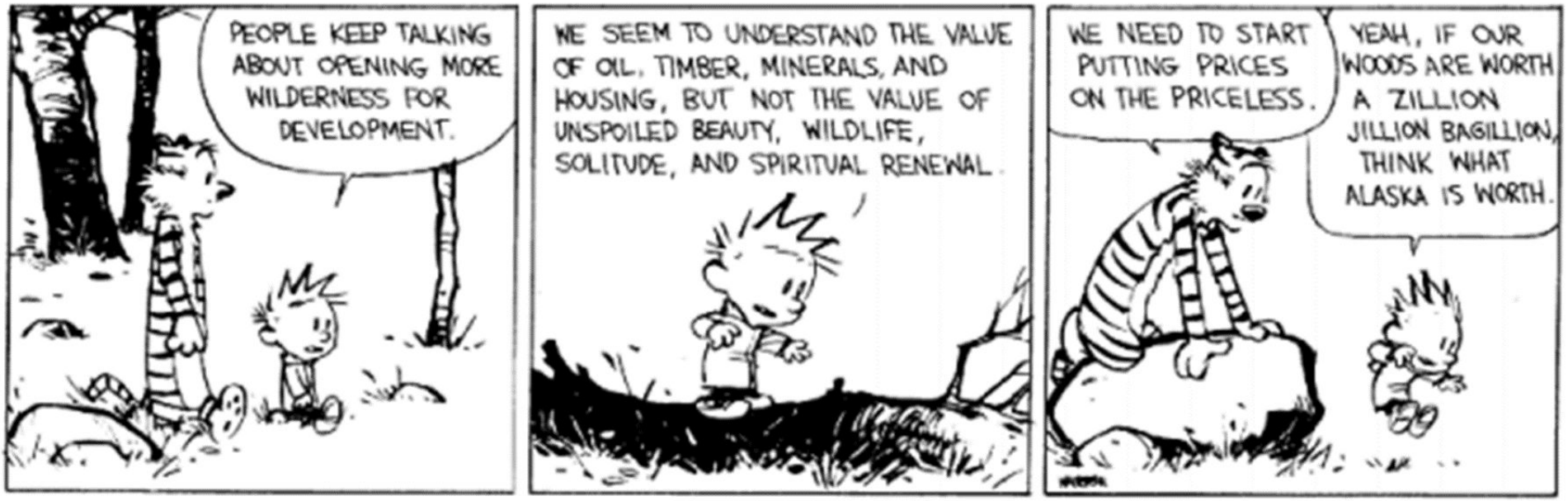
Duke
NICHOLAS INSTITUTE
FOR ENVIRONMENTAL POLICY SOLUTIONS



Ecosystem Services Guidance, Models, and Prioritization

Lydia Olander, Nicholas Institute, National Ecosystem Services Partnership, Duke University

2017 Albemarle-Pamlico Symposium – Nov 1, Raleigh NC

Duke
NICHOLAS INSTITUTE
FOR ENVIRONMENTAL POLICY SOLUTIONS

NICHOLAS INSTITUTE

Linking academic knowledge and decision makers to solve environmental challenges

ECOSYSTEM SERVICES PROGRAM

Integrating Ecosystem Services into public and private decision making through improving methods, incentives and markets - *carbon offsets, REDD, wetland and stream mitigation, conservation banking, water quality trading, etc…*

NATIONAL ECOSYSTEM SERVICES PARTNERSHIP (NESP)

Engages both public and private individuals and organizations to enhance collaboration within the ecosystem services community and to strengthen coordination of policy, market implementation, and research at the national level

National Ecosystem Services Partnership (NESP)

- NESP Community of Practice
- Quarterly newsletter
- Webinars
- FRMES Online guidebook
- Best Practice Guidance & Workshops
- Engaged Expert Network

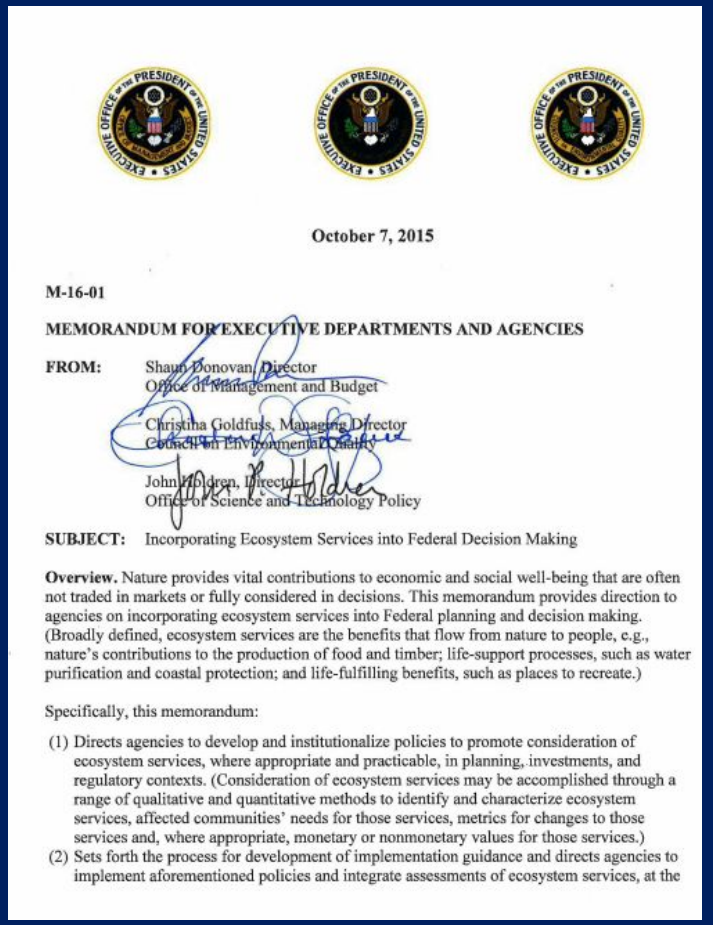
https://nicholasinstitute.duke.edu/focal-areas/national-ecosystem-services-partnership

Duke
NICHOLAS INSTITUTE
FOR ENVIRONMENTAL POLICY SOLUTIONS

White House Memo

White House memorandum calling on Federal agencies to incorporate ecosystem services into Federal decision making requests:

1. a description of **current agency practice and work plans** were submitted to the Council on Environmental Quality (CEQ)
2. plans for **implementation guidance** to be developed in collaboration with the agencies



October 7, 2015

M-16-01

MEMORANDUM FOR EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Shaun Donovan, Director
Office of Management and Budget

Christina Goldfuss, Managing Director
Council on Environmental Quality

John Holdren, Director
Office of Science and Technology Policy

SUBJECT: Incorporating Ecosystem Services into Federal Decision Making

Overview. Nature provides vital contributions to economic and social well-being that are often not traded in markets or fully considered in decisions. This memorandum provides direction to agencies on incorporating ecosystem services into Federal planning and decision making. (Broadly defined, ecosystem services are the benefits that flow from nature to people, e.g., nature's contributions to the production of food and timber; life-support processes, such as water purification and coastal protection; and life-fulfilling benefits, such as places to recreate.)

Specifically, this memorandum:

(1) Directs agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments, and regulatory contexts. (Consideration of ecosystem services may be accomplished through a range of qualitative and quantitative methods to identify and characterize ecosystem services, affected communities' needs for those services, metrics for changes to those services and, where appropriate, monetary or nonmonetary values for those services.)
(2) Sets forth the process for development of implementation guidance and directs agencies to implement aforementioned policies and integrate assessments of ecosystem services, at the

How are Ecosystem Services useful?

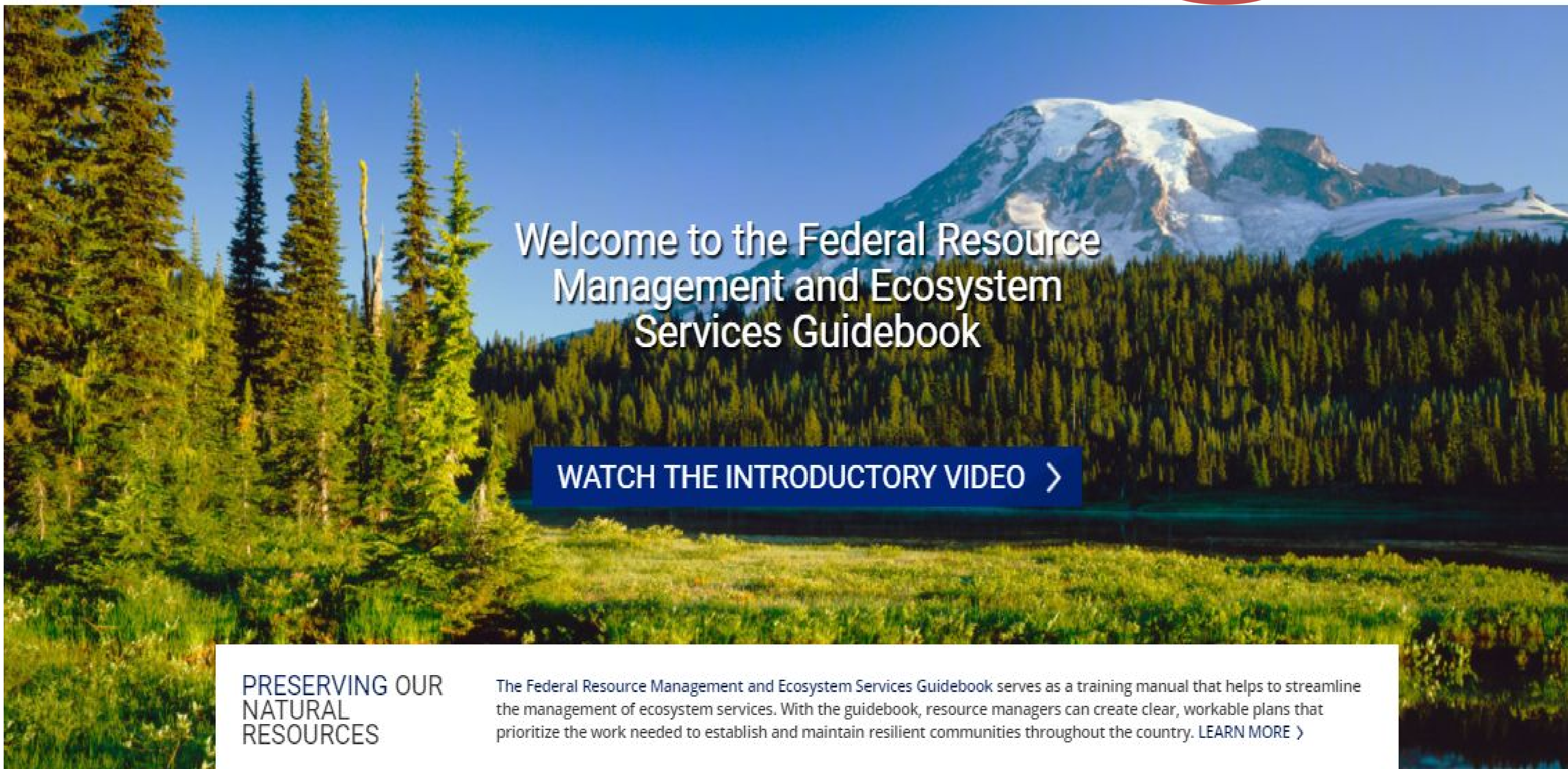
- Communicate about the benefits ecosystems provide to people
- Explicit consideration of trade-offs
- More complete comparison of alternatives (such as greener vs grayer infrastructure options)
- Identification of new partners (e.g. PWS)
- Fuller consideration of important but often undervalued benefits (non-use values, e.g., Klamath)
- Streamline assessments (NEPA, comparison of alternatives)
- Prioritize conservation/restoration/mitigation to increase ROI

