



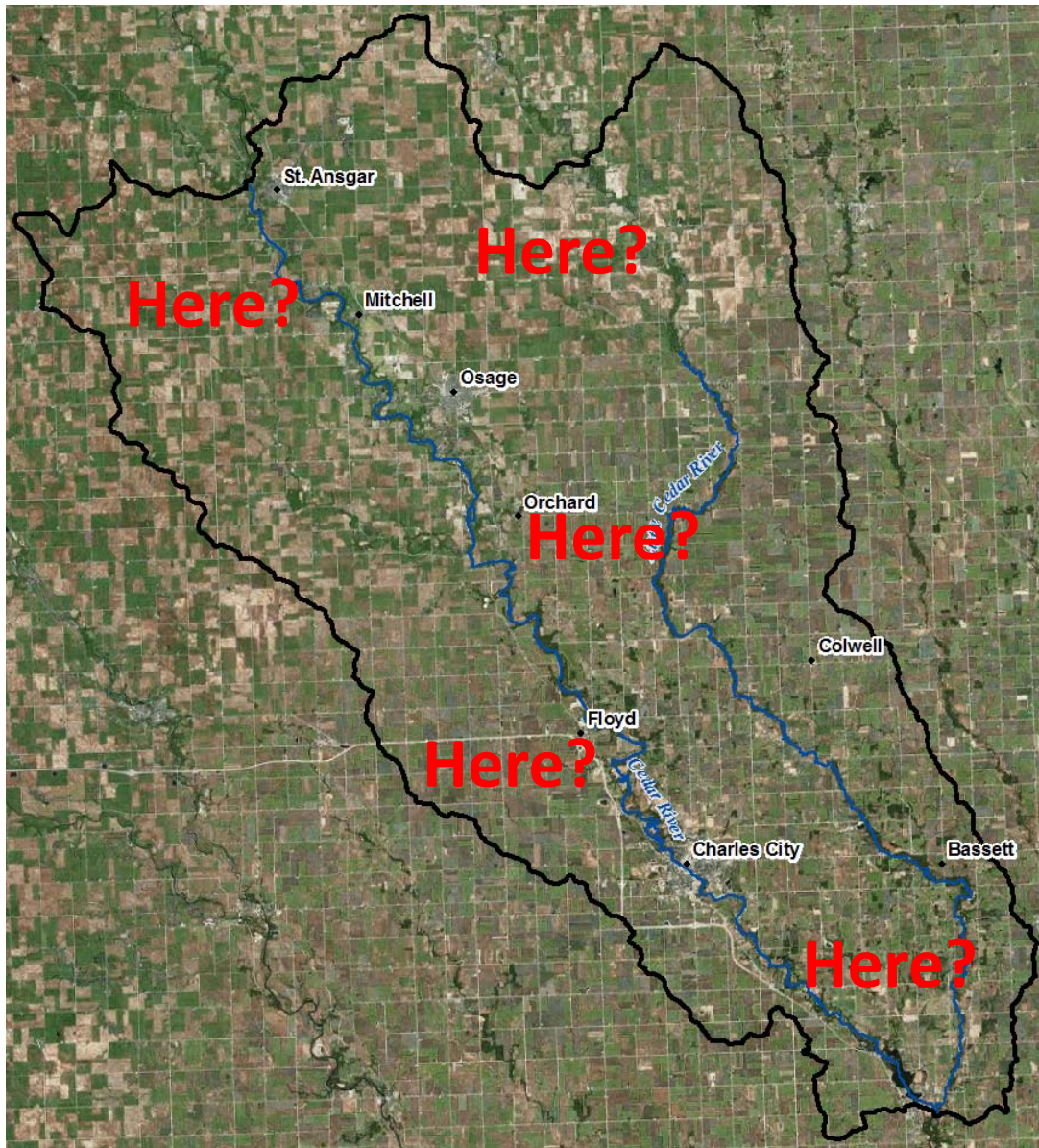
# Prioritizing Investments in Natural Infrastructure to Deliver *Multiple Benefits* for People and Nature

# RIOS

resource investment  
optimization system



# Watershed Planning for Multiple Benefits: Upper Cedar River, Iowa



- Iowa Nutrient Reduction Strategy
- Watershed planning
- Targeting activities for nutrient reductions *and* co-benefits

