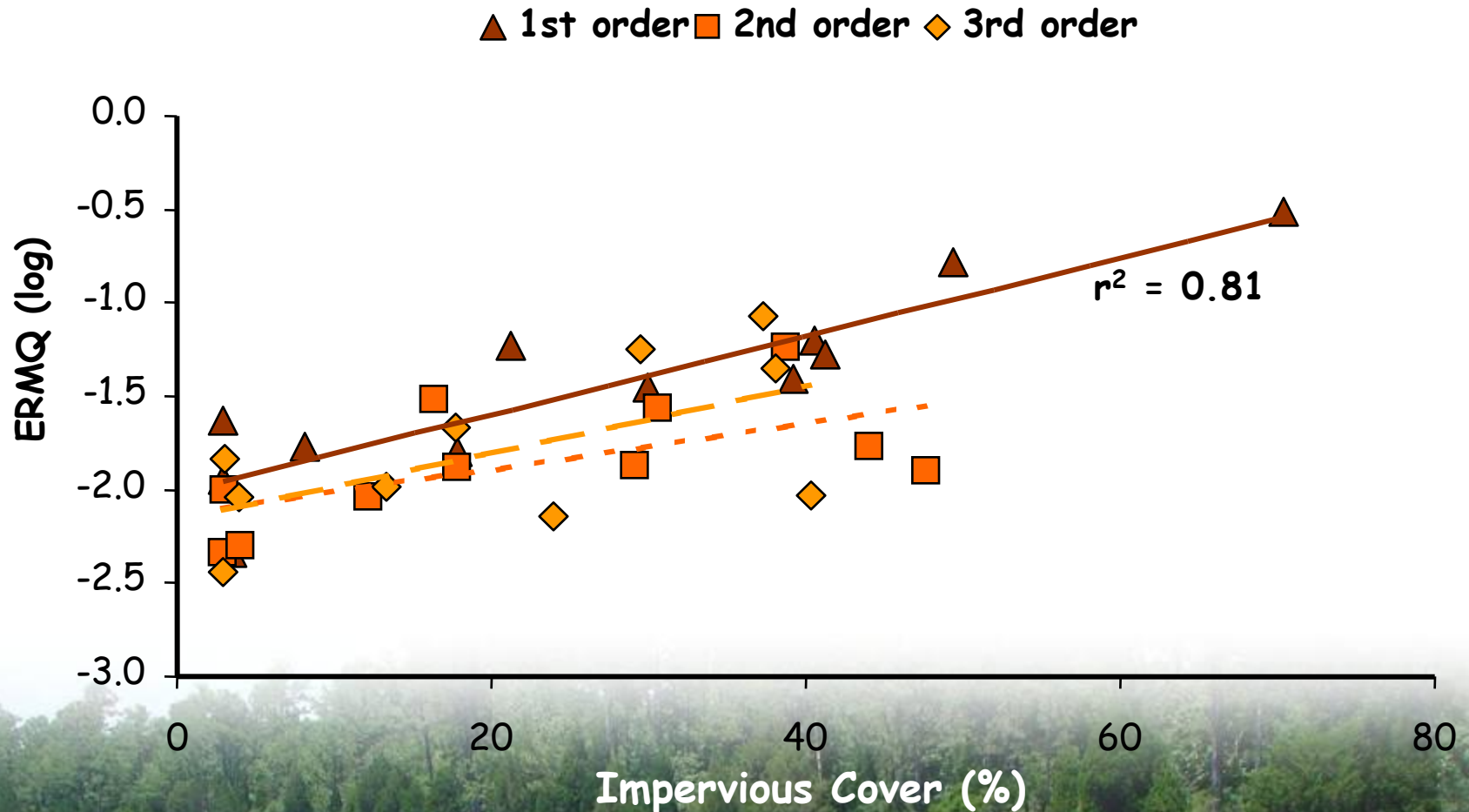
Physical-chemical changes

Microbial indicators increase with development



Physical-chemical changes

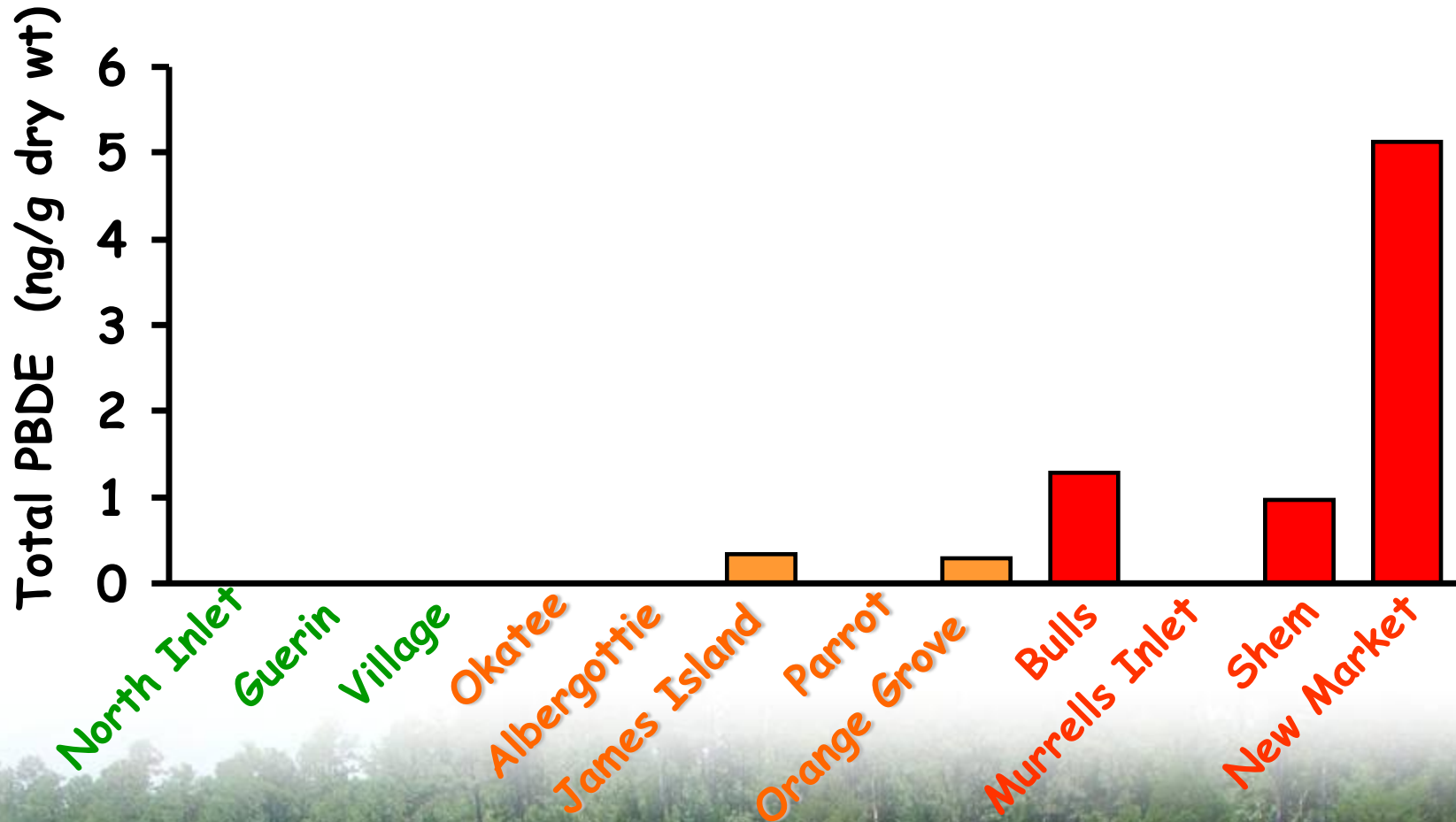
Chemical contamination increases with development