FEDERAL RESOURCE MANAGEMENT AND ECOSYSTEM SERVICES GUIDEBOOK

National Ecosystem Services Partnership

Enter your search term(s)

ABOUT THE PROJECT | WHY ECOSYSTEM SERVICES? | AGENCY USE | ASSESSMENT FRAMEWORK | AGENCY EXAMPLES | RESOURCES



PRESERVING OUR NATURAL RESOURCES

The Federal Resource Management and Ecosystem Services Guidebook serves as a training manual that helps to streamline the management of ecosystem services. With the guidebook, resource managers can create clear, workable plans that prioritize the work needed to establish and maintain resilient communities throughout the country. LEARN MORE ›

UNDERSTAND THE **MOTIVATION**

- Integrating Ecosystem Services Into Federal Resource Management
- Frequently Asked Questions
- Is an Ecosystem Services Approach Right for My Project?

EXPLORE **AGENCY USE**

- Introduction to Agency Use
- National Oceanic and Atmospheric Administration
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Fish and Wildlife Service
- U.S. Forest Service

VIEW THE **ASSESSMENT FRAMEWORK**

- Overview and Best Practices
- Scoping
- Benefit-Relevant Indicators
- Analysis
- The Decision Process
- Stakeholder Engagement

Ecosystem Services Methods

Ecosystem services can be used in planning and decision processes in many ways.

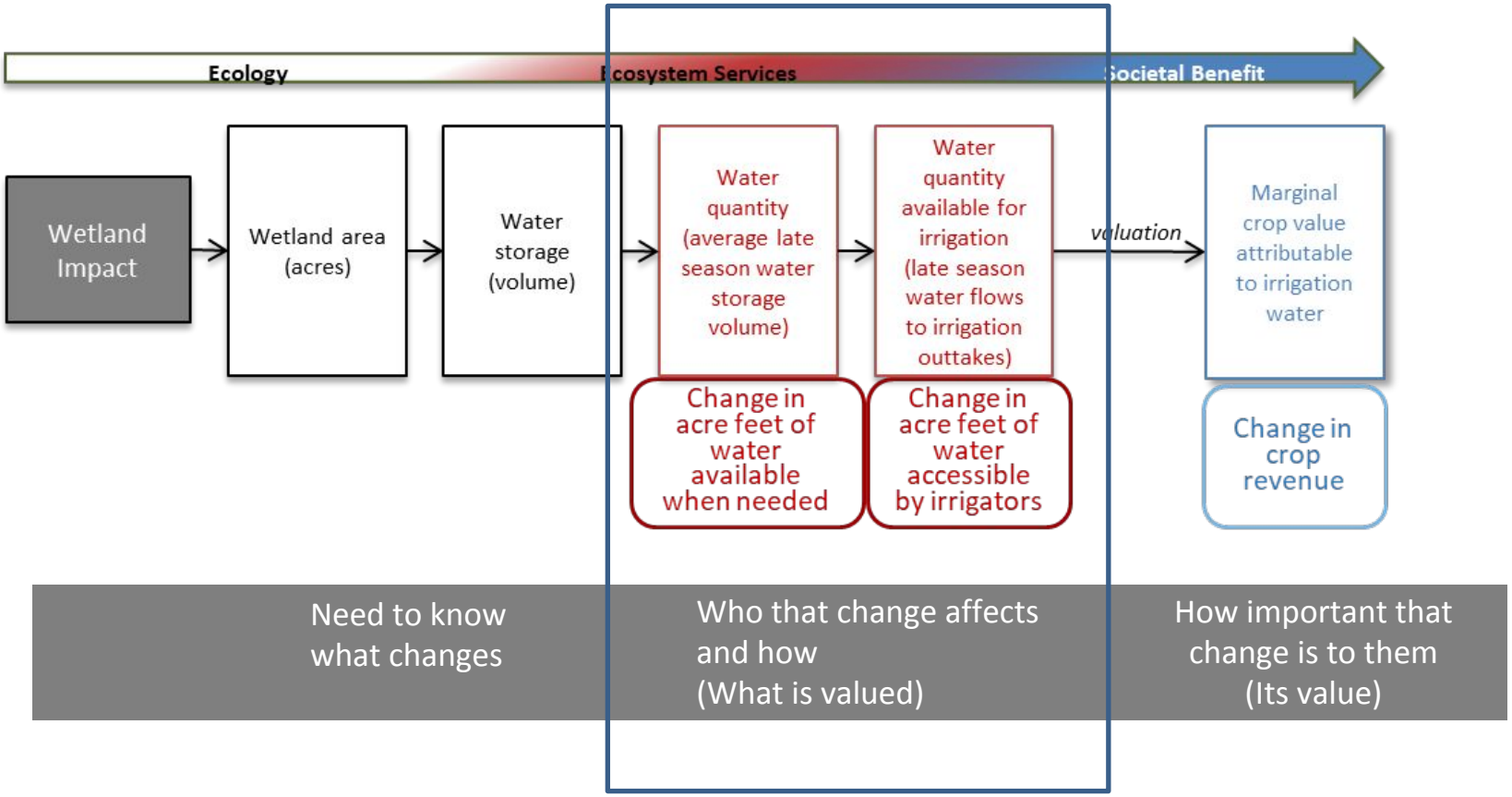
They can be incorporated into existing tools and methods – for example cost benefit analysis, risk assessment etc…).

BROWSE ASSESSMENT FRAMEWORK

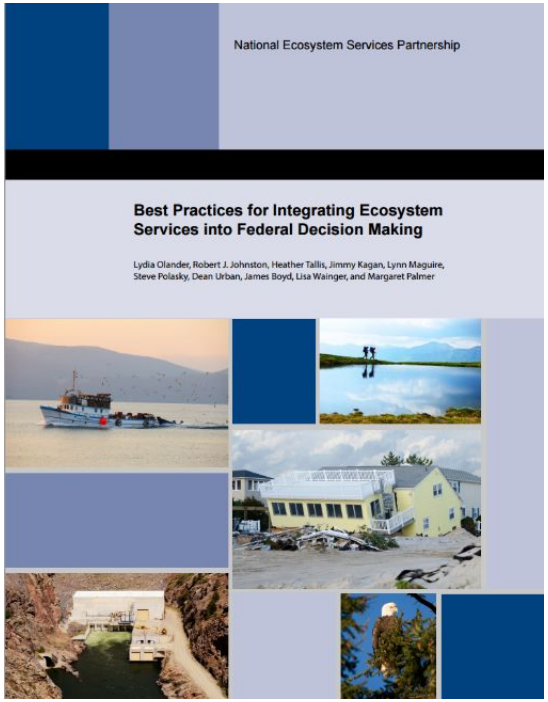
- Overview and Best Practices
- Scoping
- Benefit-Relevant Indicators
- Analysis
  - Selecting Services and Causal Chains
  - Quantifying BRIs
  - Benefits Assessment
    - Overview of Benefits Assessment
    - Monetary Valuation
    - Non-Monetary Methods: Multi-Criteria Evaluation for Ecosystem Services
    - Other Methods
- The Decision Process
- Stakeholder Engagement
- Using Indicators Effectively
- Scenario Analysis and Green Accounting

Non-monetary Measures of Ecosystem Services

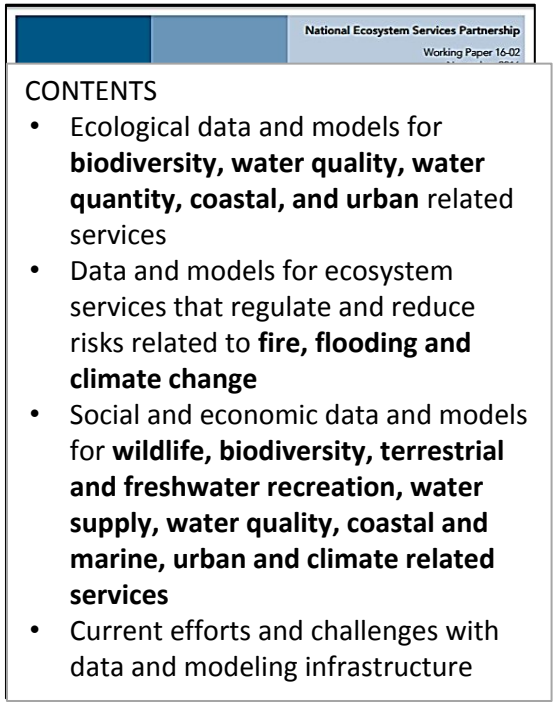
- Benefit Relevant Indicators (BRIs) – non-monetary measures of what is valued
- Values – monetary ($) or non-monetary (rank)