**WHICH activities and  
WHERE to deliver  
multiple benefits?**

# Upper Cedar: Objectives for Analysis

## Identify priority areas for activities to improve...



### Water Quality

- Nitrogen retention
- Phosphorous retention
- Erosion control



### Flood Mitigation

## Overlays



### Crop Production



### Provision of Habitat



# Upper Cedar Watershed Planning



Flood risk reduction

-

+

Nutrient retention

+

+

Erosion control

-

+

Habitat for biodiversity

+

+

***WHICH activities to invest in and WHERE to capture multiple benefits?***



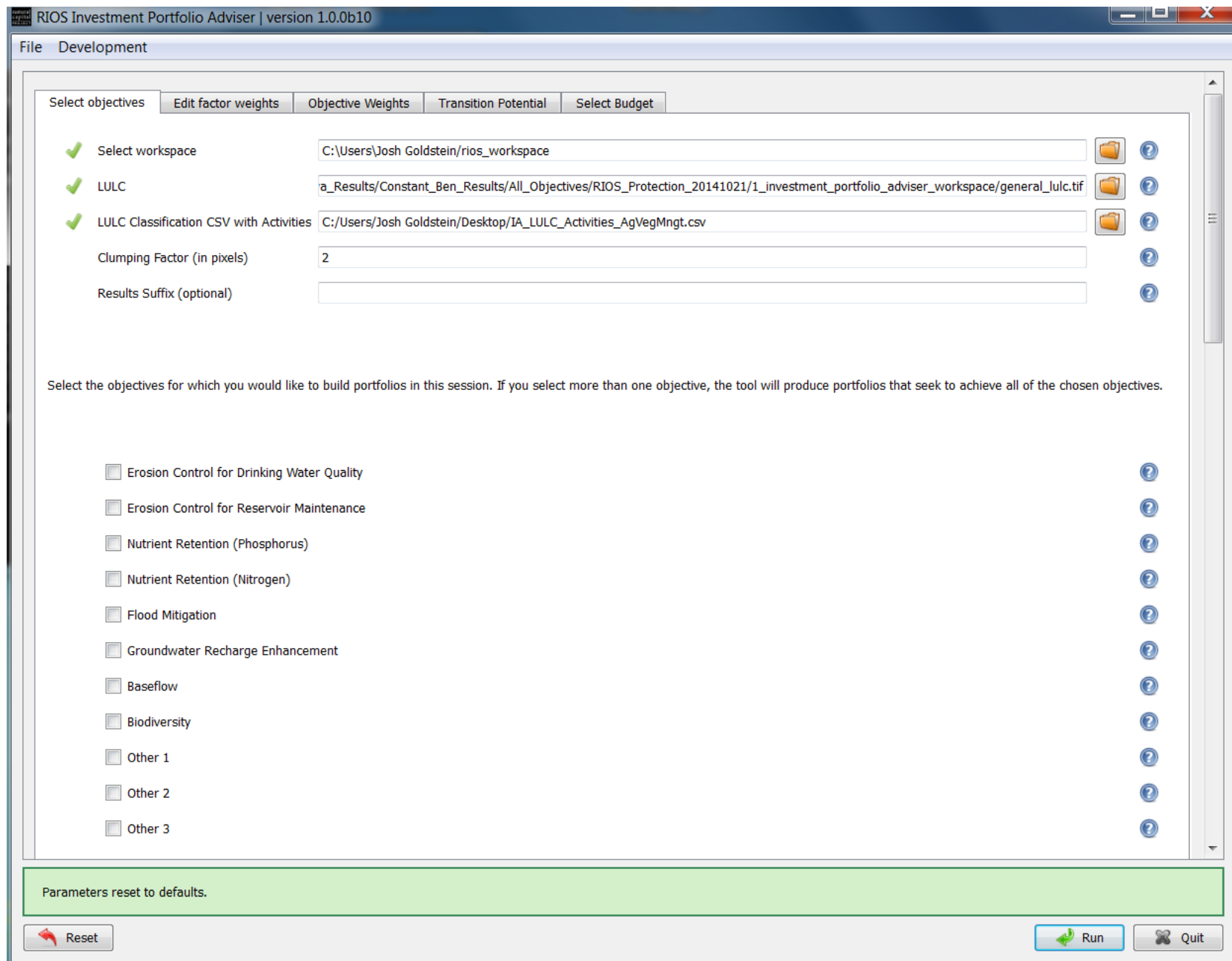
Systematic  
spatial  
analysis





*A science-based approach to **prioritize watershed investments** by identifying where **protection, restoration, or improved management activities** are likely to yield the **greatest benefits** for people and nature.*





<http://www.naturalcapitalproject.org/RIOS.html>

# Targeting Investments in Water Funds



# Multiple Benefits Approach

## Watersheds

- Sediment retention
- Nitrogen retention
- Phosphorous retention
- Flood mitigation
- Groundwater recharge
- Terrestrial biodiversity
- \*Recreation and tourism

## Coastal

- \*Coastal protection
- \*Fisheries (habitat dependent)
- \*Recreation and tourism
- \*Marine biodiversity

\* = in development

Flexibility to add additional objectives for specific decision contexts (e.g., target vulnerable communities, avoid high opportunity cost areas)



# RIOS Modeling Framework

*How effective is each activity at achieving each objective across the entire watershed?*

## Cover Crops



Nutrient  
retention

Flood  
mitigation

...

## Examples of Upper Cedar Activities:

1. Agricultural vegetation management practices (e.g., cover crops, no till)
2. Fertilizer management practices (e.g., nitrogen side-dress)
3. Habitat protection
4. Habitat restoration (e.g., riparian buffers)

