



## ECOLOGICAL RESEARCH PROGRAM

BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

[www.epa.gov/ord](http://www.epa.gov/ord)

# ***The Ecological Research Program: MYP Overview***

For the Ecosystems Processes and Effects Committee of the EPA  
Science Advisory Board

By

Rick A. Linthurst and Iris Goodman  
National Program Director and Acting Deputy for Ecology  
Office of Research and Development  
USEPA

## ***Presentation Outline***

- Setting the stage: Visions of “a” future
- Ecological Research Program Goal
- What does it all mean?
  - The science behind the proposal
- Highlights of the ERP Multi-Year Plan
- Research coordination and partnerships

## ***As an ecologist, do you ever wonder?***

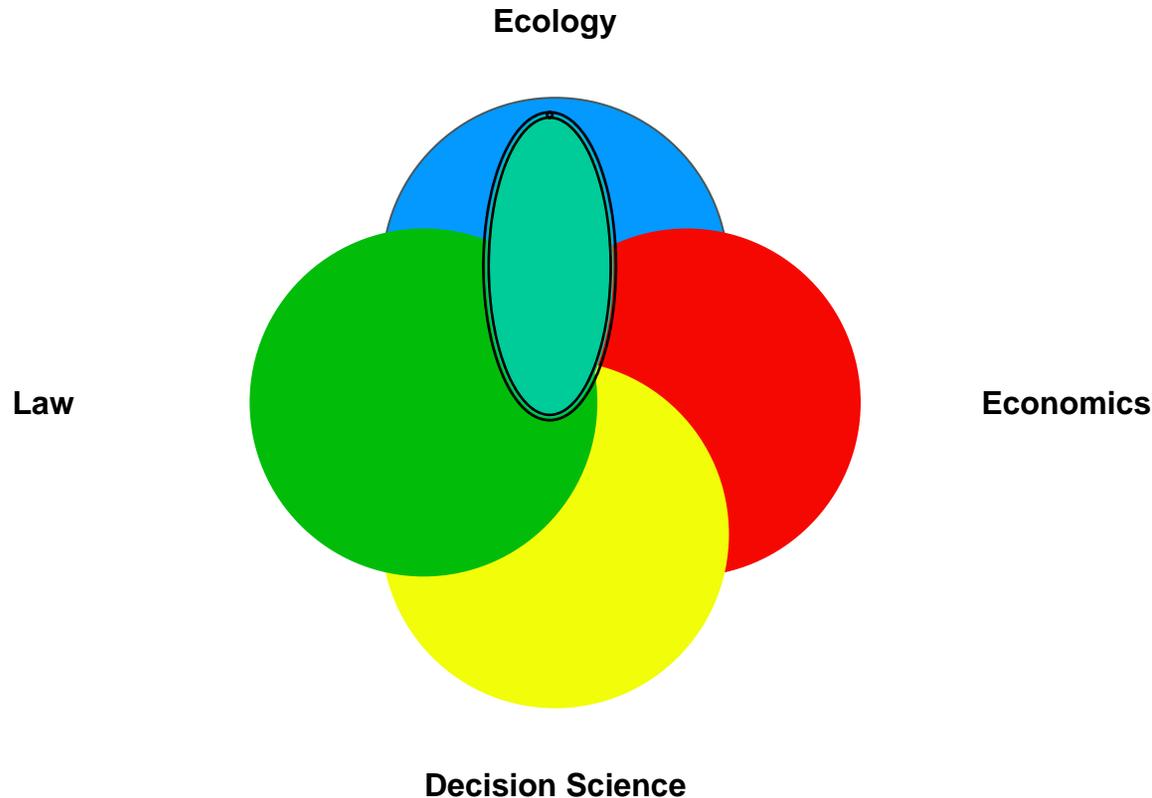
- Is it the science or the will that is missing from our actions (e.g., regulations, environmental stewardship, incentives, enforcement) ?

***You decided to do what?***  
***S.T.A.P.L.E.***

- Social
- Technical—Science and Technology
- Administrative
- Political
- Legal
- Economic