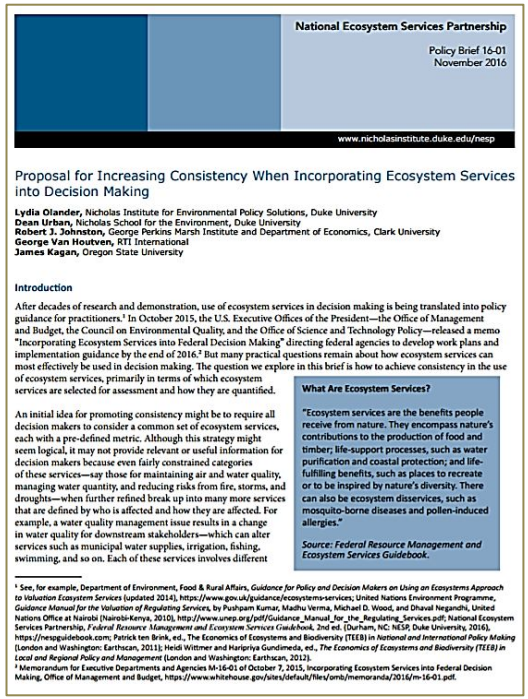
NESP support of implementation



Non-monetary measures of ES

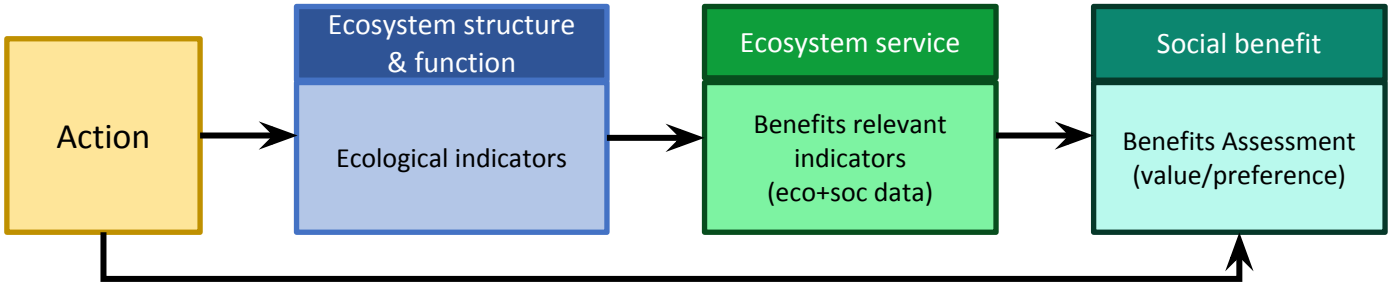


Data and models for quantifying ES

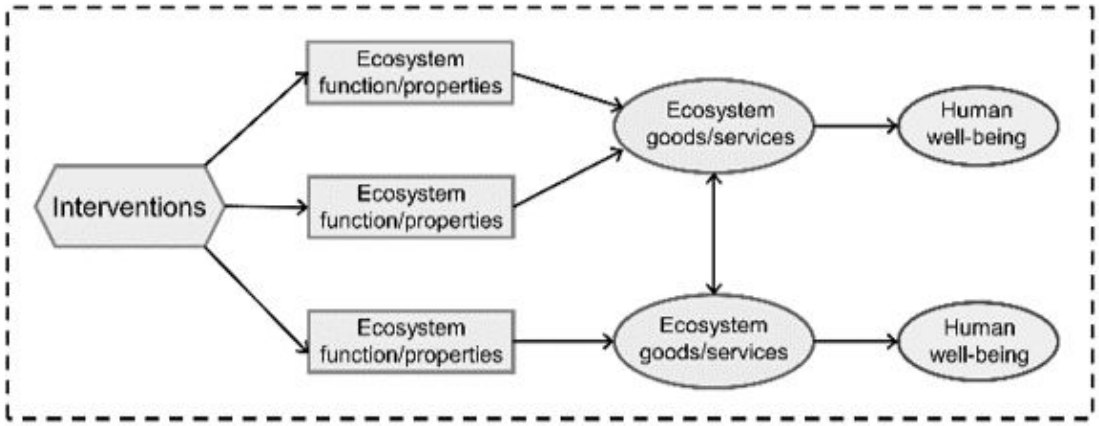


Consistency in ES measures

What do we mean by ES conceptual model?

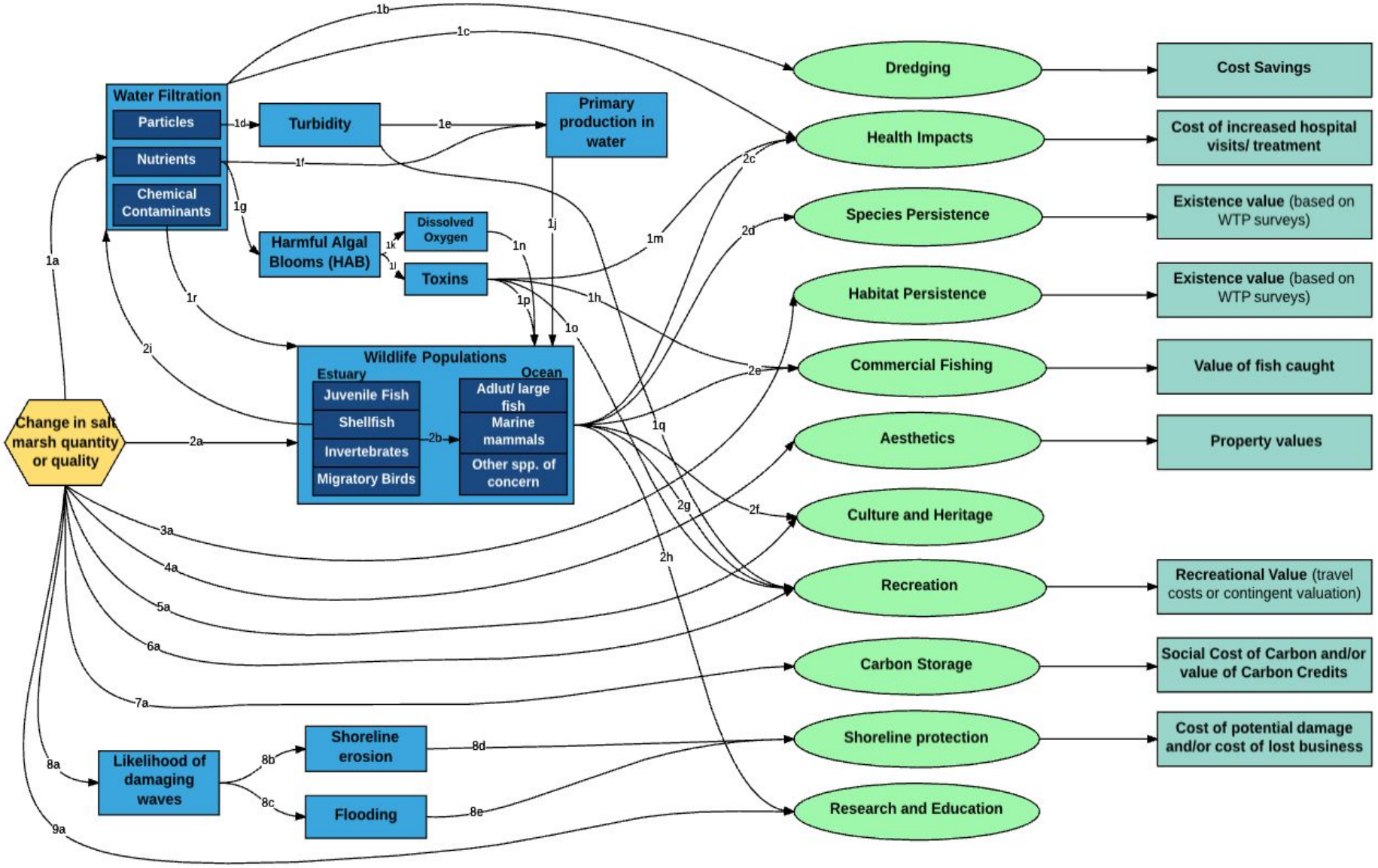


We suggest the use of conceptual models built with causal chains connecting an action or intervention through the resulting changes in the biophysical or social systems to outcomes that matter to people.