# RIOS Data Inputs

## Land use/Land cover + Coefficients

Vegetation retention, land practice and management

## Topography

Digital elevation model, slope threshold

## Rainfall Erosivity

Based on intensity and kinetic energy of rainfall

## Soil Properties

Depth, erodibility, texture

## Watershed Areas

Catchment areas, beneficiaries

## Stakeholder Input

Activities, budget, preferences, restrictions

## And other inputs...



# RIOS Data Inputs

## Land use/Land cover + Coefficients

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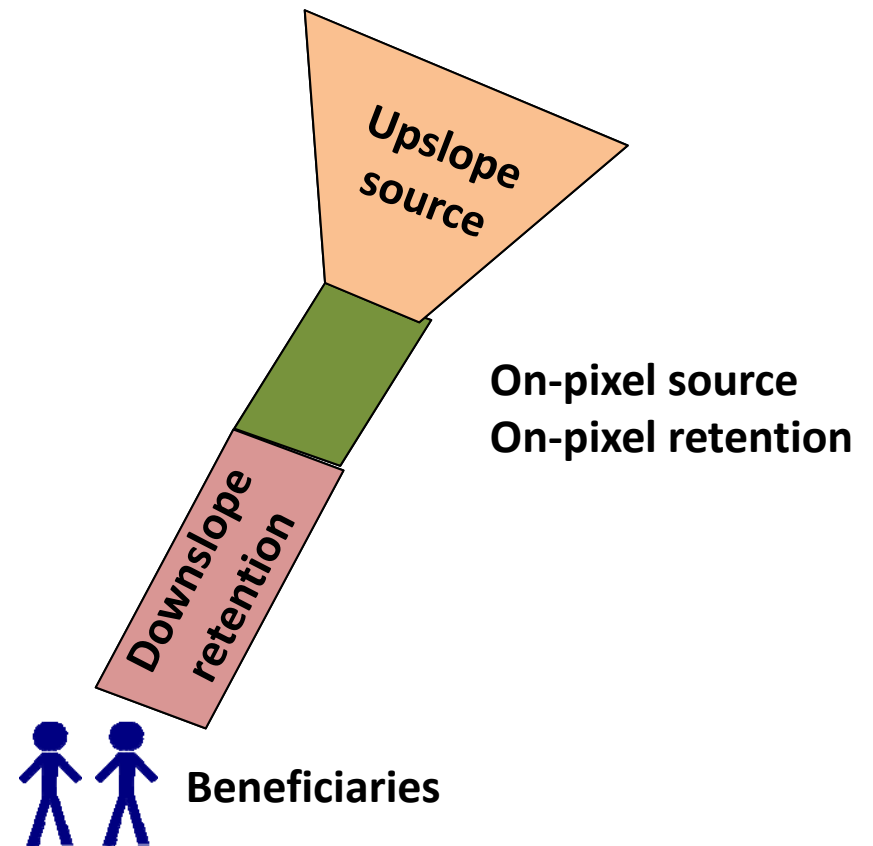
Catchment areas, beneficiaries