**S+T+A+P+L+E = 100% of the Decision**

# *Transdisciplinary Approach to Conserving Ecosystem Services*



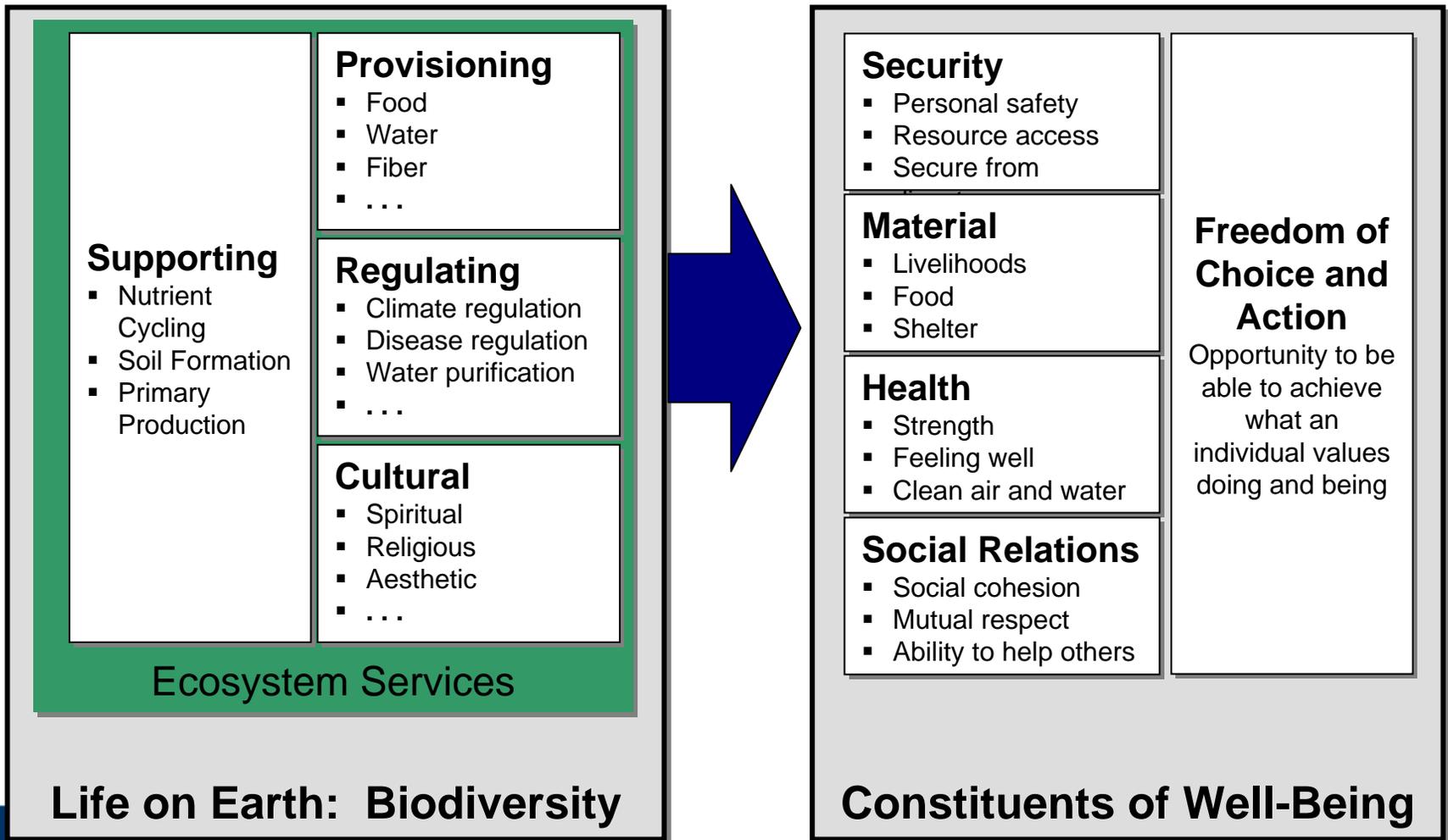
# LIVING BEYOND OUR MEANS



## NATURAL ASSETS AND HUMAN WELL-BEING

*Statement from the Board*

# Consequences for People



## ***Two key MEA findings greatly influenced the Ecological Research Program***

- “Everyone in the world depends on nature and ecosystem services to provide the conditions for a decent, healthy, and secure life.”
- “Even today’s technology and knowledge can reduce considerably the human impact on ecosystems. They are unlikely to be deployed fully, however, until ecosystem services cease to be perceived as free and limitless, and their full value is taken into account.”

ERP’s role is to provide the science to (1) clarify this dependence, (2) describe the full range of values, (3) quantify what we know about the limited v. limitless nature of different services.

## ***Choices are, and will continue to be, made!***

- Decisions at all scales are being made using some weighting, whether defined or not.
- Our approach is not a substitute for regulatory mandates to protect ecosystems, it is a complement.
- Our goal is to lay out a systems-approach for managing the whole suite of services to enable better choices and solutions.
- We believe ERP science can be a catalyst for innovative management, strategic investment, and real innovation in sustaining resilient ecosystems and their services.
- We are **not** proposing to put a dollar value on every service/ecosystem

## ***The EPA Challenge:***

**Change the economic and human well-being foundation for environmental decision-making relating to ecosystems.**

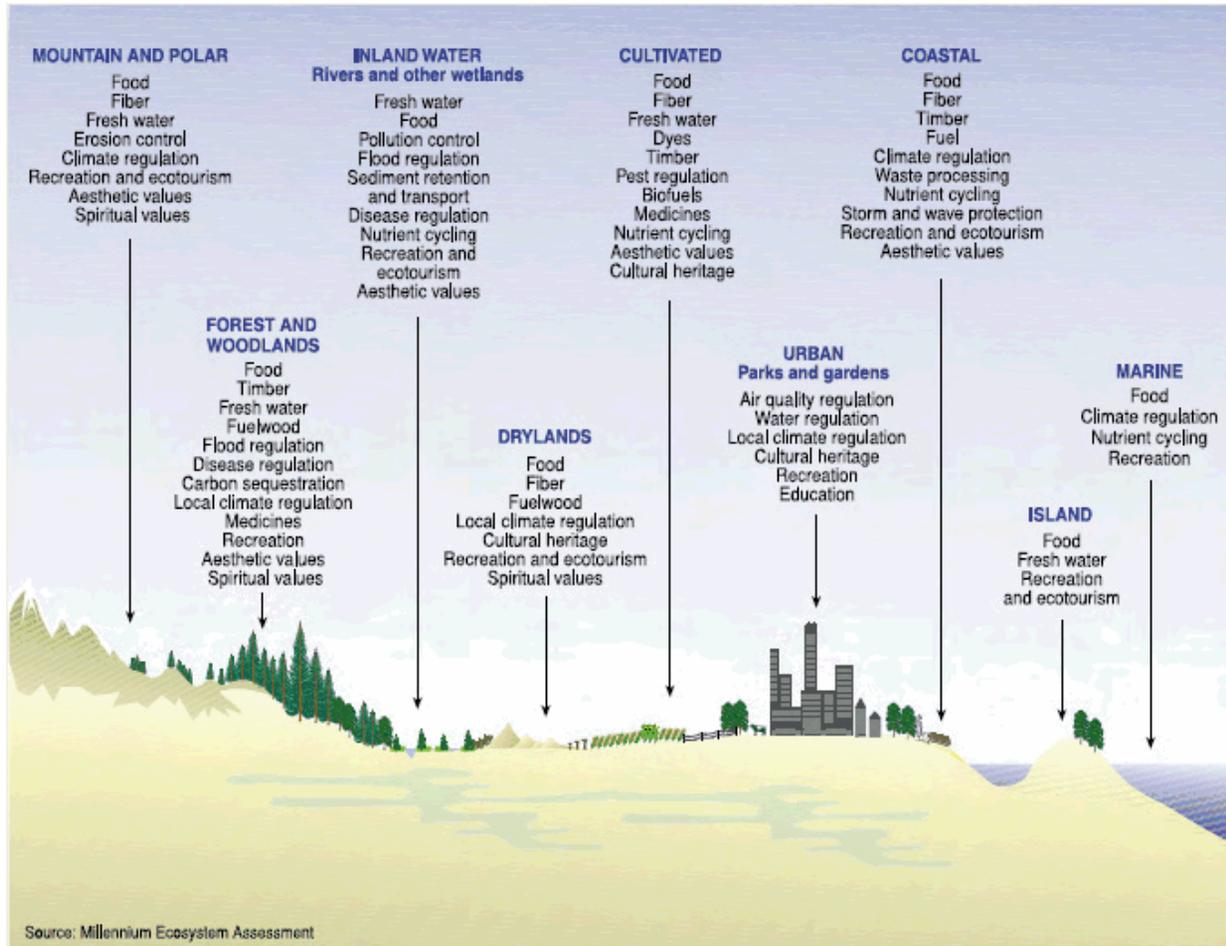
## ***Ecological Research Program Goal***

**To transform the way we understand and respond to environmental issues by making clear the ways in which our choices affect the **type, quality and magnitude** of the services we receive from ecosystems -- such as clean air, clean water, productive soils and generation of food and fiber.**