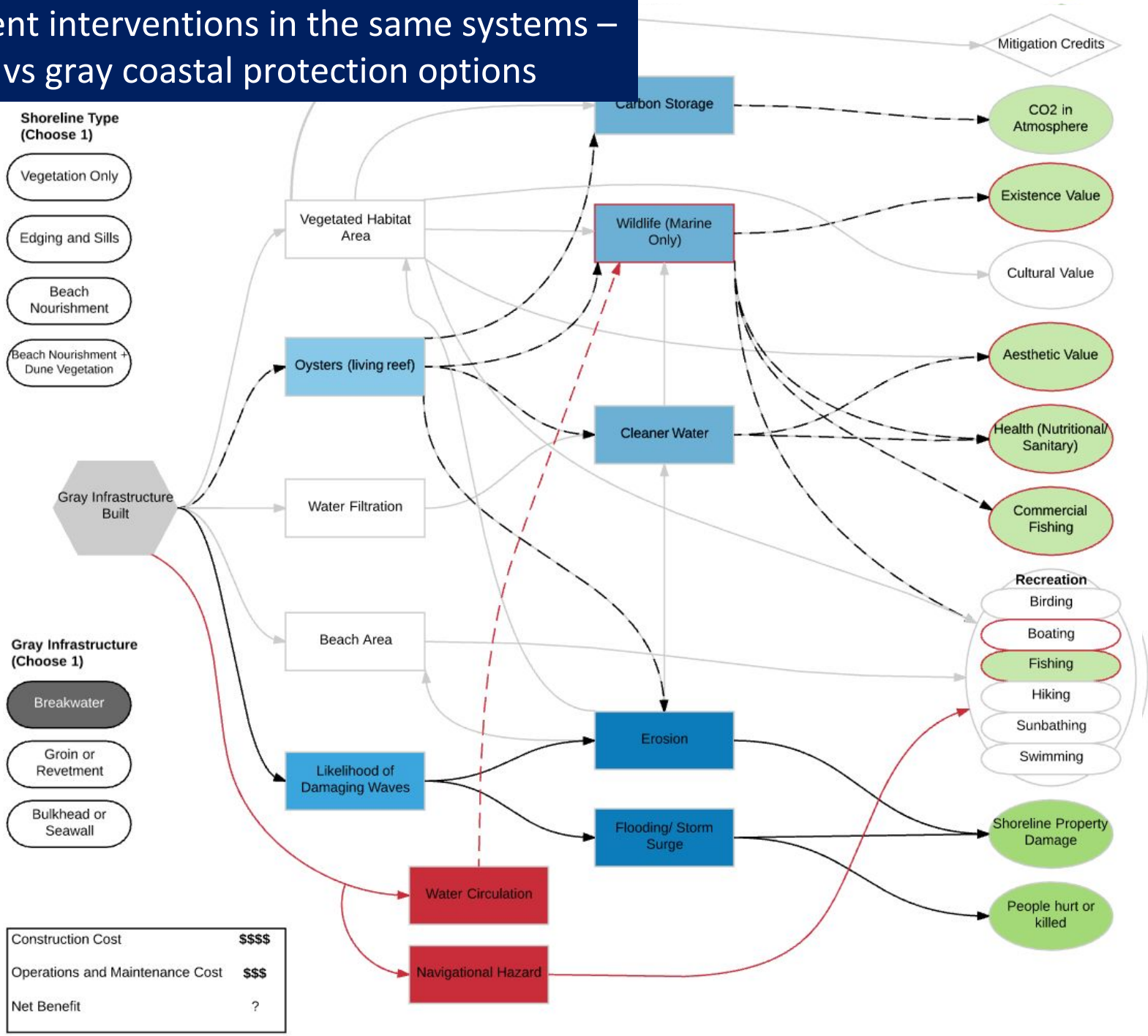
Generalized ESCM

Salt marsh restoration for NOAA



While models will vary with context, intervention and geography, they can have significant overlap and similarity allowing integrated use and comparison of alternatives.

Different interventions in the same systems – Green vs gray coastal protection options



What can an ES conceptual model based toolkit include?

1. A generalized model for each common management action at NERRS sites (marsh restoration, dredging, levee removal, etc…)
2. General evidence library associated with the model (predictive models, systematic reviews, etc...) and evidence gap map.
3. A common set of associated socio-ecological indicators (BRIs)
4. Foundation for quantitative predictive model

Adding Evidence

Evidence Template

ID#: Node 1 → Node 2

ID #'s correspond to arrow labels in the conceptual model diagram

Description of Relationship

Describe the relationship between the starting and ending node. When possible include a specific statement of a change and the direction and magnitude of the change.

Summary of Evidence

Discuss how the relationship between the nodes works and what supporting evidence exists for that relationship.

Strength of Evidence

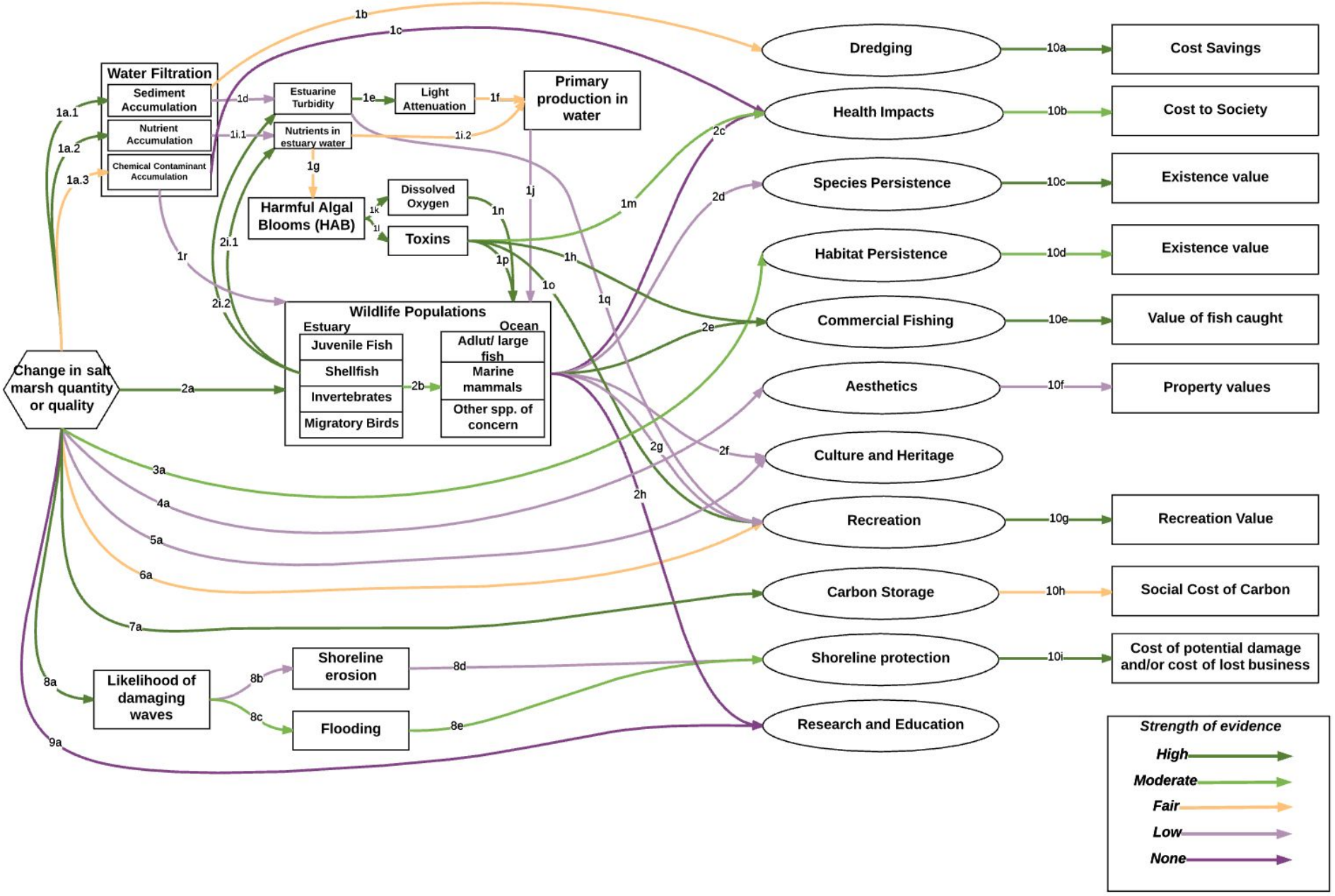
Use an evidence matrix to assess the strength of evidence that supports the relationship

Other Factors

List and discuss other factors that influence the relationship between the nodes.

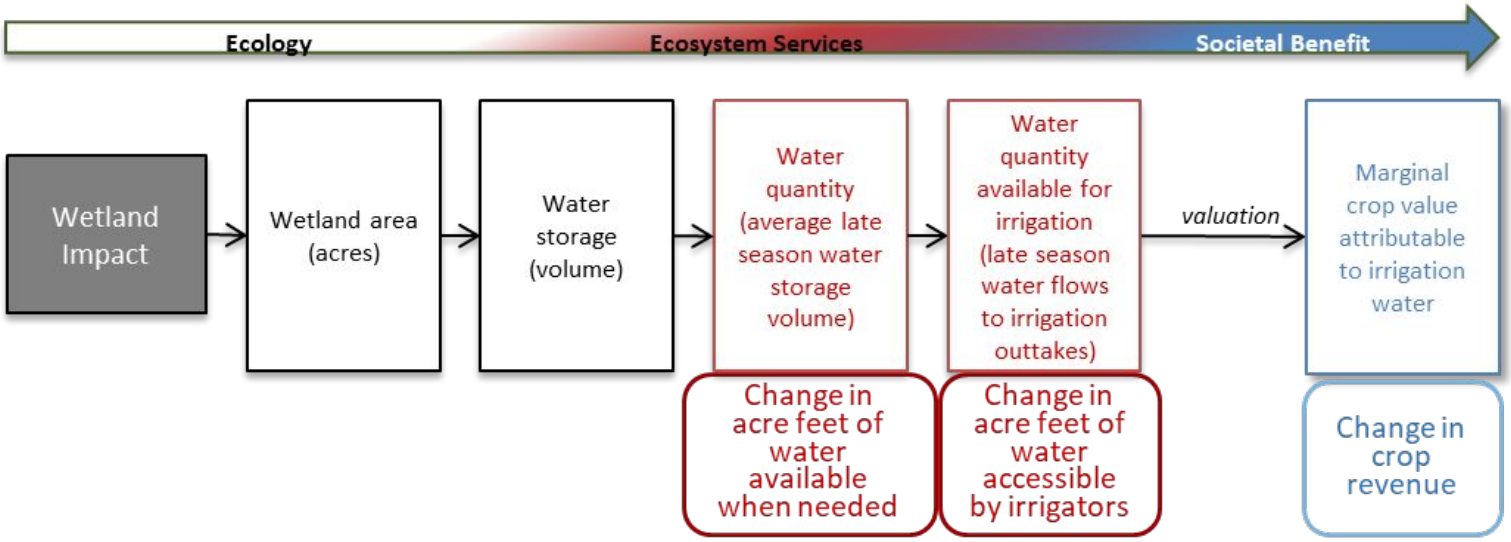
Sources

Evidence gap map



Adding measures of ecosystem services?