## Stakeholder Input

Activities, budget, preferences, restrictions

## And other inputs...

Systematic analysis across the entire study region

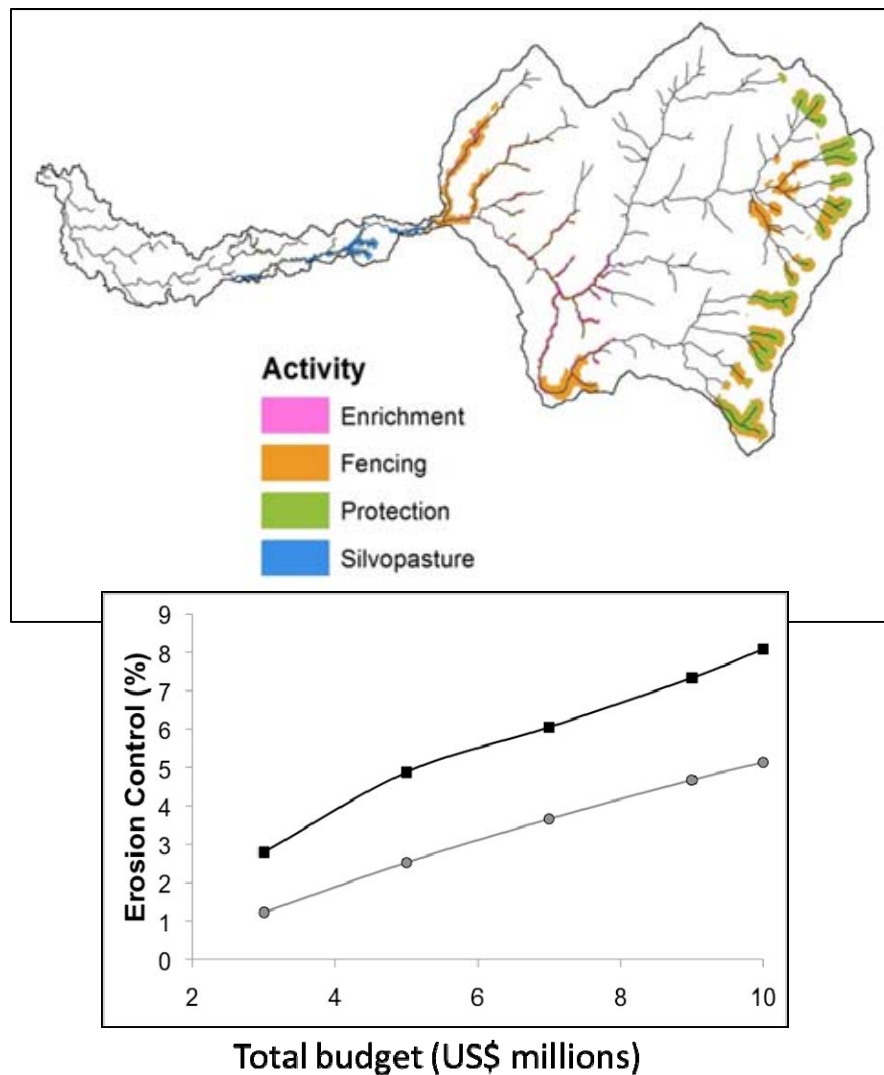


**OUTPUT: Relative ranking scores of activity effectiveness for each pixel**

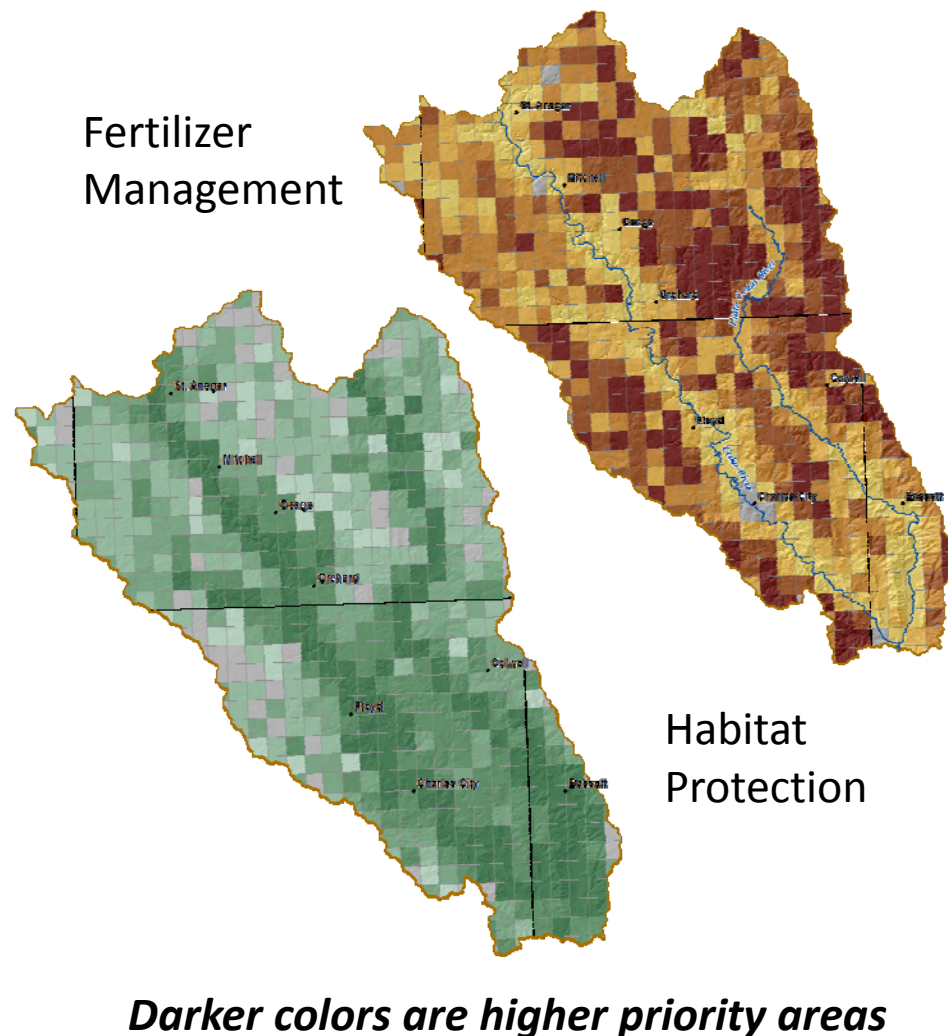


# RIOS: Example Outputs

## Activity Portfolio for Budget Allocation (e.g., Water Fund)



## “Wall-to-Wall” Activity Effectiveness Maps (e.g., project screening)



# Tool Enhancements

Beta releases in Winter 2015



- Floodplain Reconnection Screening Tool
- RIOS Coastal
- Habitat Suitability Index

# Tool Enhancements

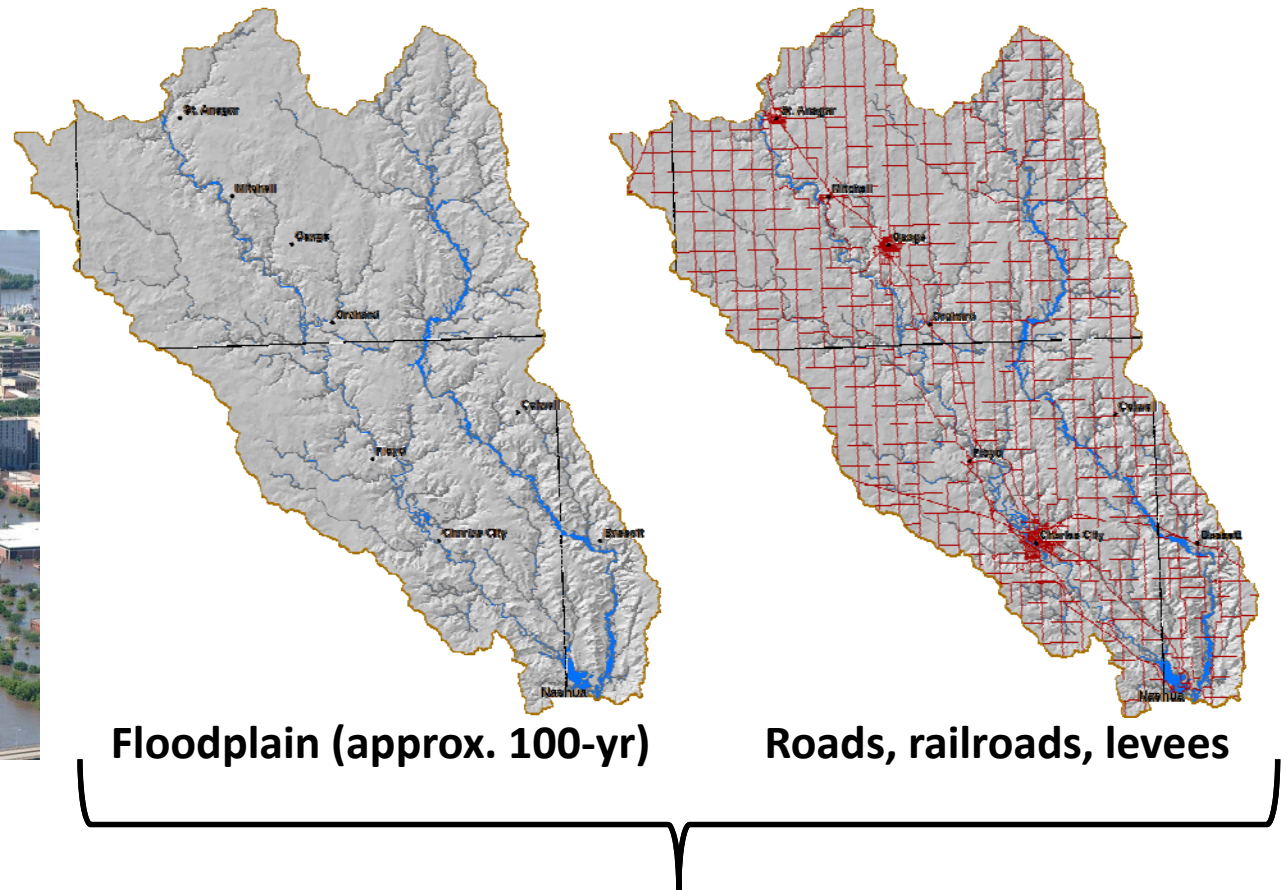
Beta releases in Winter 2015



- **Floodplain Reconnection Screening Tool**
- RIOS Coastal
- Habitat Suitability Index