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Physical-chemical changes

Flame retardant contamination is found in developed creeks



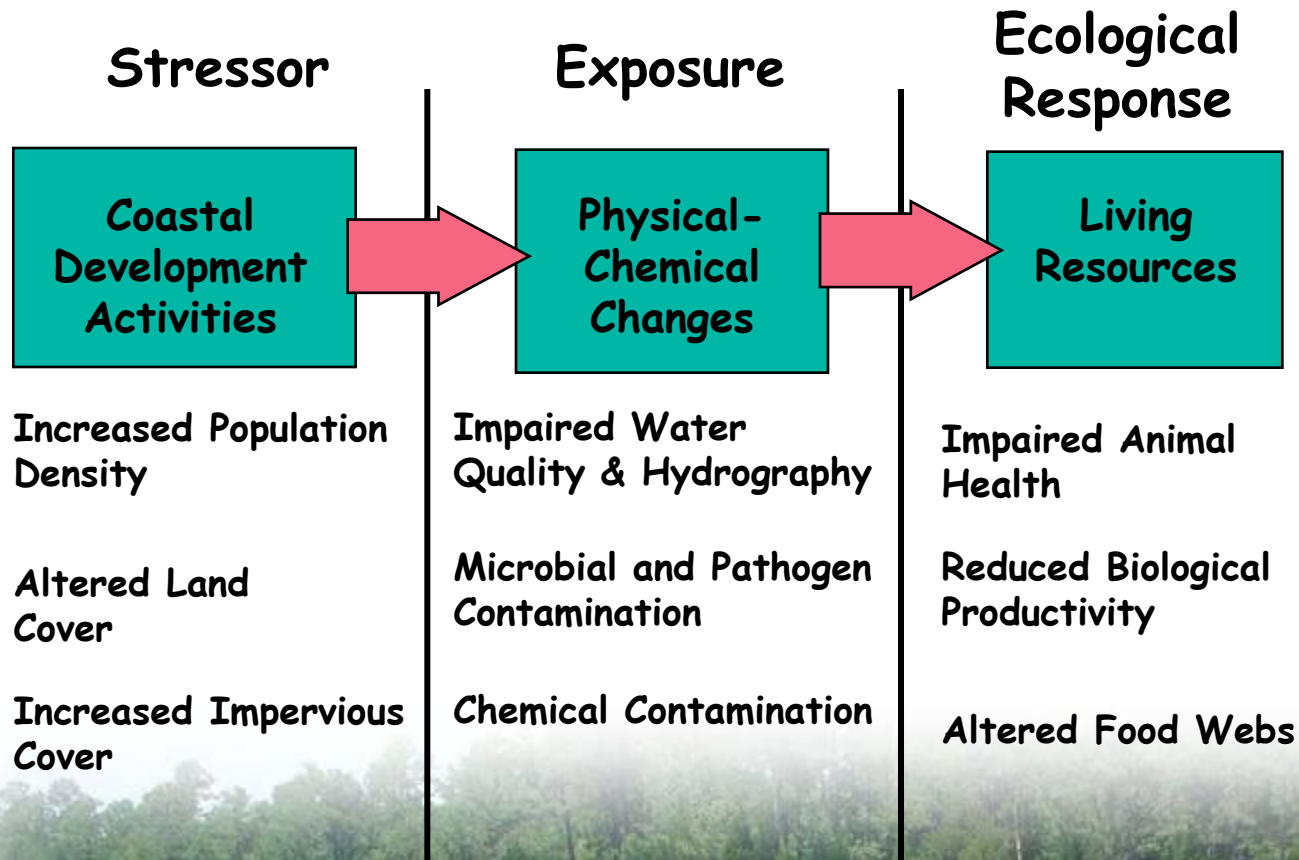
Forested

Suburban

Urban

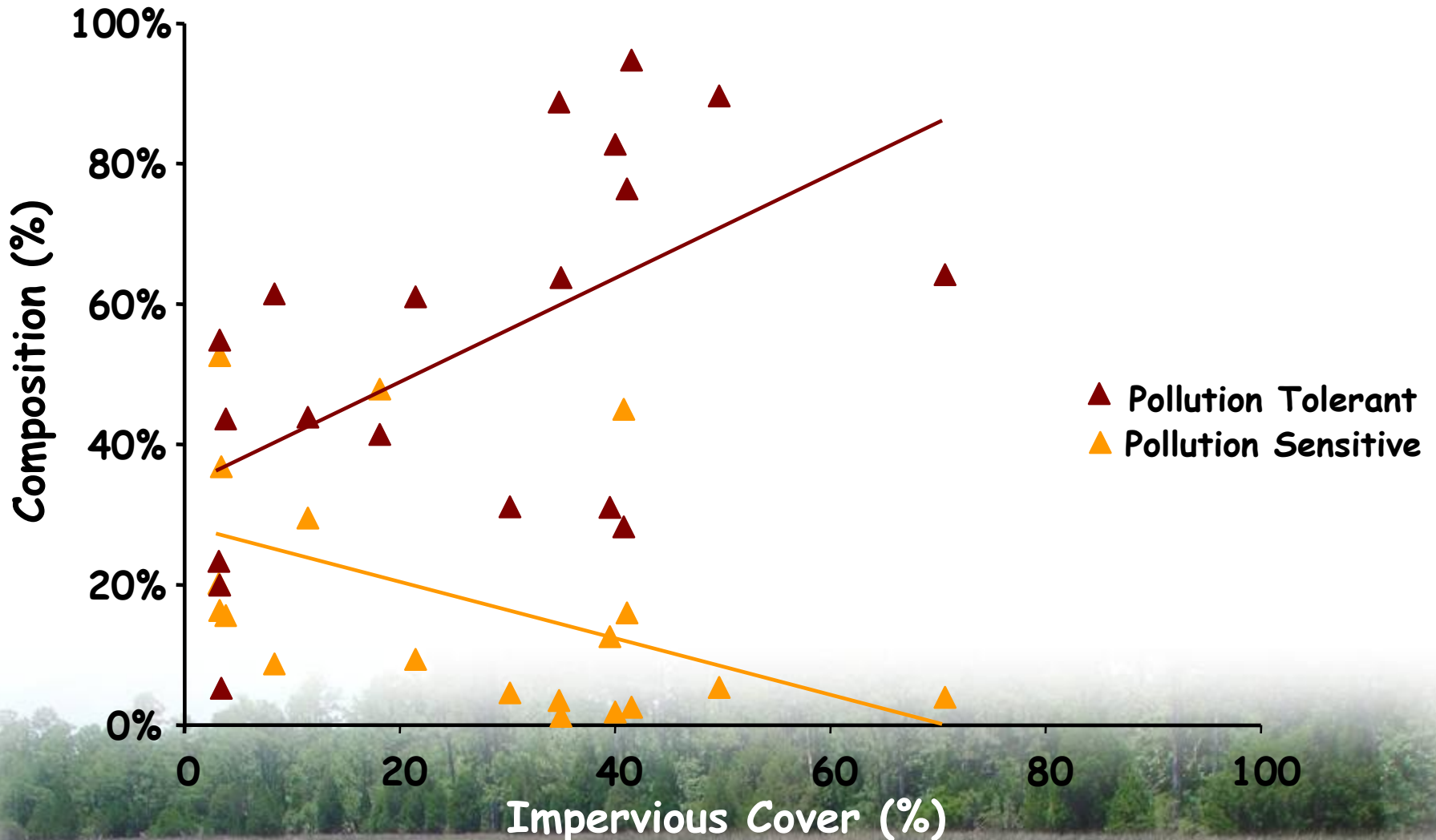
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Coastal development impacts creek ecology