- Benefit Relevant Indicators (BRIs) – non-monetary measures of what is valued
- Values – monetary ($) or non-monetary (rank)



	Need to know what changes	Who that change affects and how (What is valued)	How important that change is to them (Its value)

Service/ Social Benefit	Potential Indicator(s) ($ = monetary measure)
Dredging	Avoided costs of navigational waterways dredging ($)
Health Impacts	Reduction in number of households exposed to water borne disease with the project in place Changes in supply/ availability of fresh water due to water quality impacts Increase in number of households with improved access to seafood
Species Persistence	WTP for certain species Books, art, or literature related to a specific charismatic species
Commercial Fishing	Area of aquaculture leased bottom in the project's vicinity Number of commercial fishing/ shellfishing permit holders affected by project Increases in commercial fishing/ shellfishing revenues ($) Avoided number of days of shellfish bed closures (acres/ days)
Aesthetics	Changes in property values associated with increased aesthetics ($) Number of photos tagged at a certain site
Culture and Heritage	Number of cultural or heritage properties benefitting from the project Reduction in number of cultural or heritage properties exposed to flood events with the project in place
Recreation	Number of recreational fishing/ shellfishing sites and areas in the project's vicinity Number of recreational users living within distance of using the site Increased tourism revenues ($) Number of visitors due to improved avian and terrestrial species habitat and biodiversity
Carbon Storage	Carbon sequestration rate by habitat Social Cost of Carbon ($)
Shoreline protection	Number of households potentially affected (in terms of flood events) by a project Property value of residential and commercial properties exposed to flood events with and without project ($) Reduction in flood insurance premiums or change in the Community Rating System (CRS) rating of the NFIP as a result of the project ($)
Research and Education	Increase in number of communities and other institutions accessing project products or tools Use of science or tools by other organizations or stakeholders Number of researchers, volunteers, and students engaged at the site or with the project Increase in number of schools with access to natural resources

Predictive model exploration

GALLINAS CREEK AND MCINNIS MARSH SAN FRANCISCO BAY CALIFORNIA

"Tidal wetland portion of the restoration is focused on McInnis Marsh, a 180-acre area of diked historic wetlands located at the confluence of the North and South forks of Gallinas Creek within McInnis Park. The restoration project includes work in McInnis Marsh, as well as in adjacent reaches of both Gallinas and Miller Creeks, which lay to the south and north respectively."

Kamman, R., et al. 2016. McInnis Marsh Restoration Project: Feasibility Study and Alternative Analysis

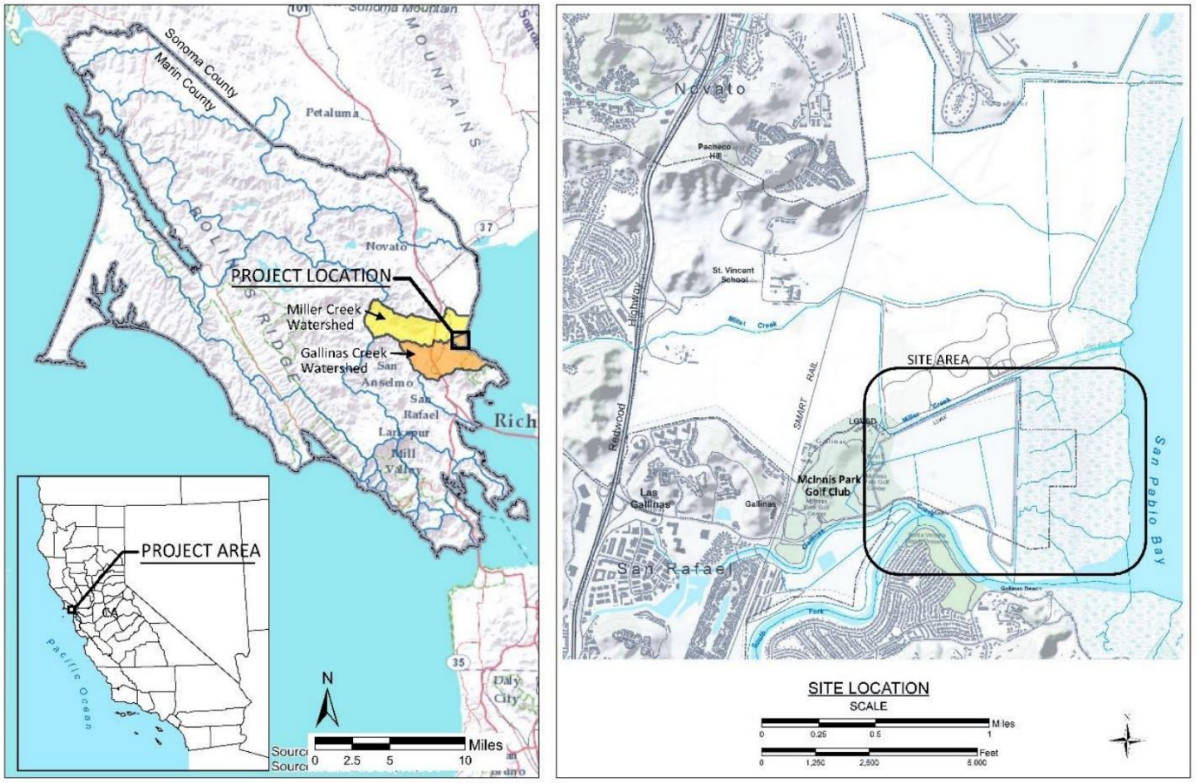


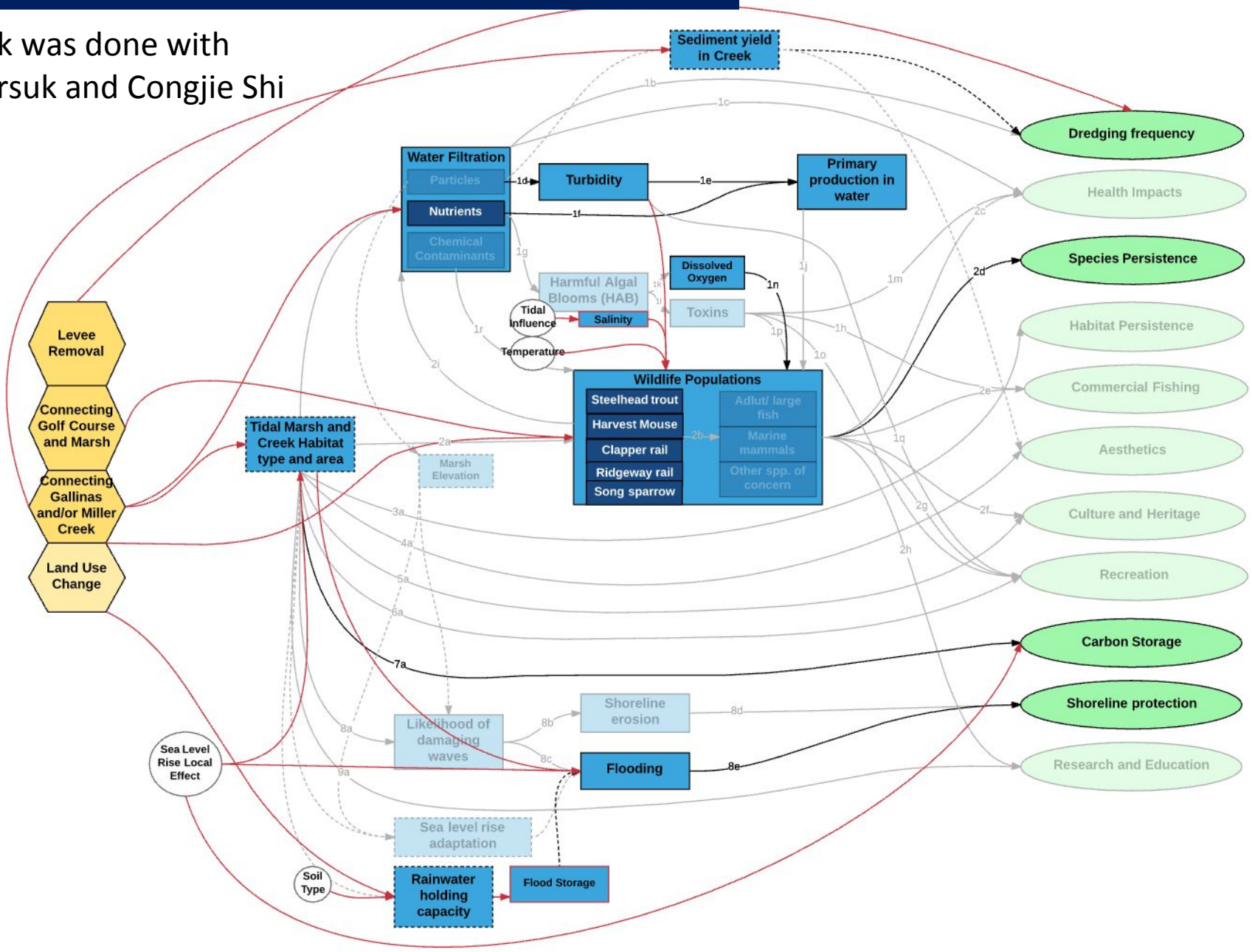
Figure 1-2: McInnis Marsh Site Location Map