# Floodplain Reconnection Screening Tool



## Collaborators

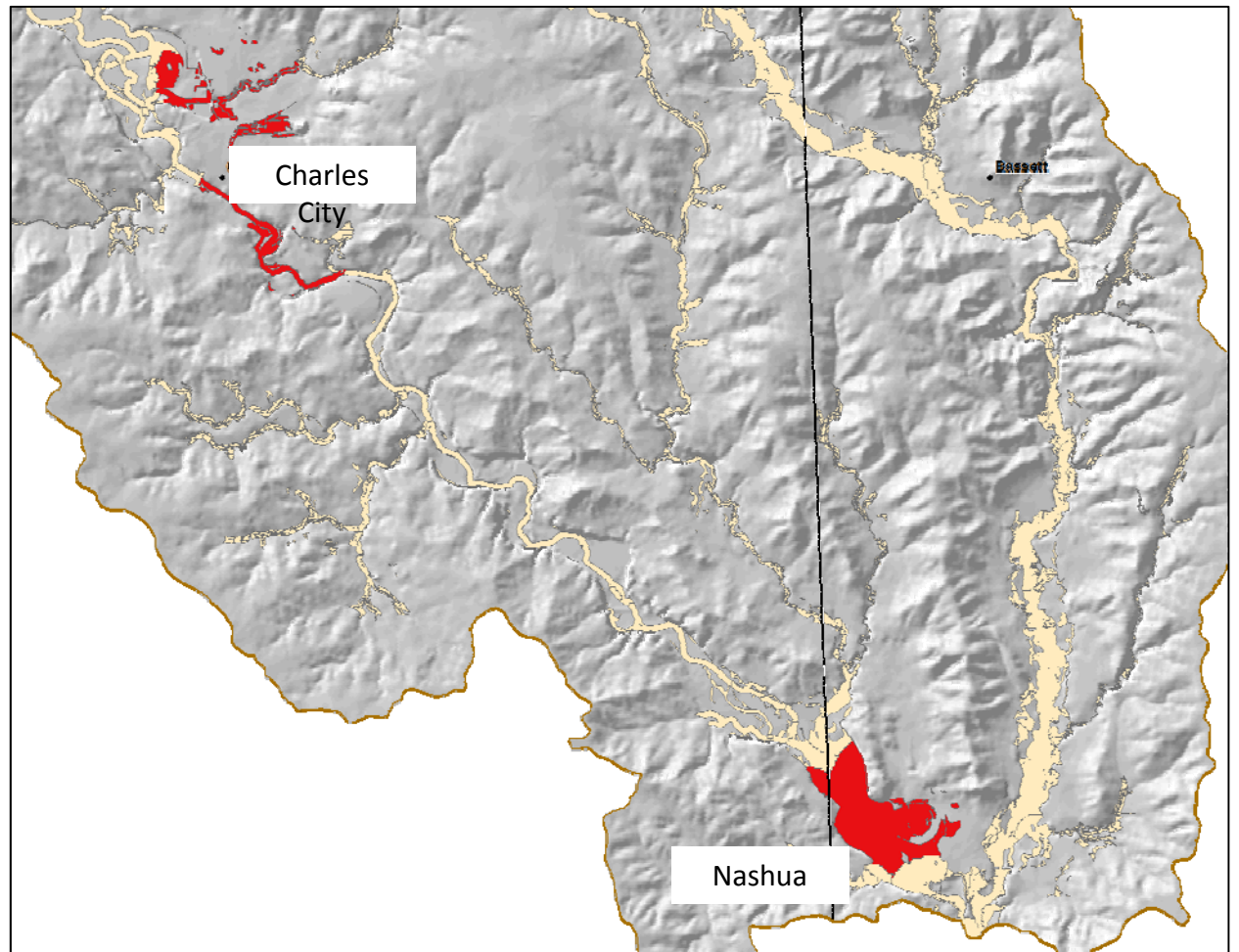
Kris Johnson (TNC)

Chris Konrad (USGS)

Ginger Kowal (NatCap)

Screen floodplain to identify areas where **flood water storage and conveyance** may be enhanced by modifying built features to reconnect parts of the floodplain.