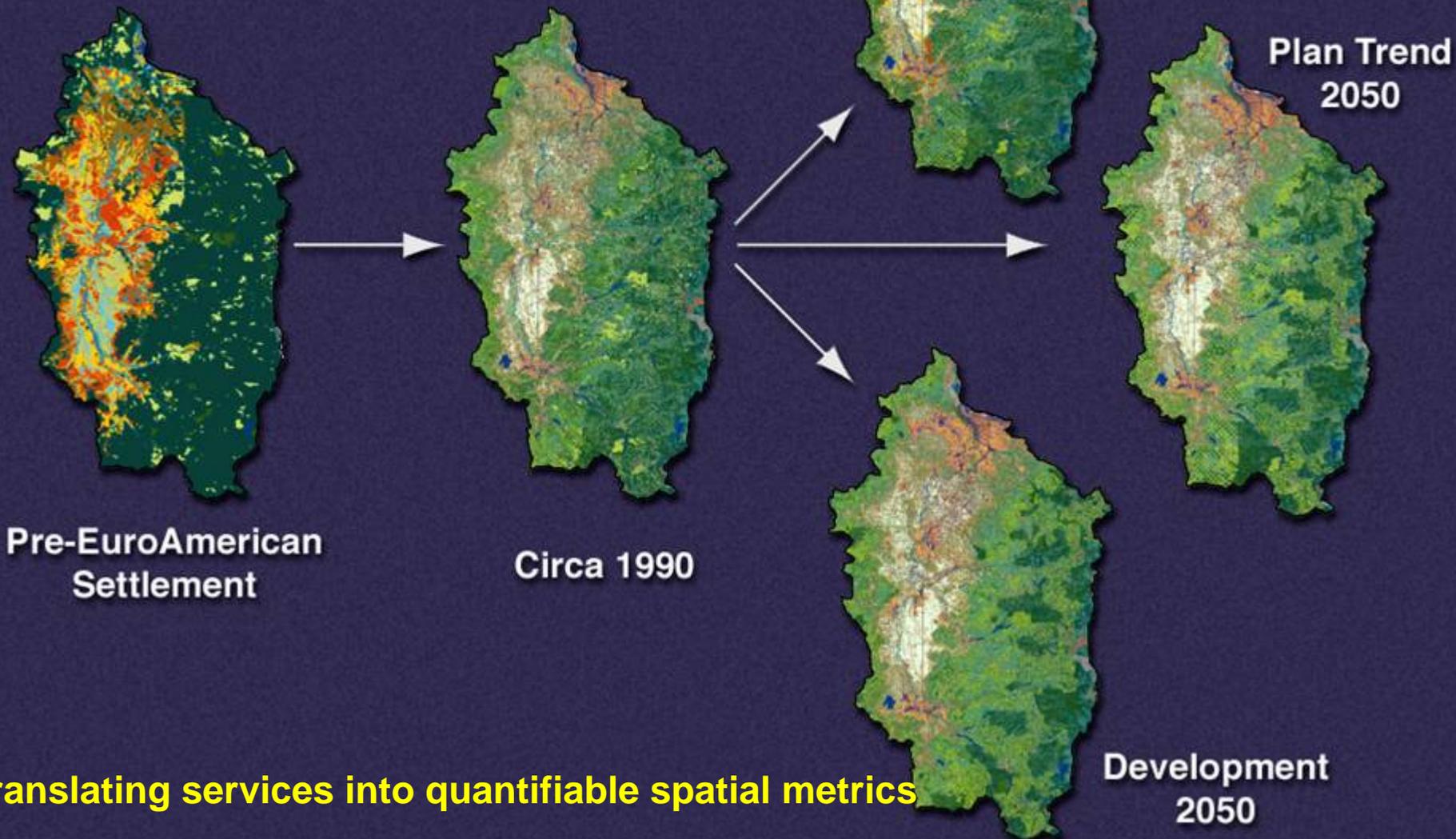
## ***How can ecology help?***

- Supporting the “art of the possible”
- Examples from previous research by ERP, grantees, and partners.

## An Intuitive View of Ecosystem Services. . . but of little help to decision-making

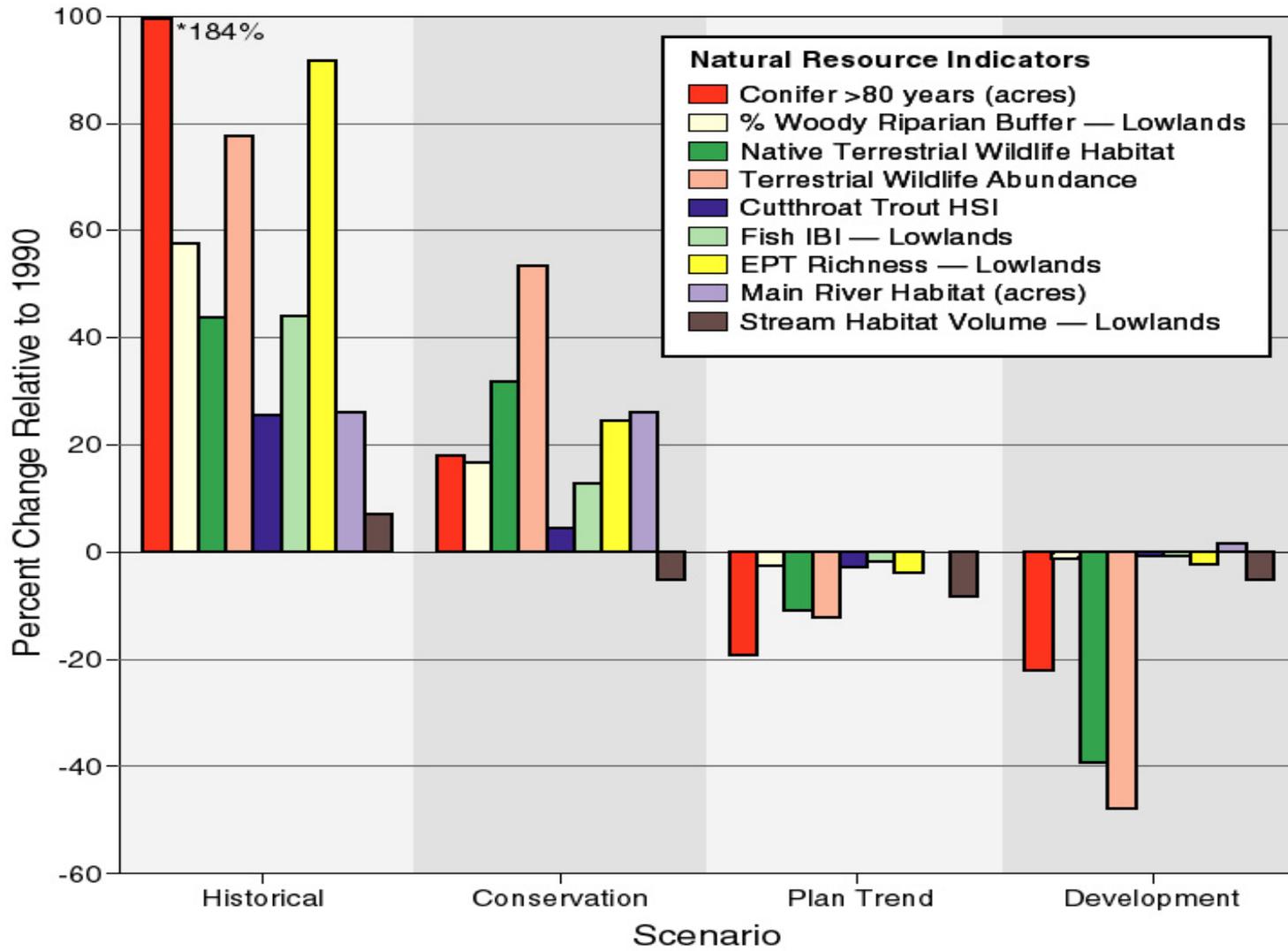


# Trajectories of Landscape Change in the Willamette Basin



Translating services into quantifiable spatial metrics

# Willamette Basin Alternative Futures Scenario Evaluations



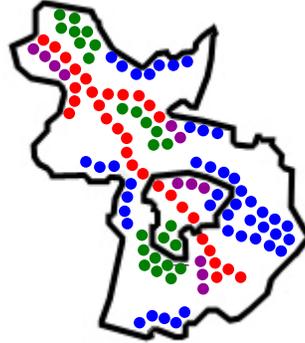
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# Systems Approach at Multiple Scales “Time 1”