Ecological response

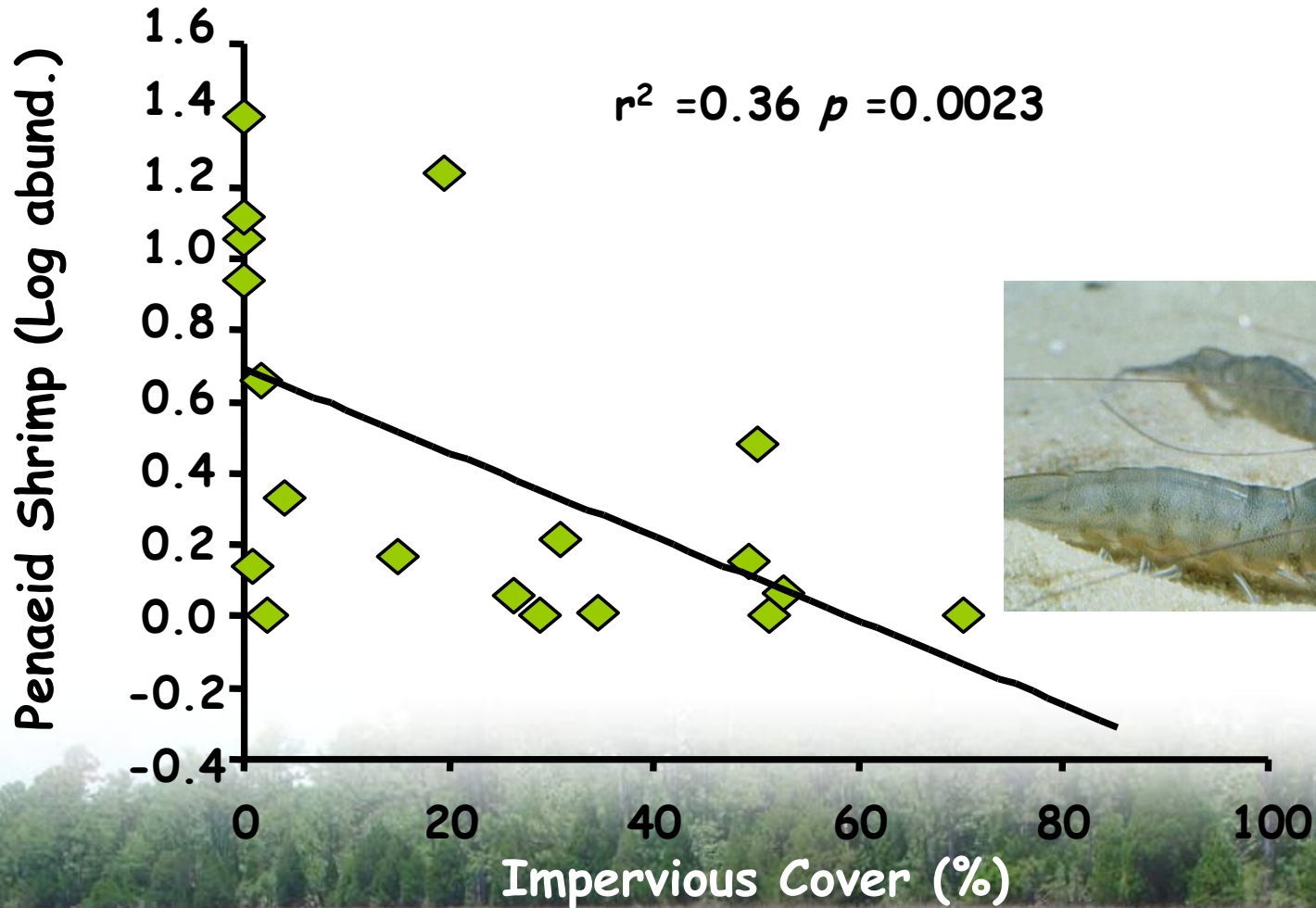
Headwater benthic assemblage changes with development