# Modifying Built Features in the Floodplain



# Tool Enhancements

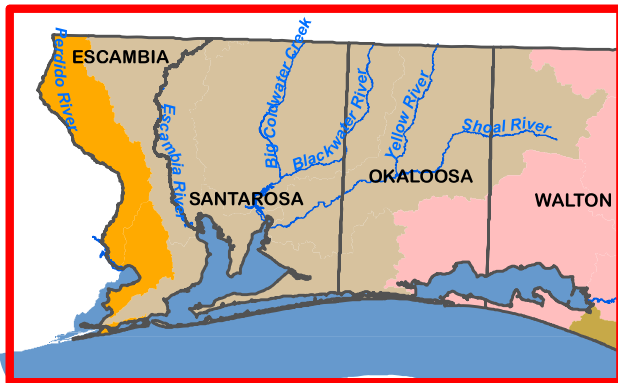
Beta releases in Winter 2015



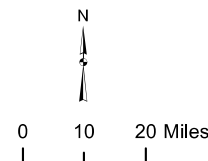
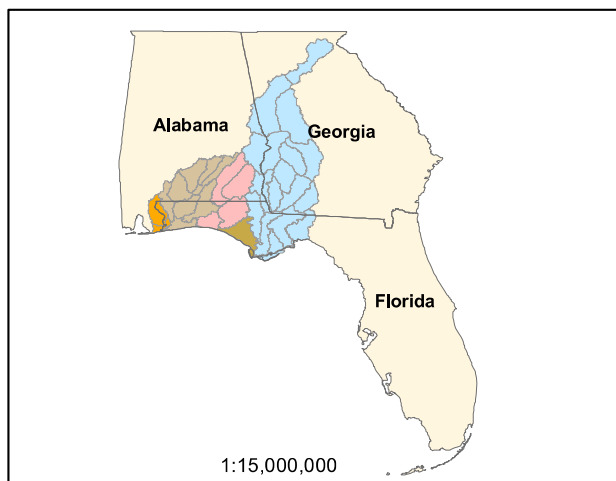
- Floodplain Reconnection Screening Tool
- **RIOS Coastal**
- **Habitat Suitability Index**



# Watershed + Coastal Planning for Multiple Benefits: Perdido & Pensacola Watersheds (FL)



- Healthy watersheds for resilient communities
- Address root causes of major issues
- Across jurisdictions and funding sources



Map: Kathy Freeman, TNC-FLFO  
Data Sources: USGS

## Legend

- Perdido Bay
- Pensacola Bay
- Choctawhatchee River and Bay
- St. Andrew Bay-St. Joe Bay
- Apalachicola to St. Marks

# RIOS Coastal



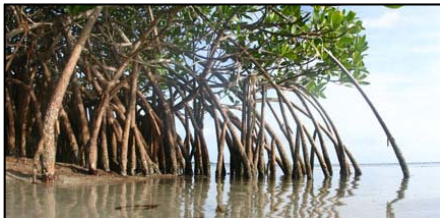
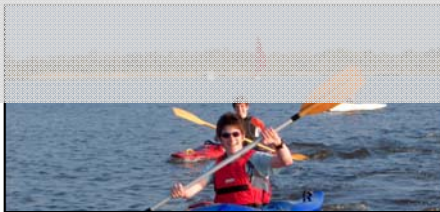
Coastal protection from storms  
and sea level rise



Near-shore fisheries: habitat dependent

**WHICH activities and WHERE to deliver  
multiple benefits?**

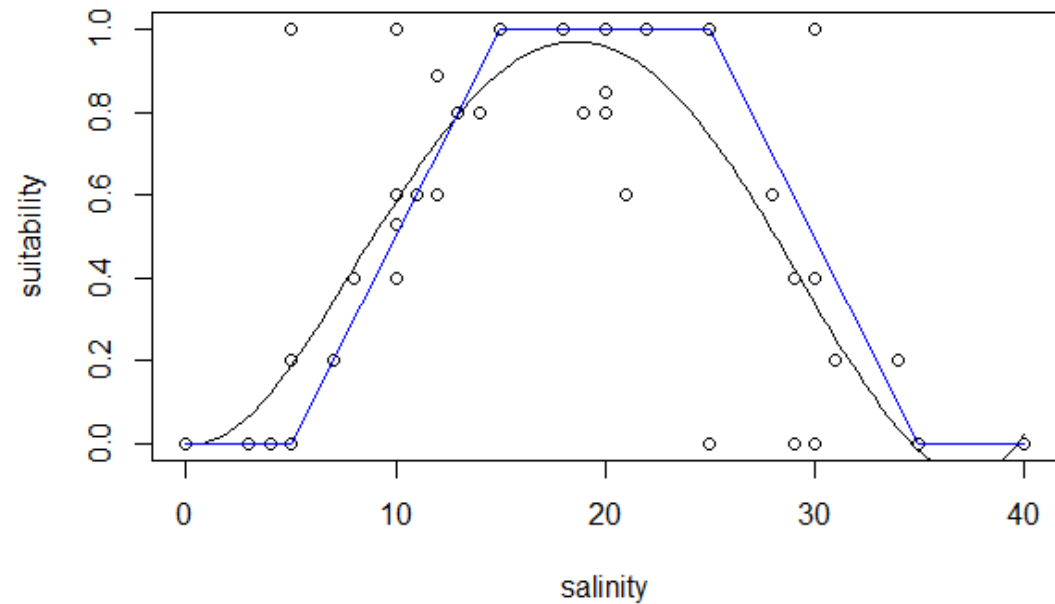
Recreation and tourism



Marine biodiversity (user input)

# Habitat Suitability Index

**Where are conditions  
favorable to restore  
habitats?**



# Habitat Suitability Index

Where are conditions  
favorable to restore  
habitats?