Gallinas Creek

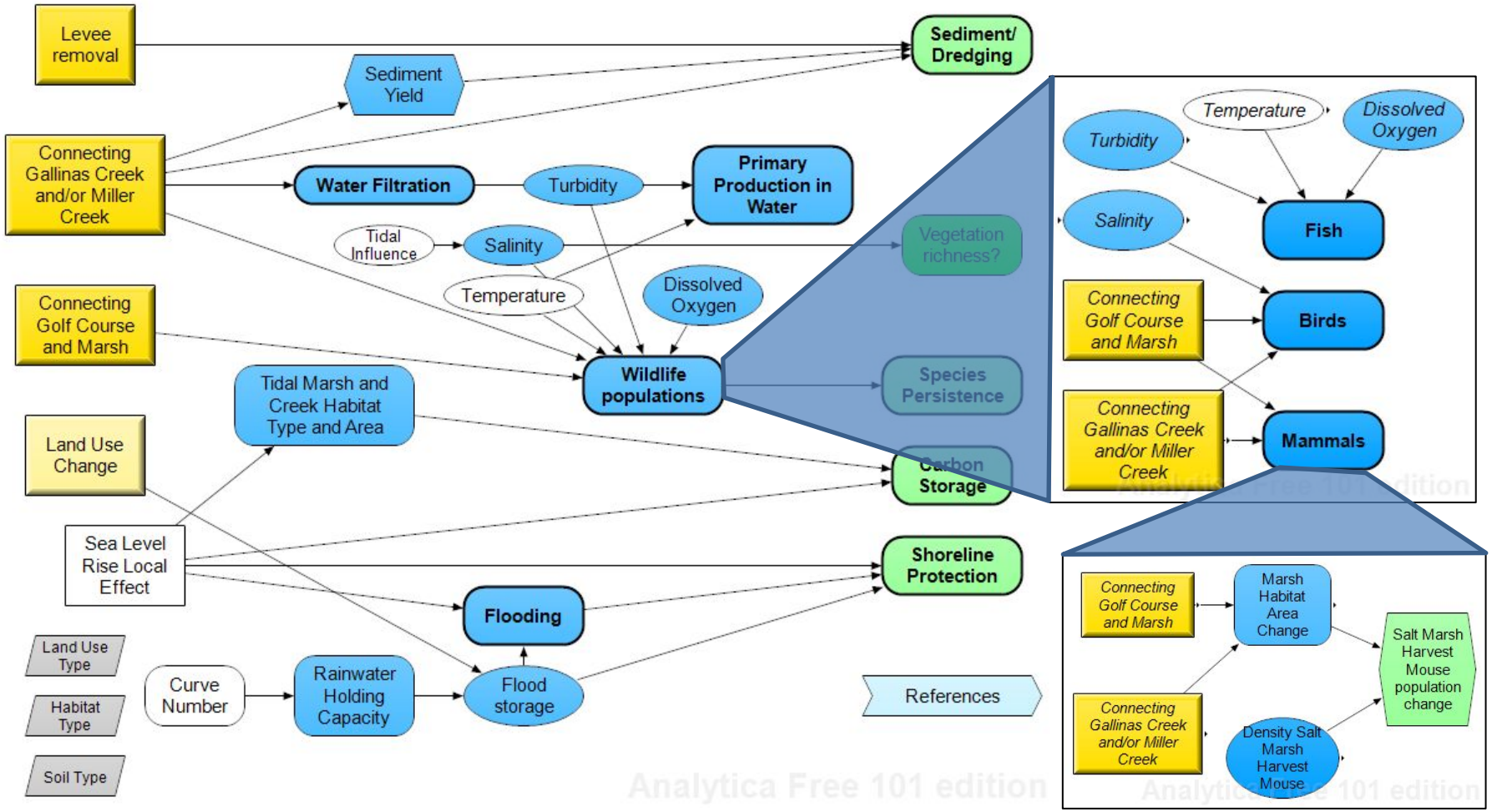
McInnis Marsh

Predictive Scenario model

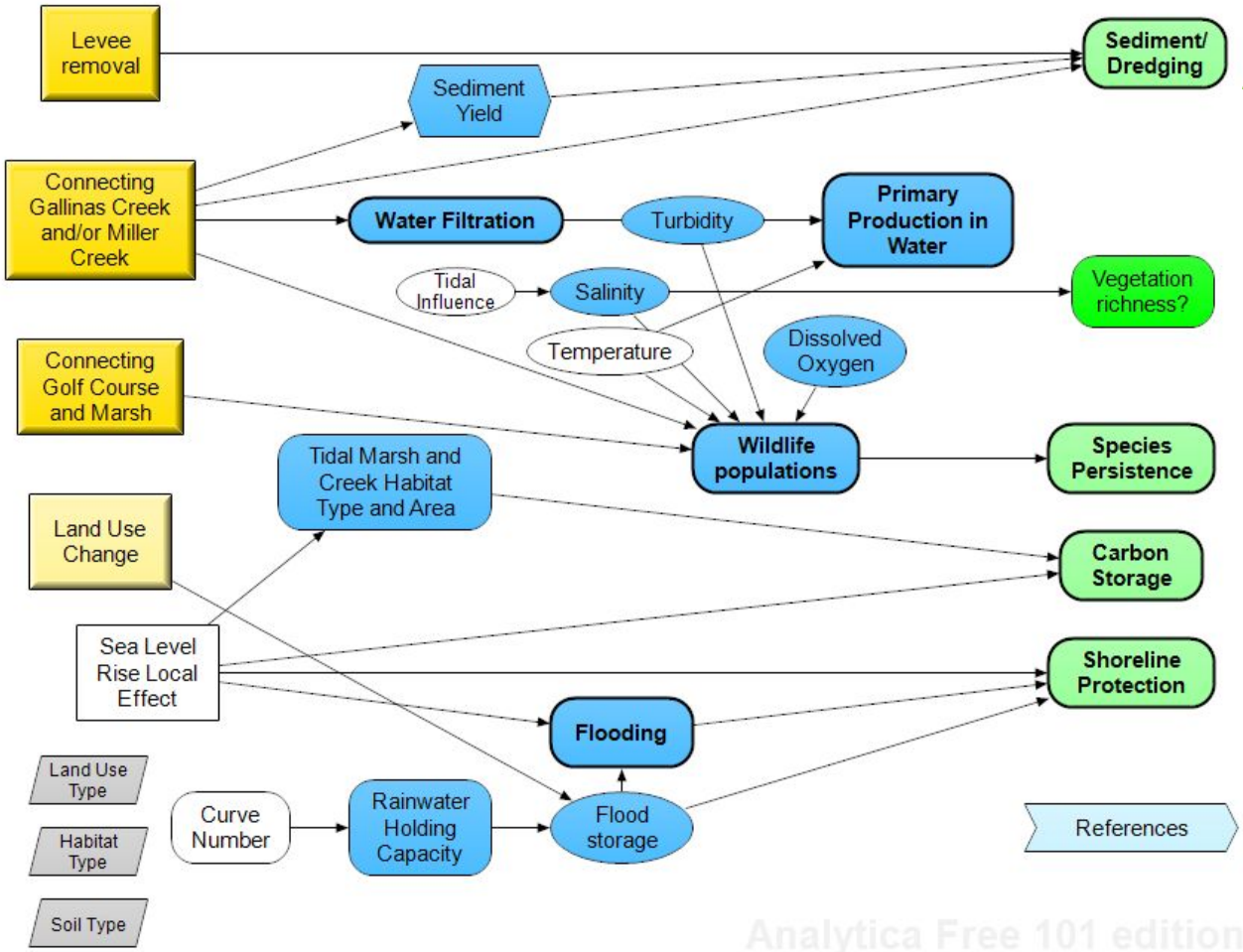
This work was done with
Mark Borsuk and Congjie Shi