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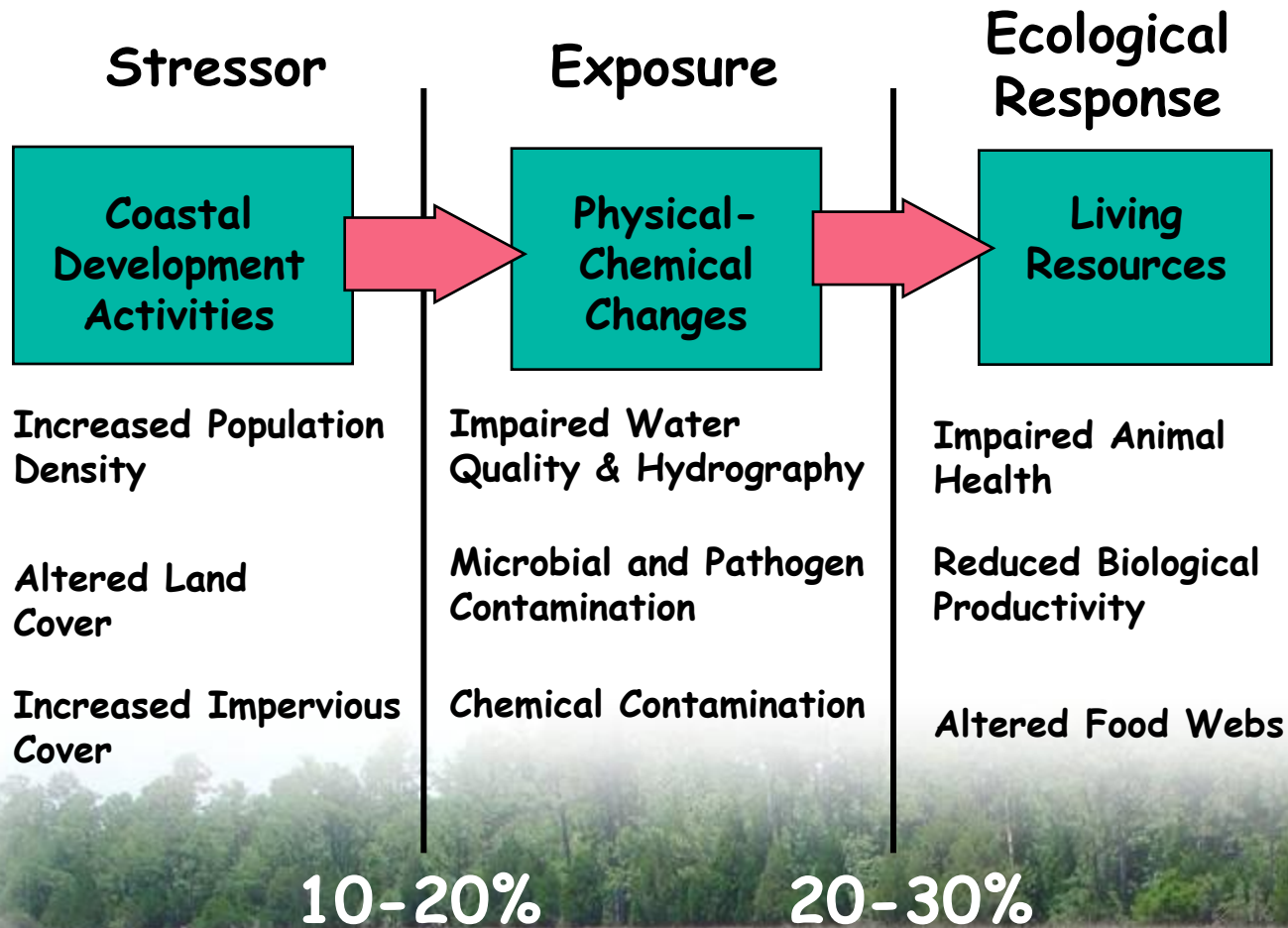
Ecological response