Salt marsh  
Oyster reefs  
Seagrass

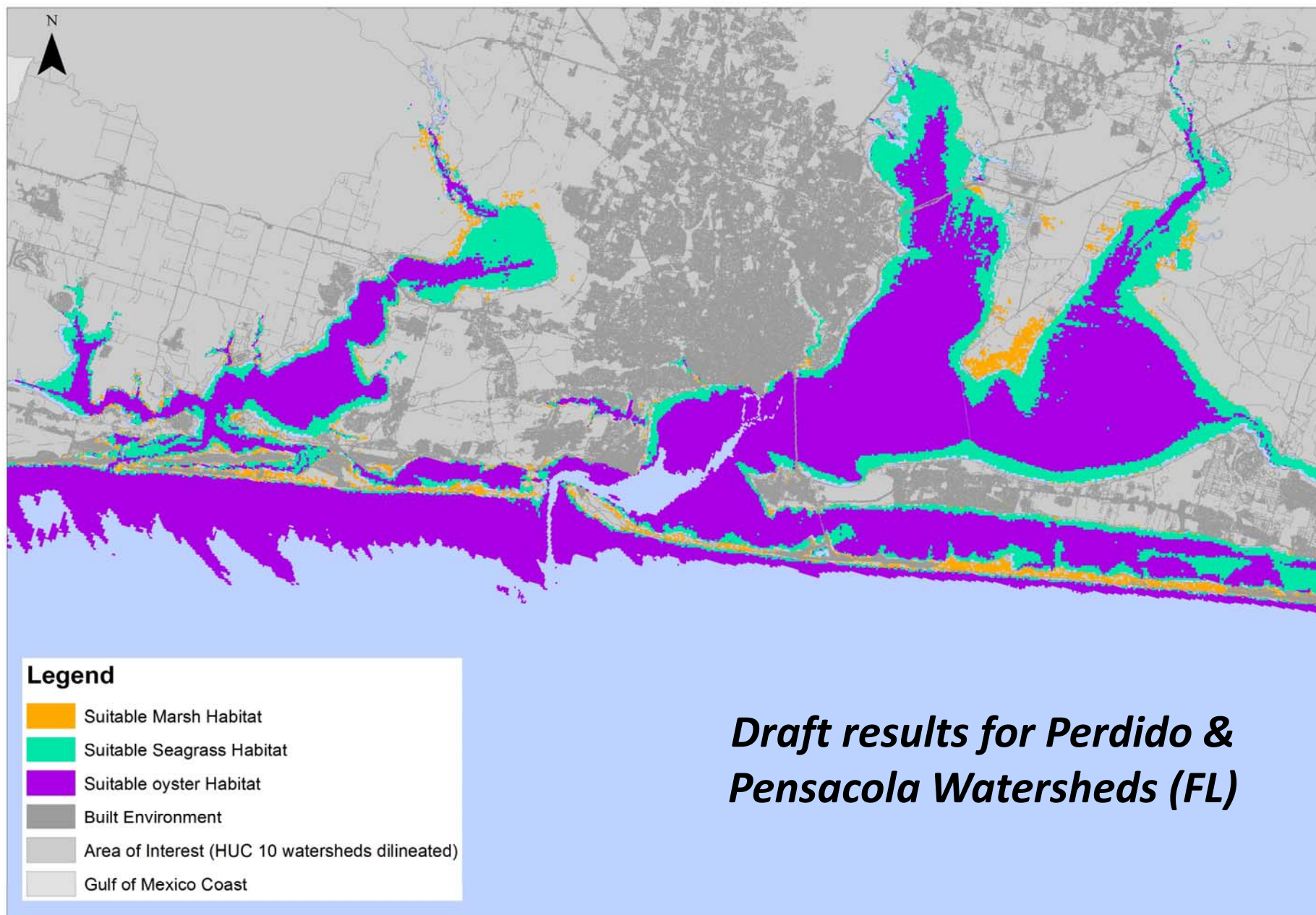
The screenshot shows the 'Habitat Suitability' application window. The title bar includes the application name and standard window controls. The menu bar has 'File' and 'Development'. The status bar at the top right displays 'InVEST Version dev370:3.0.1 [27a6978f4b1a] (32bit)' along with links to 'Model documentation' and 'Report an issue'.

The interface is divided into three main sections:

- Output Parameters:** Contains a 'Workspace' field with a green checkmark icon and a file path, a 'Habitat Threshold' field set to '0.5', and an 'Output Cell Size (optional)' field.
- Biophysical Parameters:** Contains three rows, each with a red 'X' icon, a label, and an empty text field: 'Temperature Biophysical Layer', 'Salinity Biophysical Layer', and 'Depth Biophysical Layer'.
- Oyster Habitat Suitability Parameters:** Contains three rows, each with a red 'X' icon, a label, and an empty text field: 'Oyster Reef Habitat Suitability (Temperature)', 'Oyster Reef Habitat Suitability (Salinity)', and 'Oyster Reef Habitat Suitability (Depth)'.

A green message box at the bottom states 'Parameters reset to defaults.' Below this are three buttons: 'Reset' (with a red arrow icon), 'Run' (with a green play icon), and 'Quit' (with a red X icon).