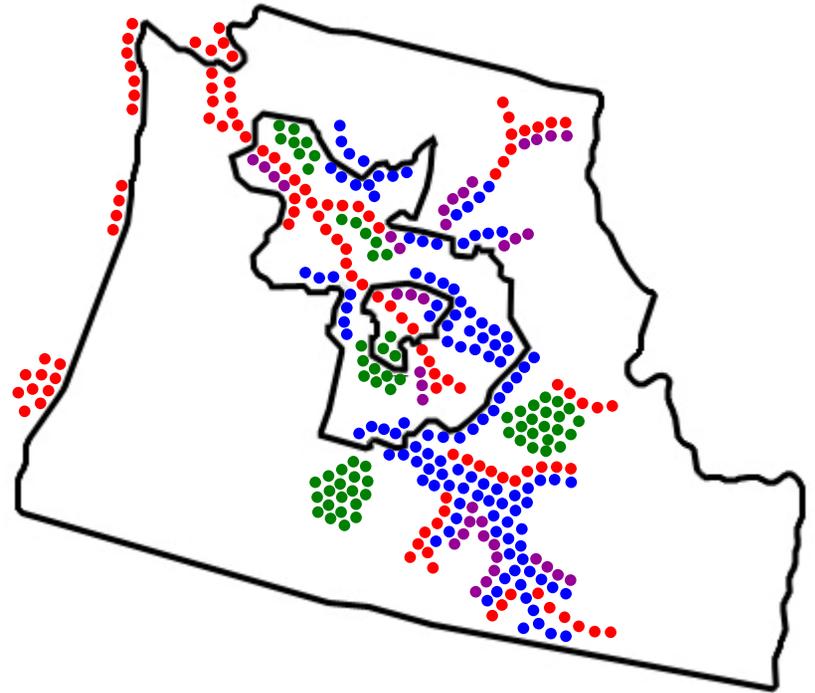
Local



Landscape



Regional



- Water provisioning
- Food production
- Fisheries
- Carbon storage

## County X

### Decision-makers

- County Commissioners
- Zoning Boards
- Local businesses
- Developers
- Municipal authorities
- Civic groups

## Watershed Y

### Decision-makers

- Ditto as for local-scale, plus:*
- Watershed organizations
- State Legislators
- Governor
- Dept. of Health
- Dept. of Natural Resources
- Conservation organizations

## Region Z

### Decision-makers

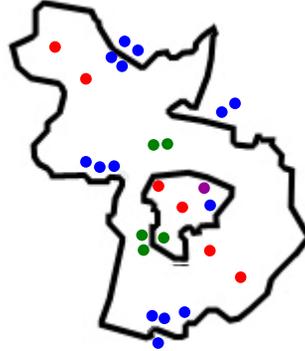
- Ditto as for watershed-scale, plus:*
- Regional EPA
- Federal Land Managers
- Tribes
- Major businesses

# Systems Approach at Multiple Scales “Time 2”

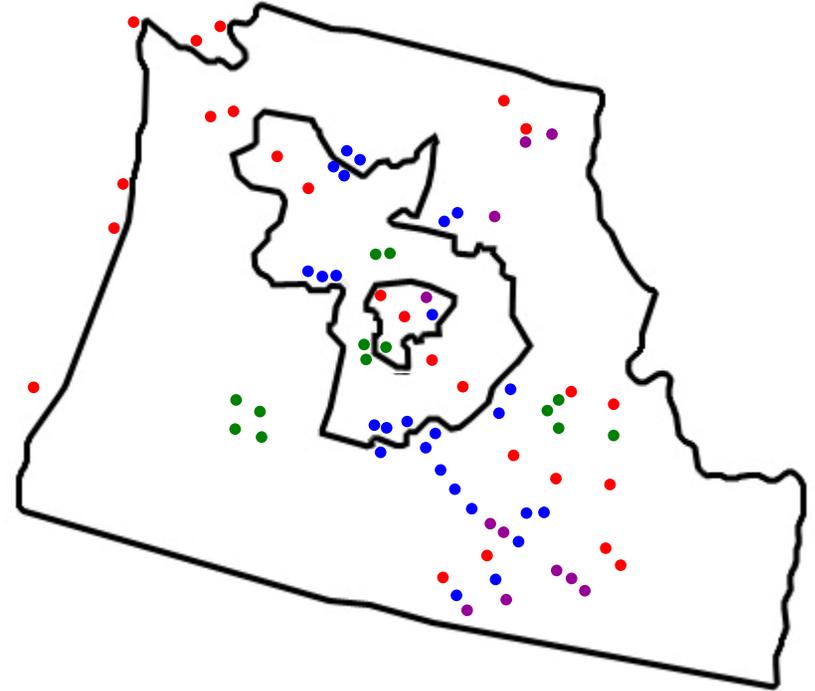
Local



Landscape



Regional



- Water provisioning
- Food production
- Fisheries
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## County X

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## Watershed Y

### Decision-makers

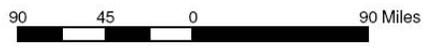
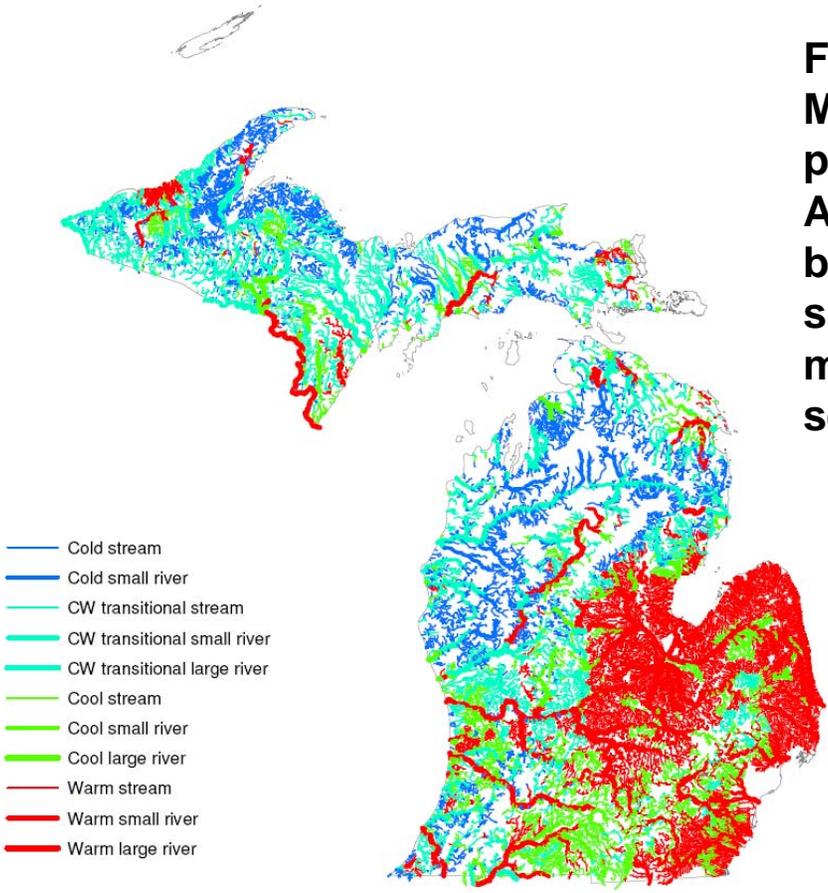
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## Region Z