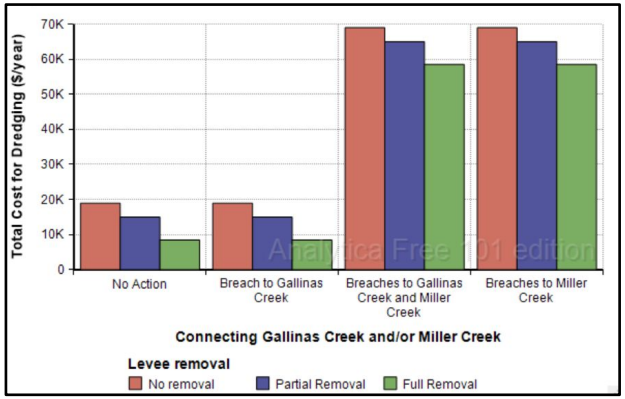


Model as it appears in Analytica – Nested submodels



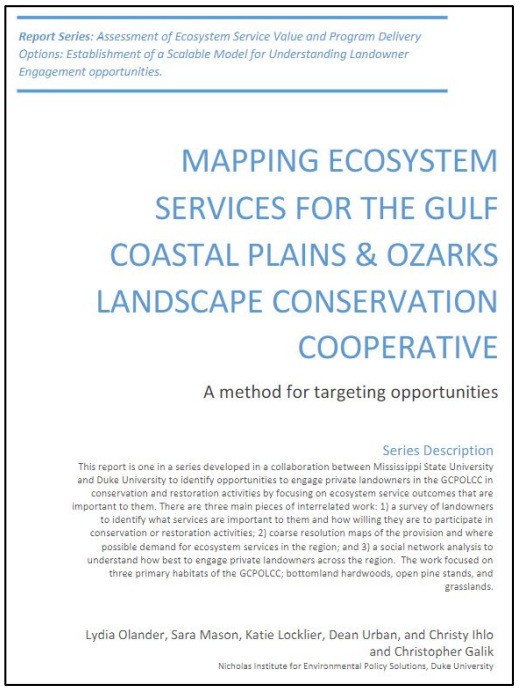
Ecosystem Service Endpoints

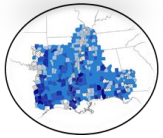




Conceptual model foundation for ES assessments and prioritization

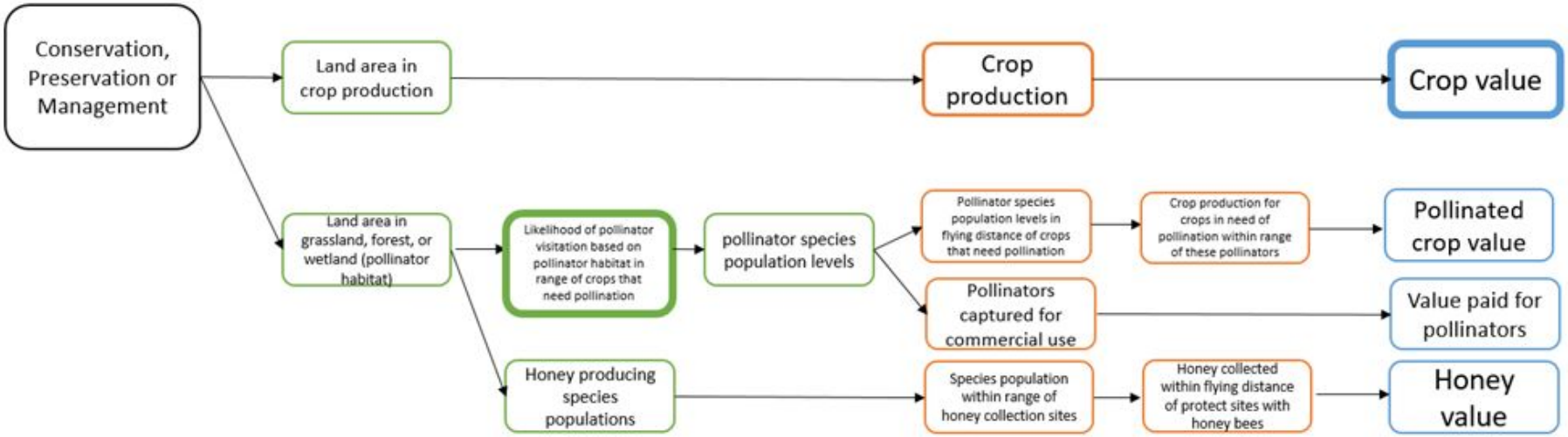
- To get stakeholders and experts on the same page
- To provide an intuitive entry point for those new to ecosystem services
- To capture effects of interventions in a transparent and systematic way
- To make sure no critical outcomes/impacts are missing
- To reduce time and expertise needed
- To reduce duplication of effort
- To identify critical research gaps and areas of uncertainty
- To identify a subset of socio-economic metrics
- To provide consistency
- To provide a credible foundation for qualitative assessment, quantitative assessments or monetary or non-monetary valuation where such methods are desired.





Gulf Coastal Plains & Ozarks
Landscape Conservation Cooperative

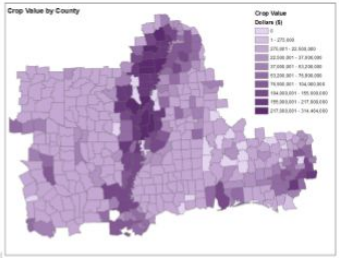
Ecosystem service data assessment and mapping



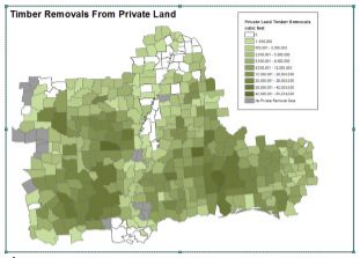
Services we were able to map…

Service	Description	Data Source	Scale
Food Provision	Crop sales per acre of cropland	USDA Cropland Data Layer (CDL)	County
Timber Production	Merchantable timber extractions	FIA	County
Pollination	Areas that support pollinators within range of crops that need them	National Land Cover Dataset (NLCD); CDL	HUC 12
Forest C Sequestration	Carbon stored in existing forests	USDA FS Forest Inventory Analysis (FIA) database	County
	Potential additional carbon storage on private lands	FIA	County
Water Filtration (proxy for water quality improvement)	Length of natural habitat in the hydrological flow path between non-point sources of pollution and waterways	NLCD; DEM	HUC 12
Infiltration Capacity (proxy for flood mitigation potential)	Length of natural habitat in the flow path between impervious surfaces and waterways	NLCD; DEM	HUC 12
Biodiversity	Vertebrate species richness	EPA EnviroAtlas (GAP project data)	HUC 12
	Rare species richness	EnviroAtlas (nature serve data)	HUC 12
	T/E species' critical habitats	USFWS	n/a
Recreational Birding	Important Bird Areas	Bird Life International/ National Audubon Society	n/a
	Ebird user areas	eBird (Cornell lab of ornithology)	HUC 12
Recreational Hunting	Waterfowl harvests	USFWS Harvest Branch	County

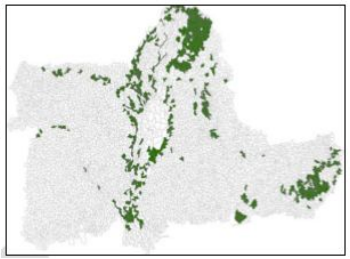
Crop values



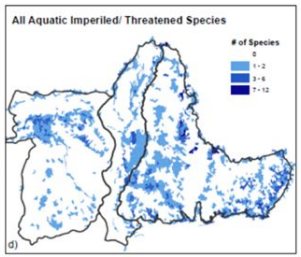
Timber Extractions



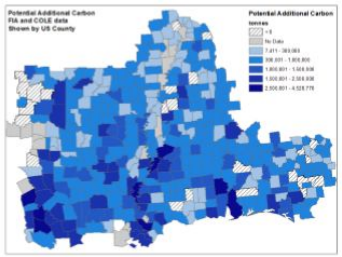
Pollination



Rare Species



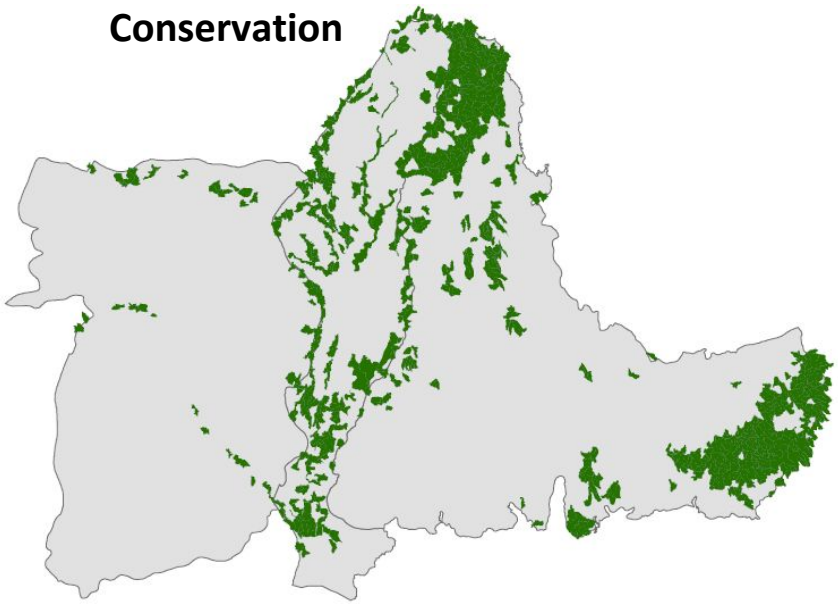
Potential C Storage



Conservation vs. Restoration

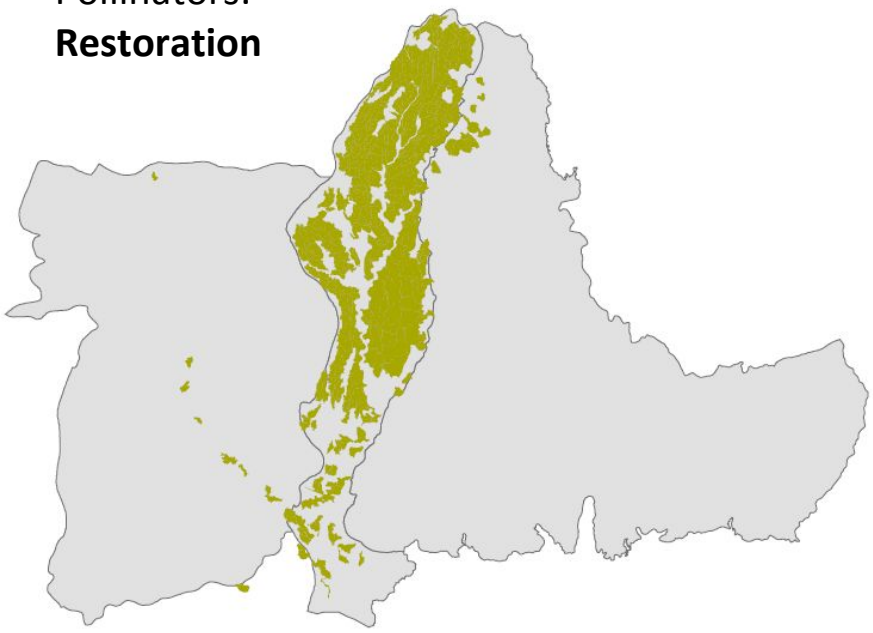
For most services we highlighted the areas most important for conservation and restoration

Pollinators:
Conservation



Areas with:
-large area of pollinator benefitted crops
-large probability of pollinator visitation