Shrimp in headwaters decrease with development



Conceptual model

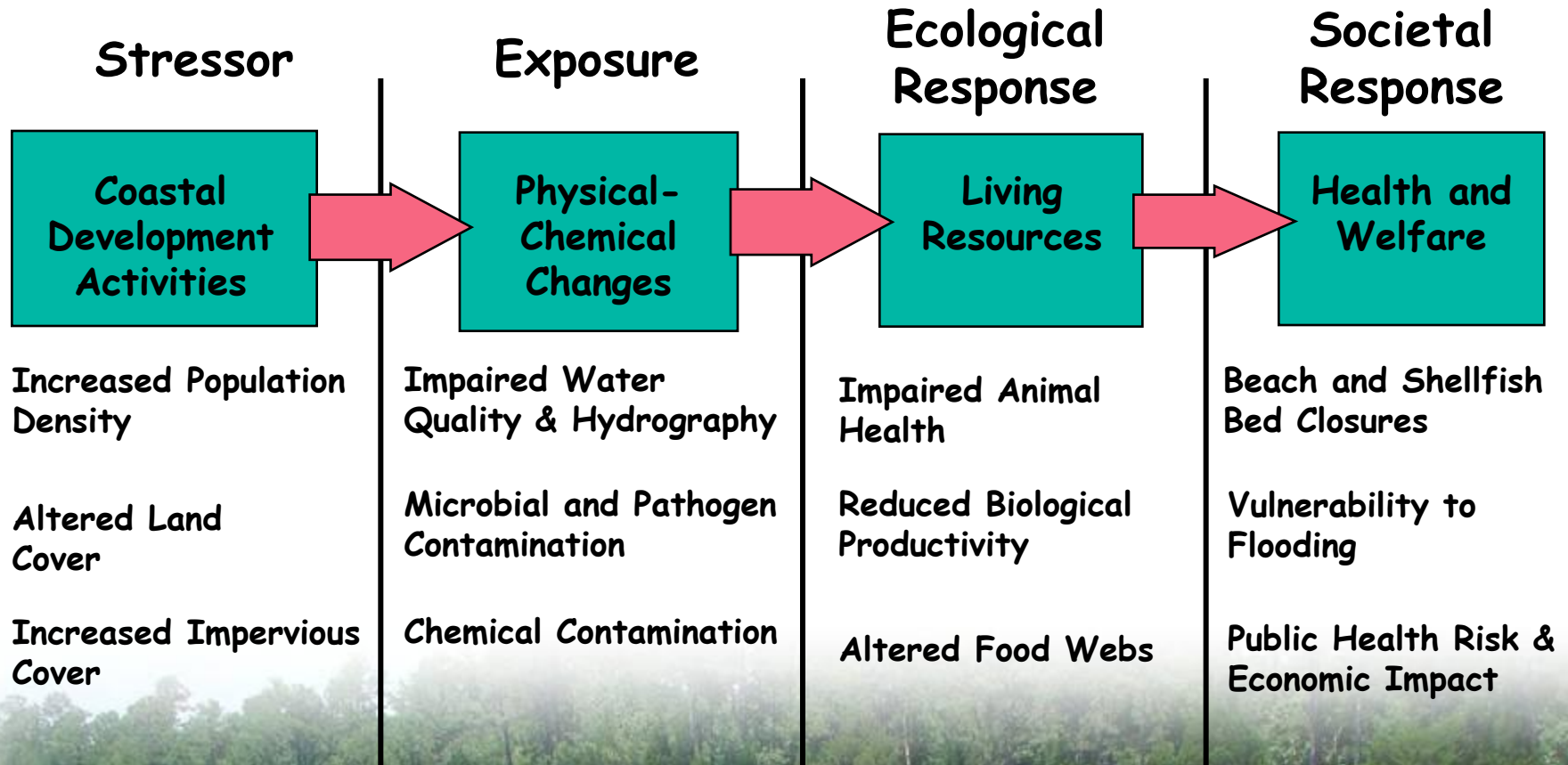
Research has identified impervious cover cutpoints



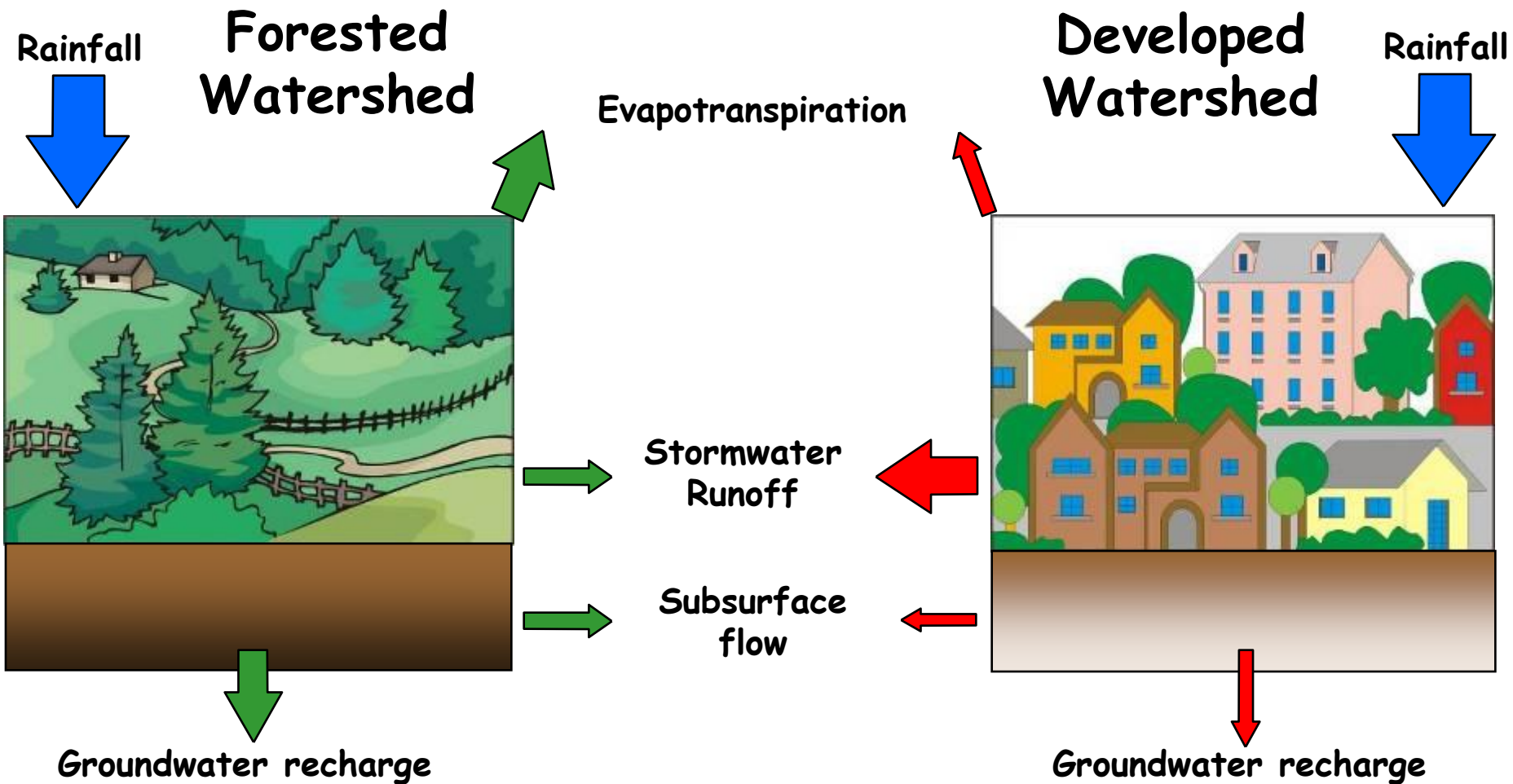
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Conceptual model