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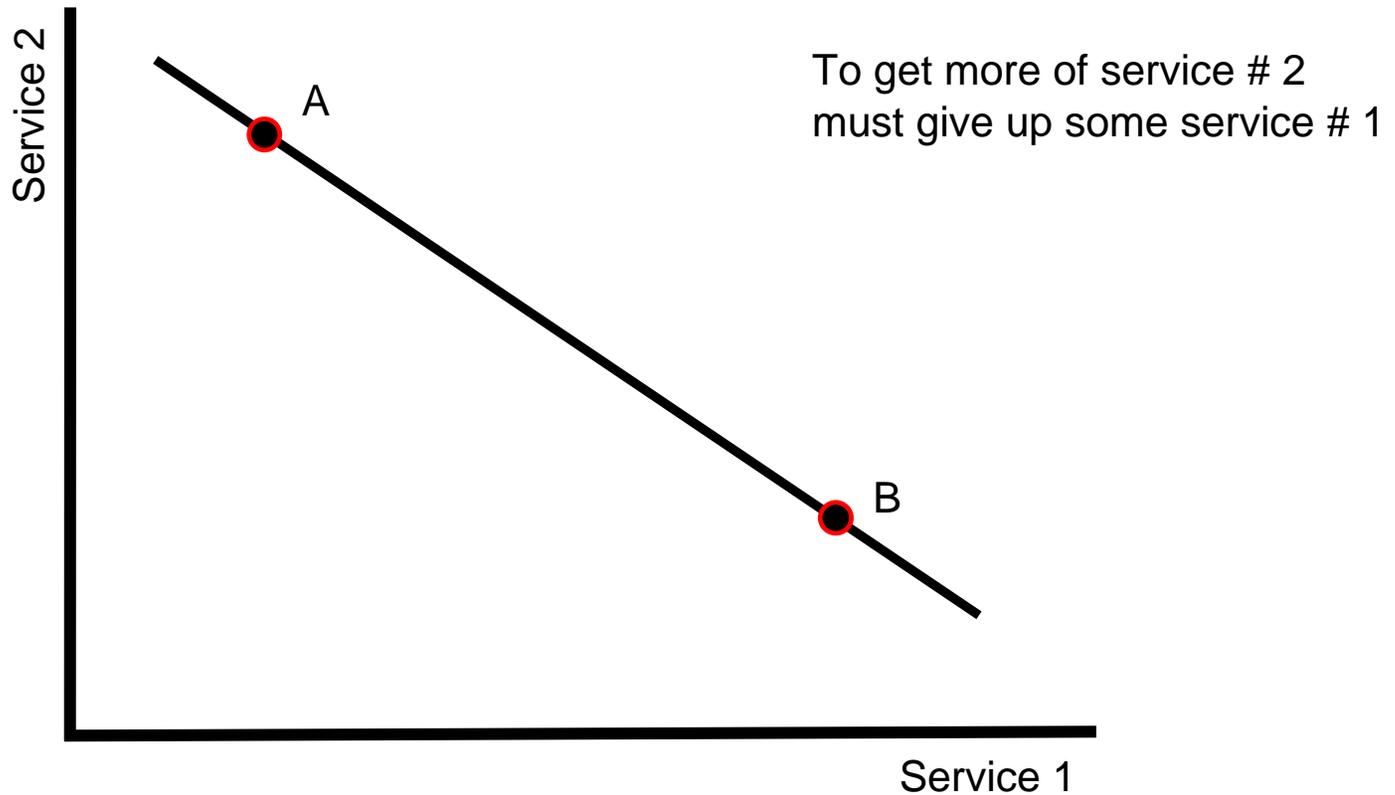
- Ditto as for watershed-scale, plus:*
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**Fisheries classification of Michigan river systems used in the proposed Water Withdrawal Assessment Tool. Classification is based on catchment area and summer temperature criteria, and mapped for ~8,000 ecological river segments.**

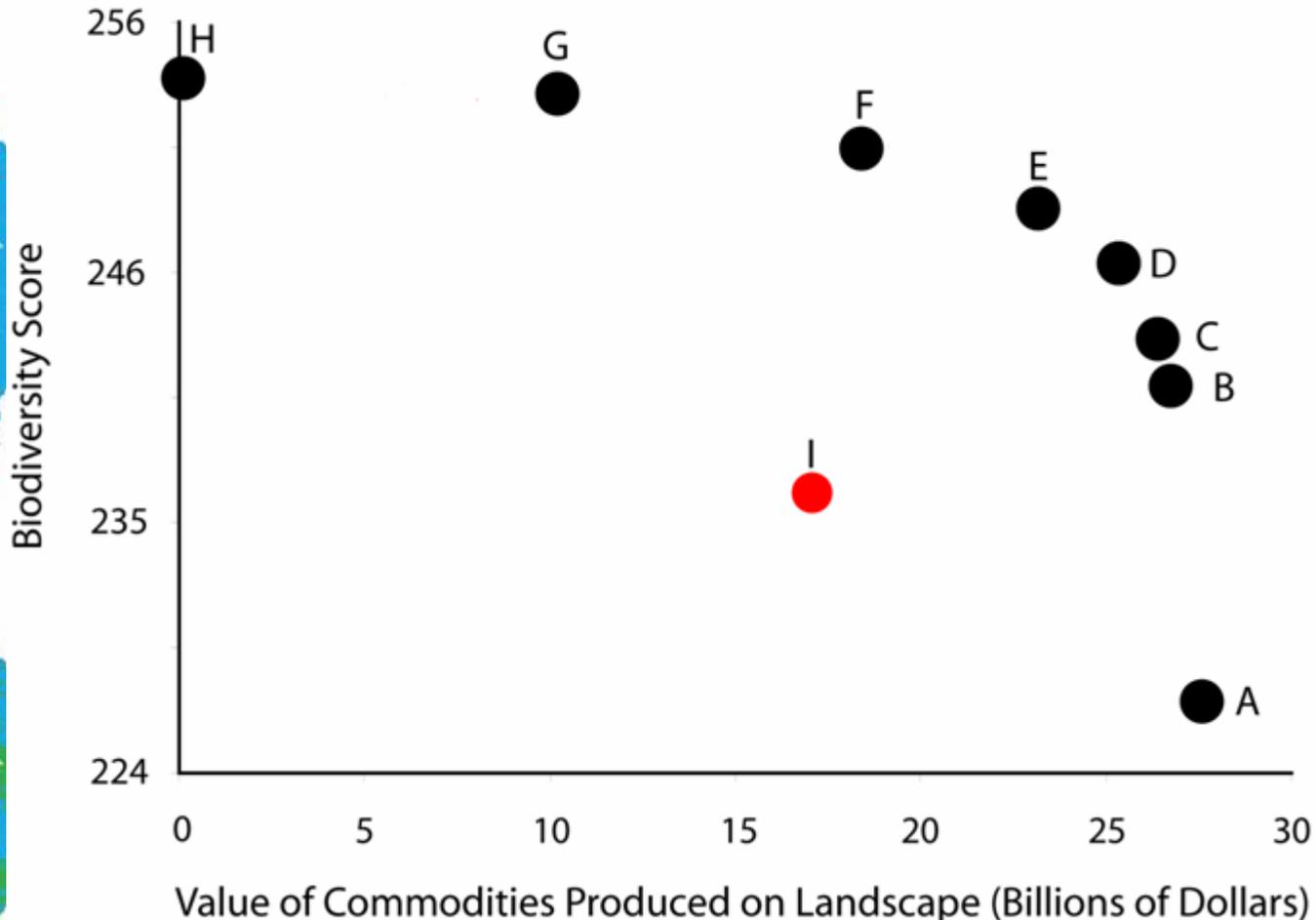
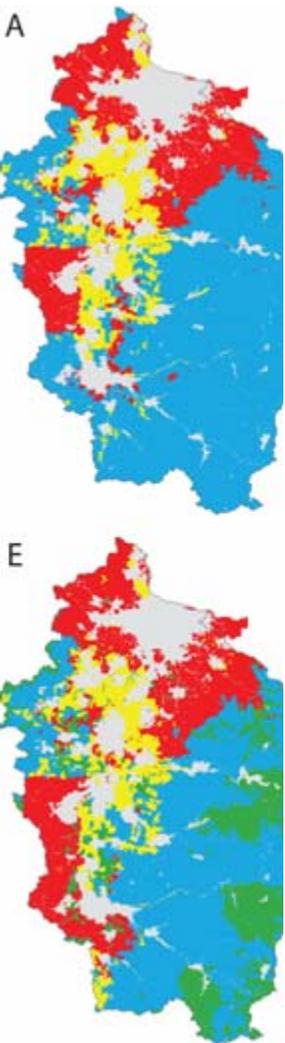