***Draft results for Perdido & Pensacola Watersheds (FL)***

# RIOS Coastal: Activity Effectiveness Maps

## Draft Results for Perdido and Pensacola Watersheds

### Objectives

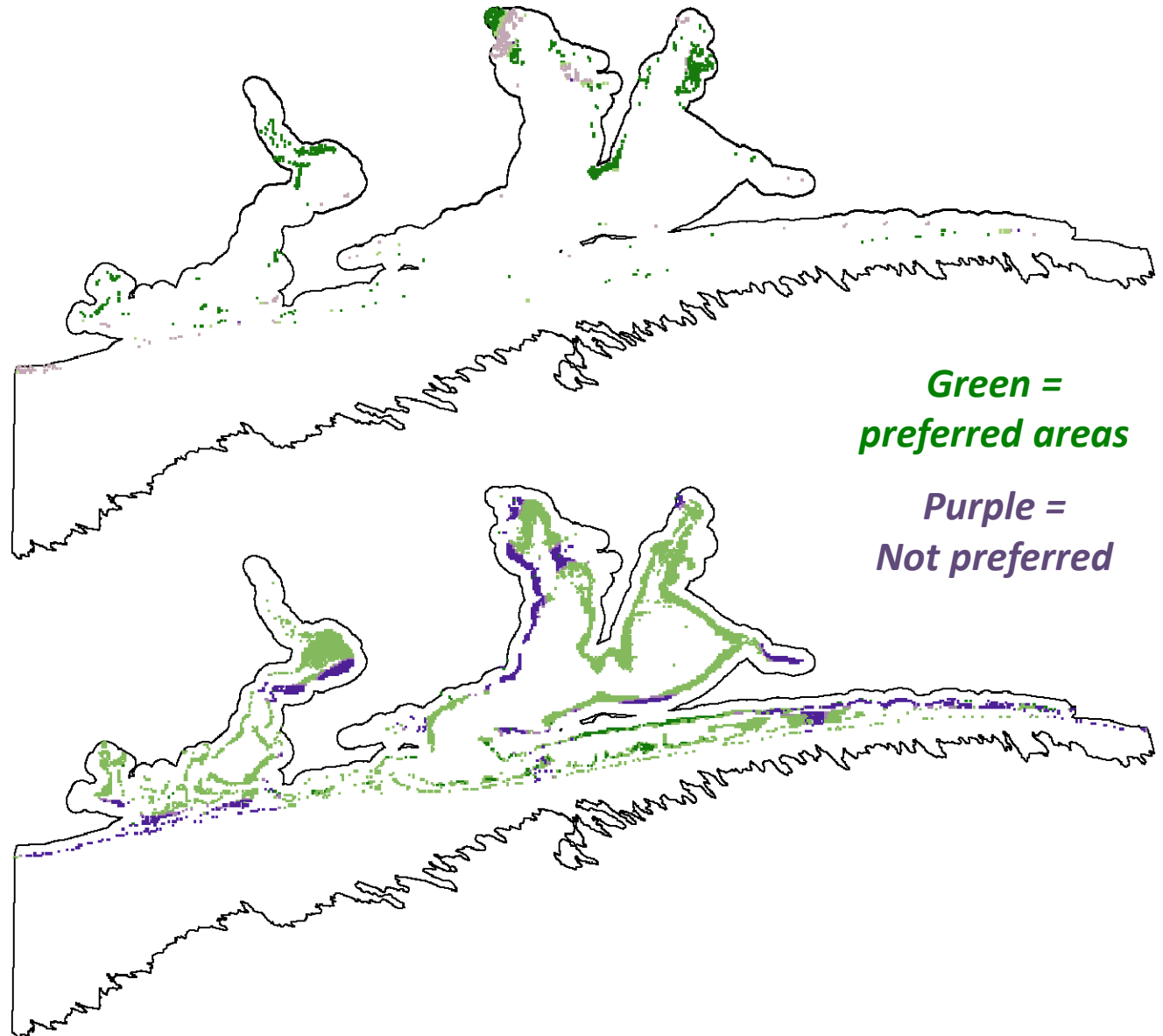
Coastal protection  
Recreation  
Red drum fishery  
Oyster fishery

Salt Marsh Protection

*Green =  
preferred areas*

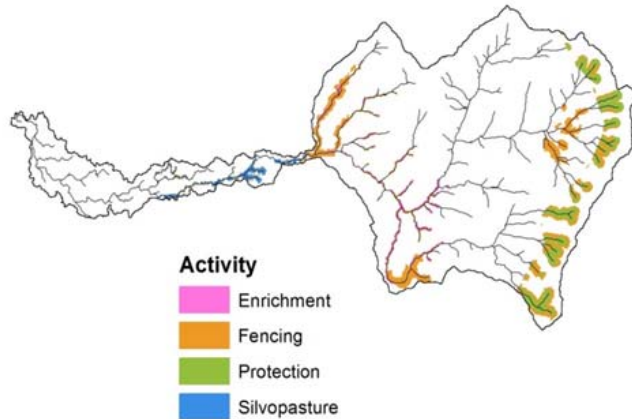
*Purple =  
Not preferred*

Seagrass Restoration



# RIOS: Examples of Decision Contexts

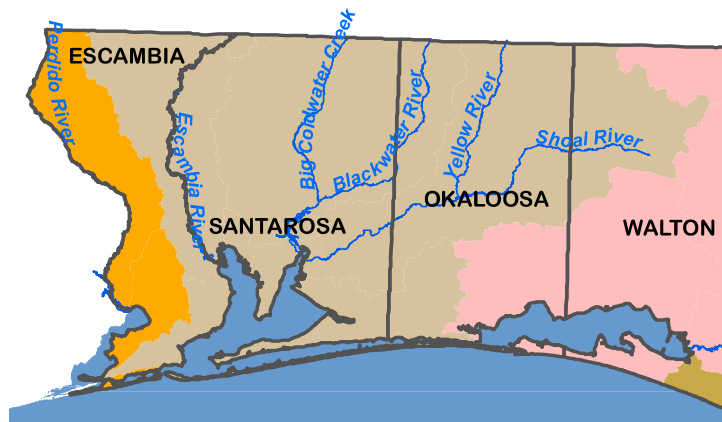
## Targeting Investments in Water Funds



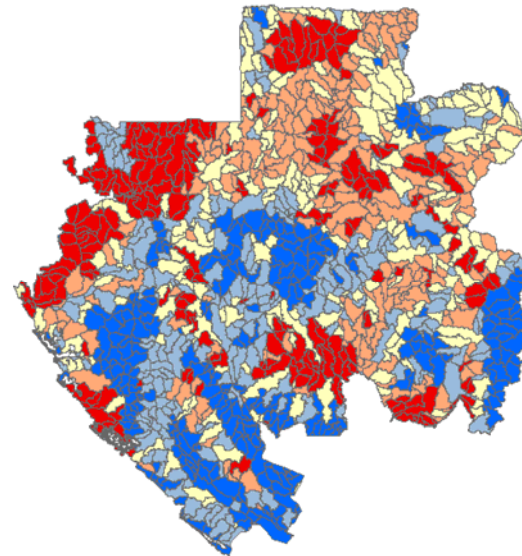
## Natural Infrastructure: Risk Reduction + Co-Benefits



## Multi-objective planning: Watershed + Coastal



## Ecosystem Services Priority Areas: National Land-Use Plan in Gabon







# RIOS

resource investment  
optimization system

**WHERE *matters***

<http://www.naturalcapitalproject.org/RIOS.html>

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