What about people?



Development alters the water distribution of watersheds



Stormwater runoff increases with development

Photos
Post & Courier
Charleston SC
13 June 2007



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Other impacts on people and their lives?

Preliminary attempt at quantifying quality

- Attempt to fold together environmental and ecological aspects of our understanding of coastal development on creeks
- Tie them to what people perceive as important elements of a place—what makes a place have a high quality?

Can we eat the seafood? Can we swim in the water?

Can we enjoy the aesthetics? Are we safe? Is it sustainable?



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Readily Available Data

National Land Cover Database

- ❑ Tree Canopy % = TREE_CAN
- ❑ Impervious cover % = IC

Tidal Creeks Research 12 S.C. Creeks

- ❑ ERMQ = ERMQ
- ❑ Precipitation/Runoff ratio = PRECIP_R

U.S. Census 2000

- ❑ Population density per acrea for watershed = POP_DEN
- ❑ Parcel Density per acre for watershed = PARC_DEN
- ❑ Median Parcel Value = MEDIAN_P
- ❑ Log10 median income = l_m_in
- ❑ Log10 median parcel value = l_m_par
- ❑ Median Income = MEDIAN_I
- ❑ Less than 25K(%) = LT_25K
- ❑ Greater than or equal to 25K(%) = GT_EQ_25