**Basis of map and fisheries classification was funded by EPA STAR grant program for Ecology**

## *Many choices affecting services require trade-offs*



# Willamette Valley, Oregon



UGB  
 Iture  
 ged Forestry  
 Residential  
 rved

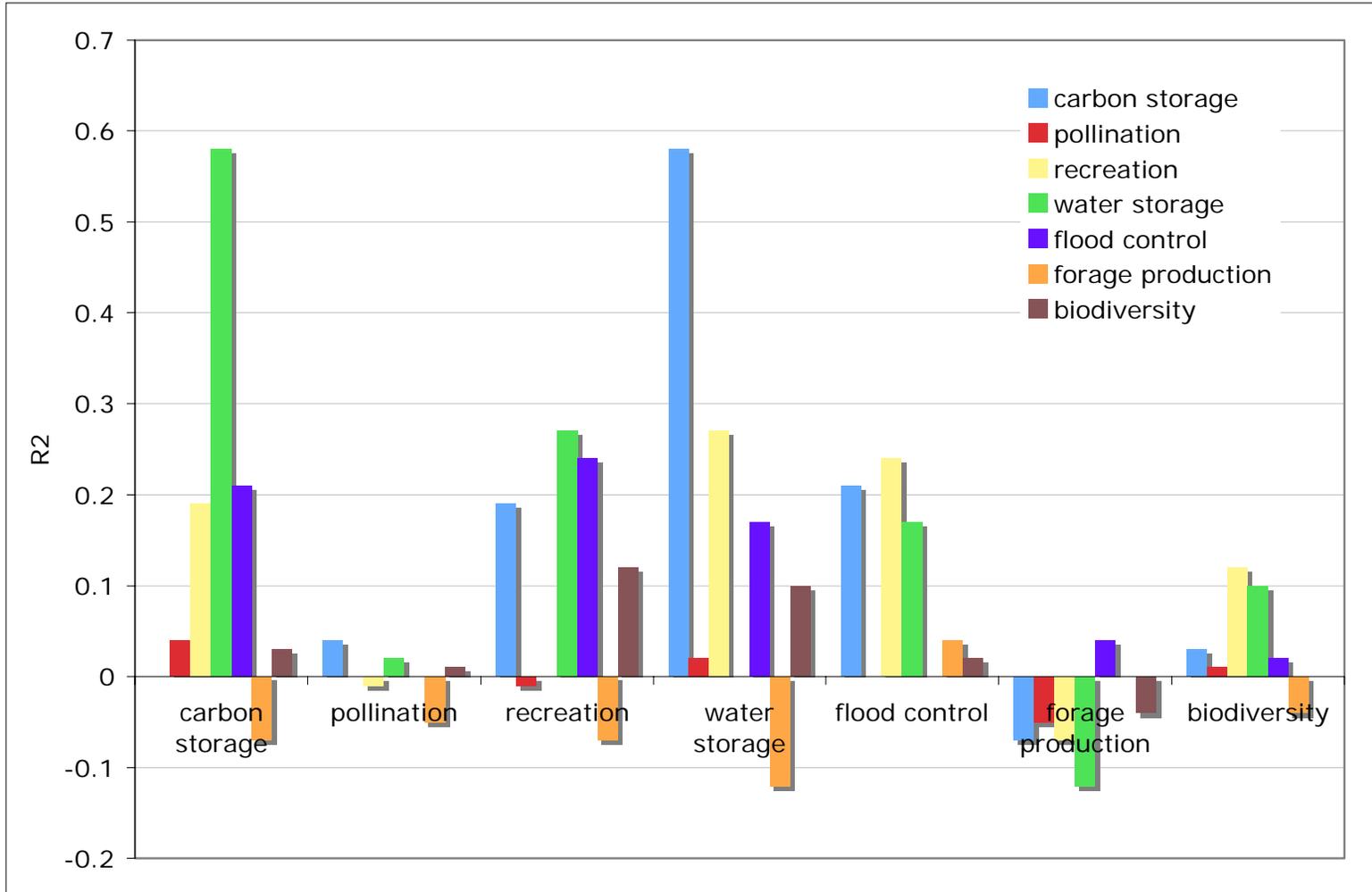
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Source: Steve Polasky, et al. Applied Economics, Univ. of Minn. "Conservation of working landscapes." Unpublished data.