Pollinators:
Restoration

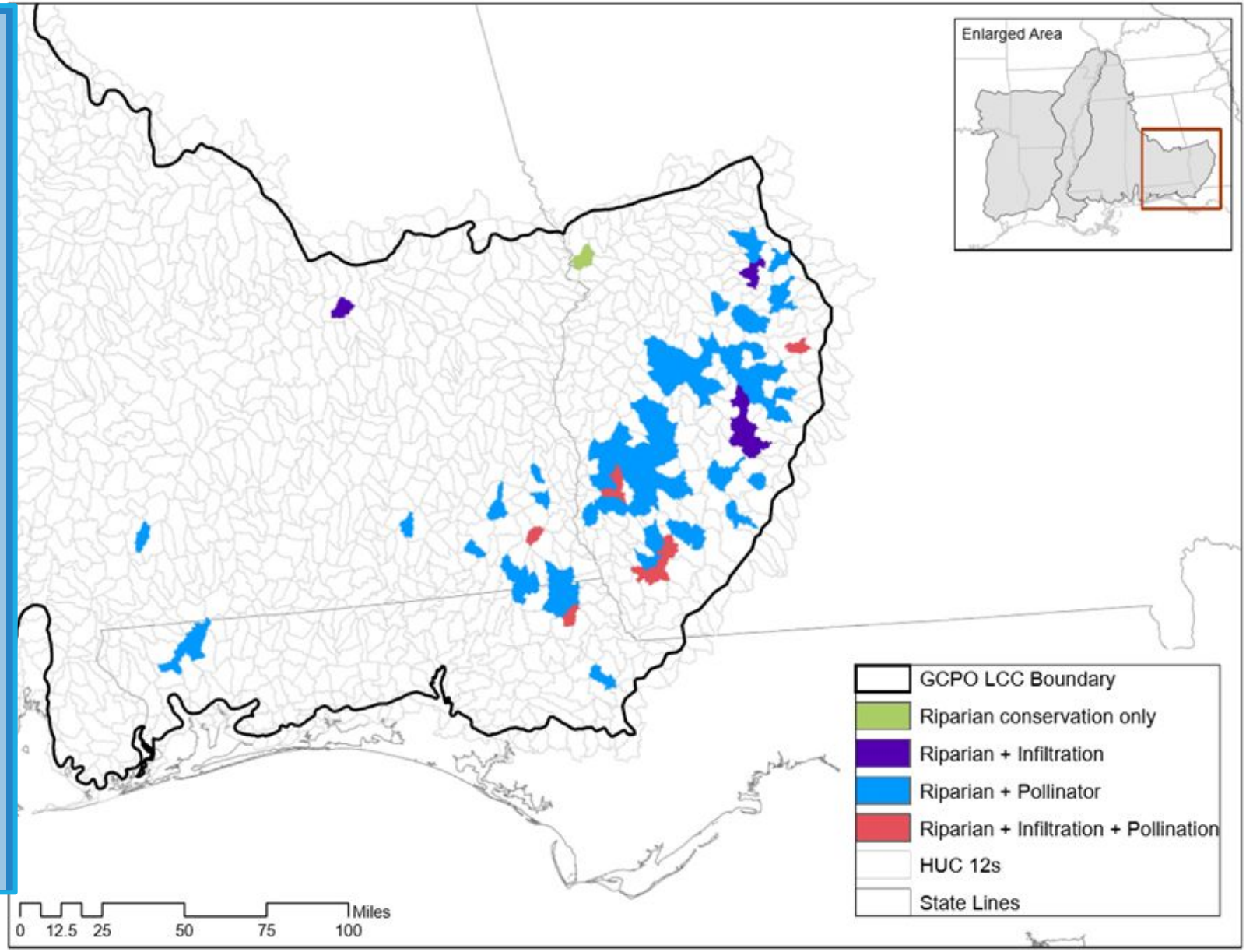


Areas with:
-large area of pollinator benefitted crops
-small probability of pollinator visitation

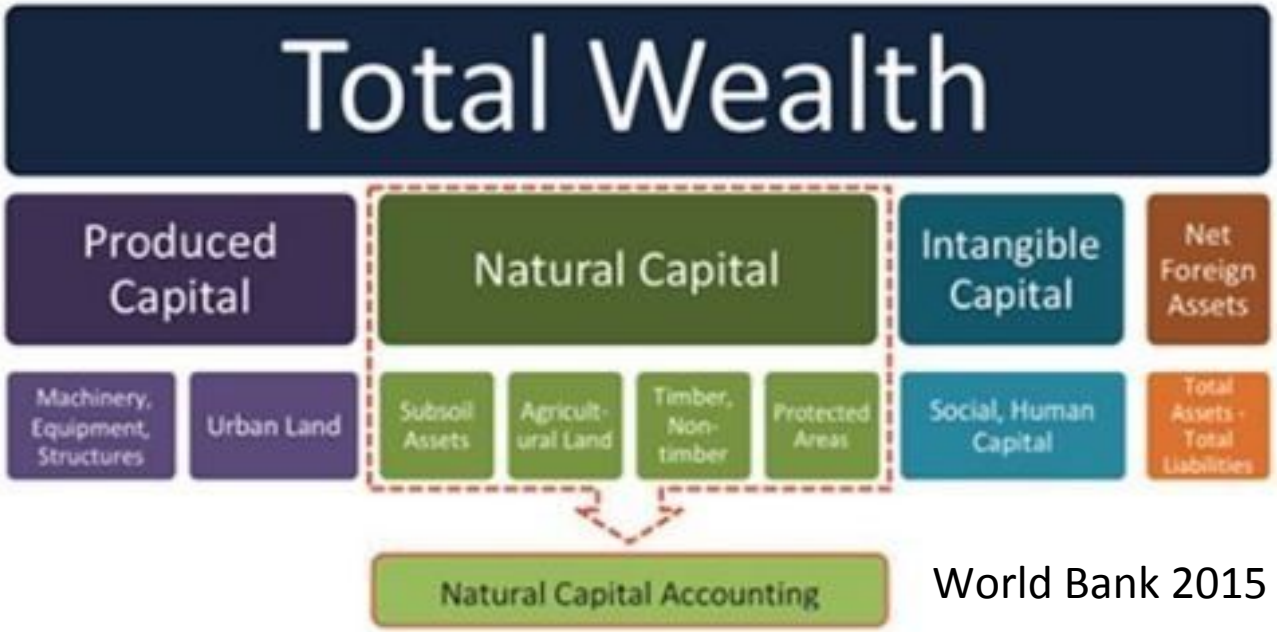
Combining data layers to answer management questions

Example:

Finding areas to **conserve for the preservation of water quality** filtration where it is needed (areas of high NPS coverage) that also provide **associated co-benefits**



Natural Capital Accounts (NCA) feed into comprehensive wealth accounting -- Beyond GDP

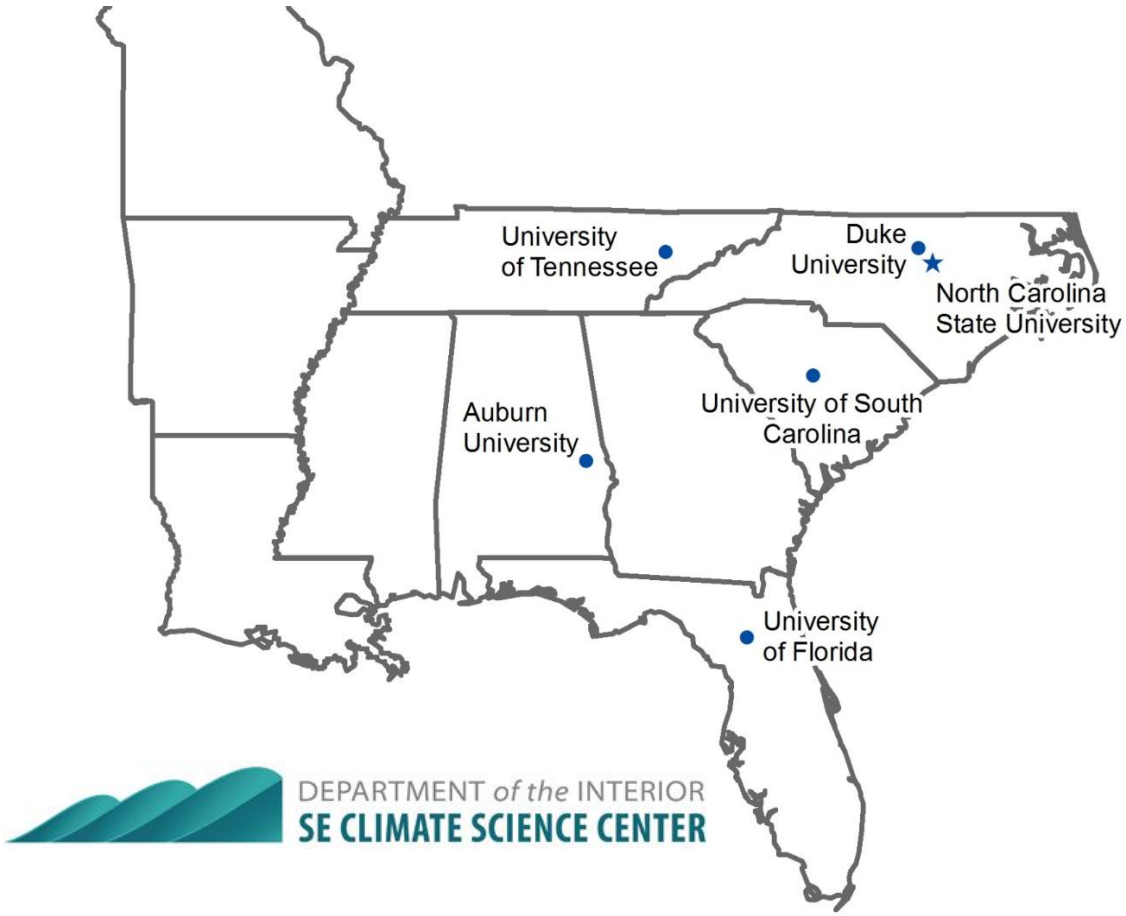


World Bank 2015

Natural capital accounting is the process of calculating the total stocks and flows of **natural** resources and services in a given ecosystem or region.

This process can subsequently inform government, corporate and consumer decision making regarding the use or consumption of natural resources and land, and sustainable behavior.

Natural Capital Accounts for ecosystem services for Southeast Climate Science Center in partnership with USGS led effort



Analyses are:

- Scalable to entire US
- Updateable (current focus on 2001 – 2006 – 2011)
- Transparent, replicable by USGS

Ecosystem service
Pollination
Water filtration
Biodiversity
Coastal protection
Forest carbon
Outdoor recreation
Air quality
…

Duke NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS

How is all of this relevant to AP NEP?

1. For core activities (repeated across the region/NEPs) develop a set of ESCMs to help reduce duplication of effort, simplify application of ecosystem services, select a core set of socio-economic indicators that complement ecological indicators (to allow roll up), increase consistency and credibility of application, and identify research gaps. (Useful for implementing National Disaster Recovery Framework?)
2. Use regional mapping of ecosystem services to inform prioritization of conservation, restoration, and management actions, and to track trends over time.

To contact me:
Lydia.olander@duke.edu

Same intervention in different systems (habitats)