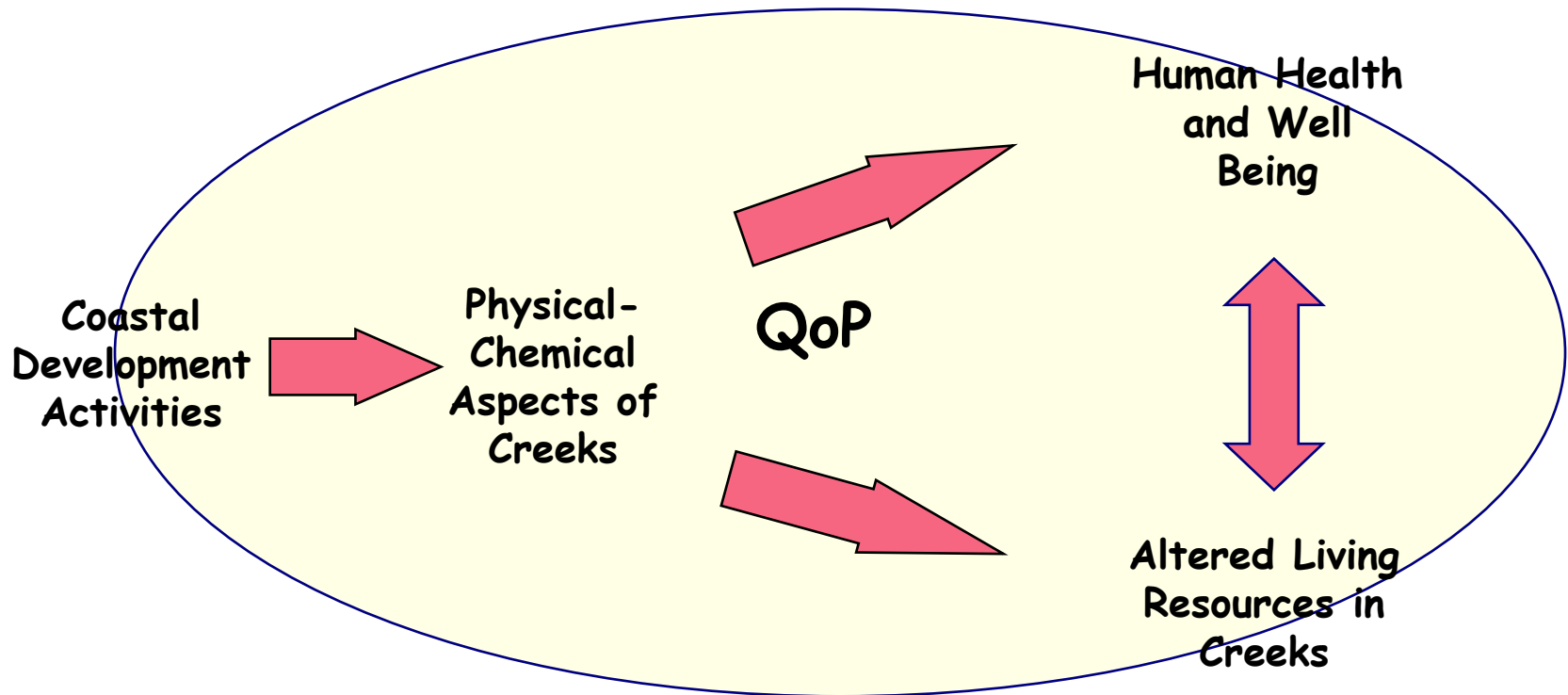
Quality of Place—Preliminary Results

Creek	Quality of Place ranking	Creek Type
Okatie	0.5822	suburban
Guerin	0.5819	forested
Village	0.5473	forested
Albergottie	0.4537	suburban
Parrot	0.4021	suburban
Orange Gr	0.1688	suburban
North Inl	-0.0462	forested
Bull	-0.0930	urban
James Isl	-0.1736	suburban
Shem	-0.3410	urban
Murrells	-0.4025	urban
New Market	-1.6797	urban

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Conceptual model

Quality of Place may help integrate across model boxes



Conclusions

- In southeastern US, tidal creeks are an important habitat
 - refuge and nursery
 - pollution & materials processing
 - part of the unique character of this place
- Coastal development has a unmistakable and negative impact on the ecological character of these creeks.
- Conceptual model provides useful tool for understanding AND relating the relationship(s) between stressor(s) and impact(s).

Conclusions, cont.

- What about the impact on human health and welfare? Development may impact the ecological services provided by these habitats, diminishing sustainability.