***Still, much work remains. We need better methods for:***

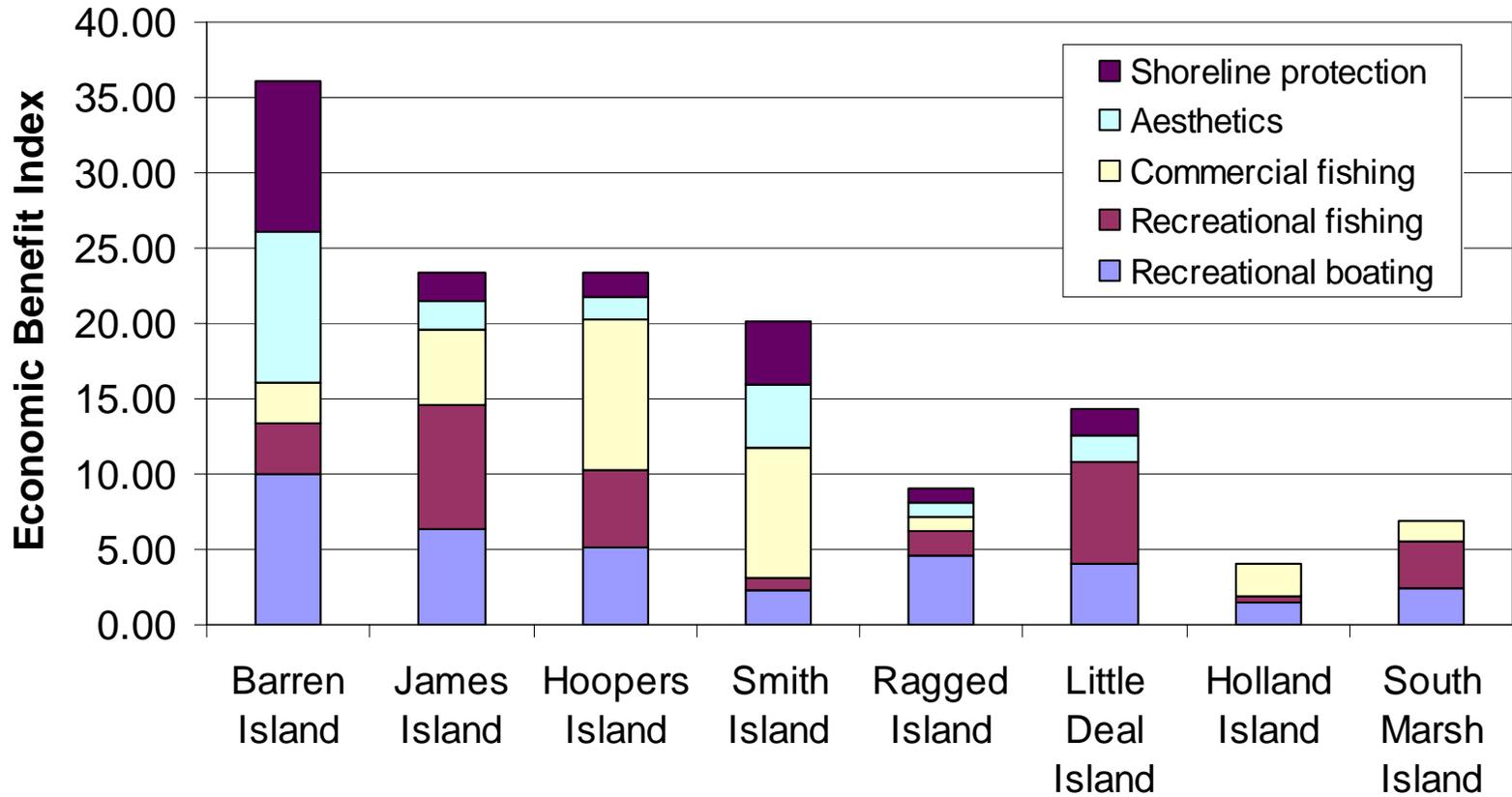
- 1) Opportunities to maximize bundled services
- 2) Interactions among related services
- 3) Methods to quantify trade-offs
- 4) Identifying, quantifying, and predicting “tipping points” and subsequent effect on services
- 5) Ecological approaches to managing risks to ecosystem services

## Correlations of Ecosystem Services: Central Coast, California



## ***Bundling Services***

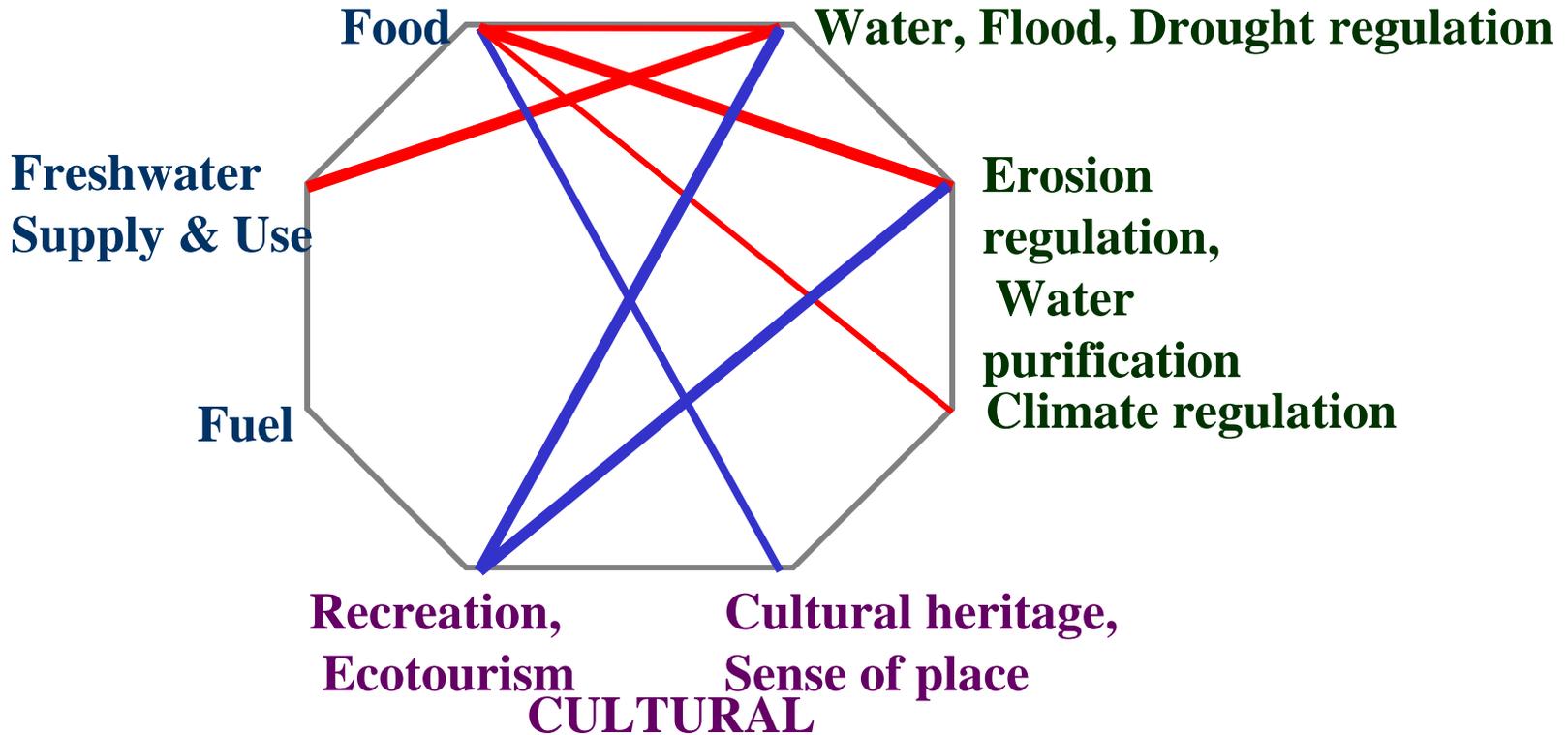
### ***Economic Benefit Indicators for Chesapeake Bay Island Sites***



Interactions of Ecosystem Services: Current Conditions

**PROVISIONING**

**REGULATING**



— **Positive interaction** (line width indicates the strength of the interaction)  
— **Negative interaction**