- Results shown are place-specific, but the sentinel habitat approach used here can be generalized.
 - Conceptual approach can be moved to other coastal areas or inland.
- Provides a platform from which to integrate disparate information and inject it into the decision-making process

Thank you! Questions?



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Quality of Place

An ecological index may provide a measurement of
"Quality of Place"

An Index includes:

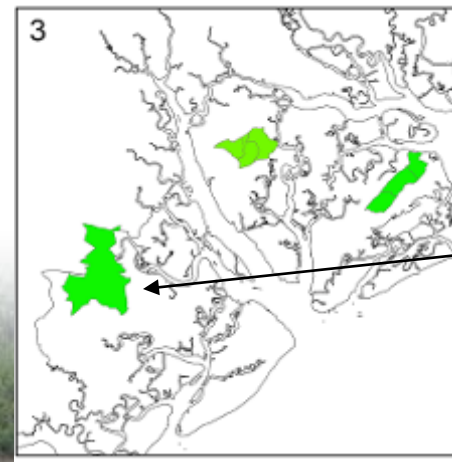
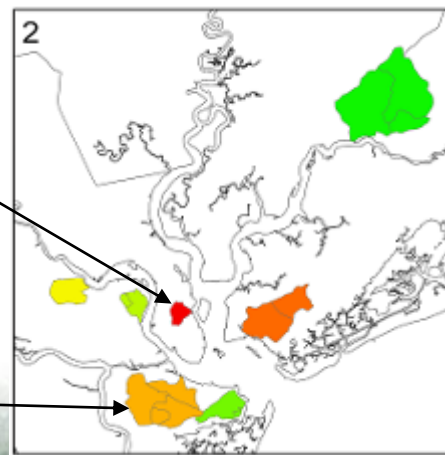
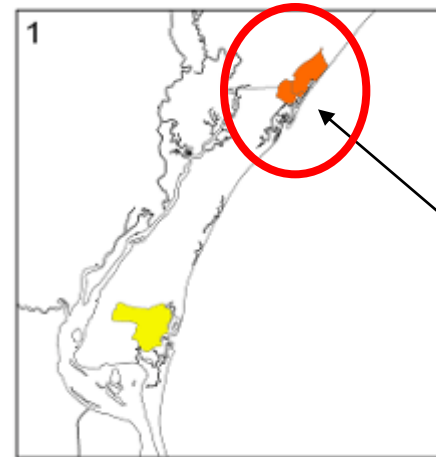
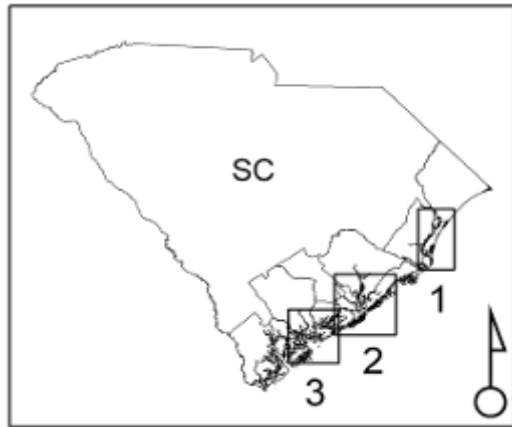
- Key indicators of health
- Sentinel habitats and organisms
- Flexibility to region, data, issues
- Useful for decision-makers to determine multiple effects brought about by changes in land use. Environmental status.
- Promotes sustainable economics



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Quality of Place

Index classifications suggest a reasonable beginning...



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