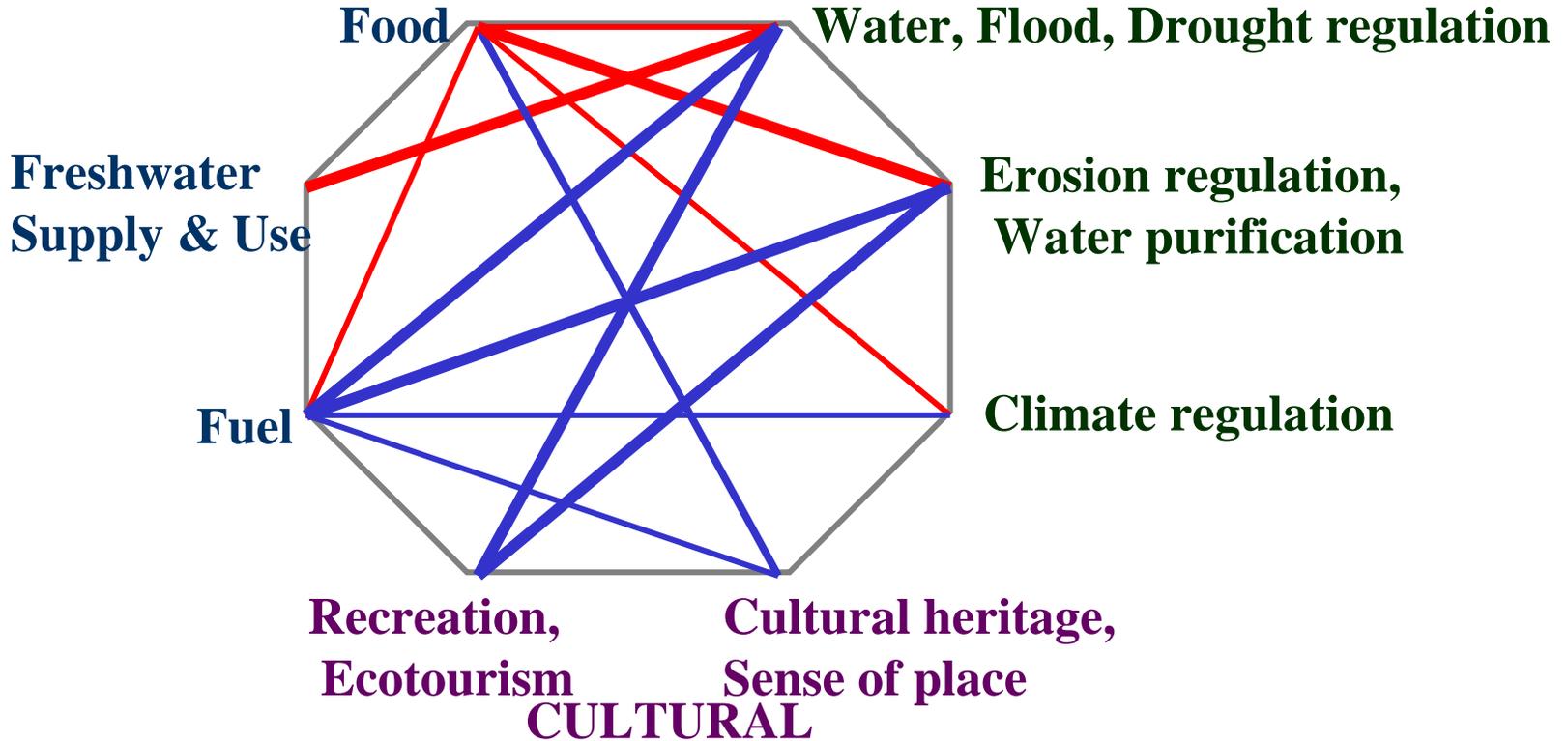
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Interactions of Ecosystem Services: Add Prairie Biofuel

PROVISIONING

REGULATING



— **Positive interaction** (line width indicates the strength of the interaction)  
— **Negative interaction**

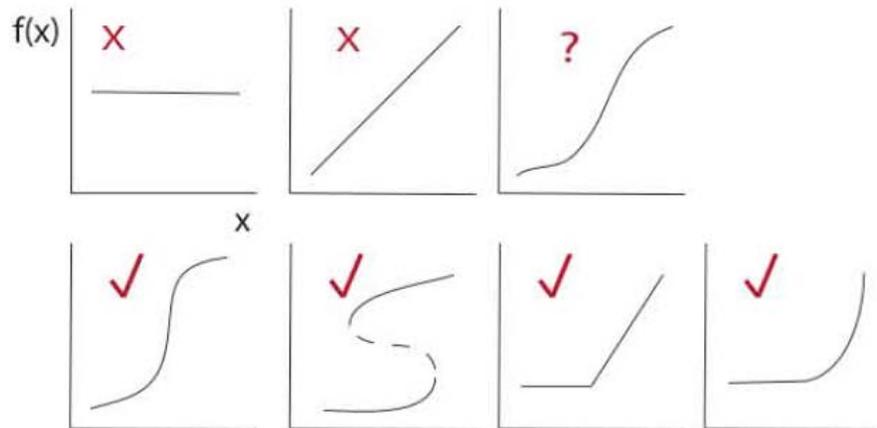
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# 1. Background: “Threshold”

6

“The separation between two distinct system behaviors.”

$$x_{crit} \equiv \text{threshold, iff } \frac{d^n f(x)}{dx^n} \Big|_{x \rightarrow x_{crit}^-} \neq \frac{d^n f(x)}{dx^n} \Big|_{x \rightarrow x_{crit}^+}, \text{ for any } n$$



## 2. Bayesian Analysis: Results

12

There's a 3.4% chance Lake Mendota is uni-stable

90.3%

reversibly bi-stable

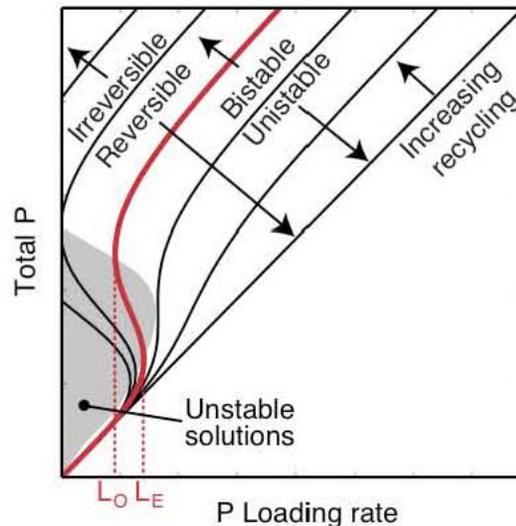
6.3%

irreversibly bi-stable

There's a 32% chance that  $L_E$  has been exceeded

15%

loads have not dropped below  $L_O$



*World Resources Institute: Steps in a corporate ecosystem services review*

Step



Key activity

Choose boundary within which to conduct ESR

- Business unit
- Product
- Market
- Landholdings
- Customer
- Supplier

Systematically evaluate degree of company's dependence and impact on ecosystem services

Determine highest "priority" services—those most relevant to business performance

Evaluate conditions and trends in priority ecosystem services, as well as drivers of these trends

Identify and evaluate business risks and opportunities that might arise due to the trends in priority ecosystem services

Outline and prioritize strategies for managing the risks and opportunities



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# ***THE Ecological Research Program***

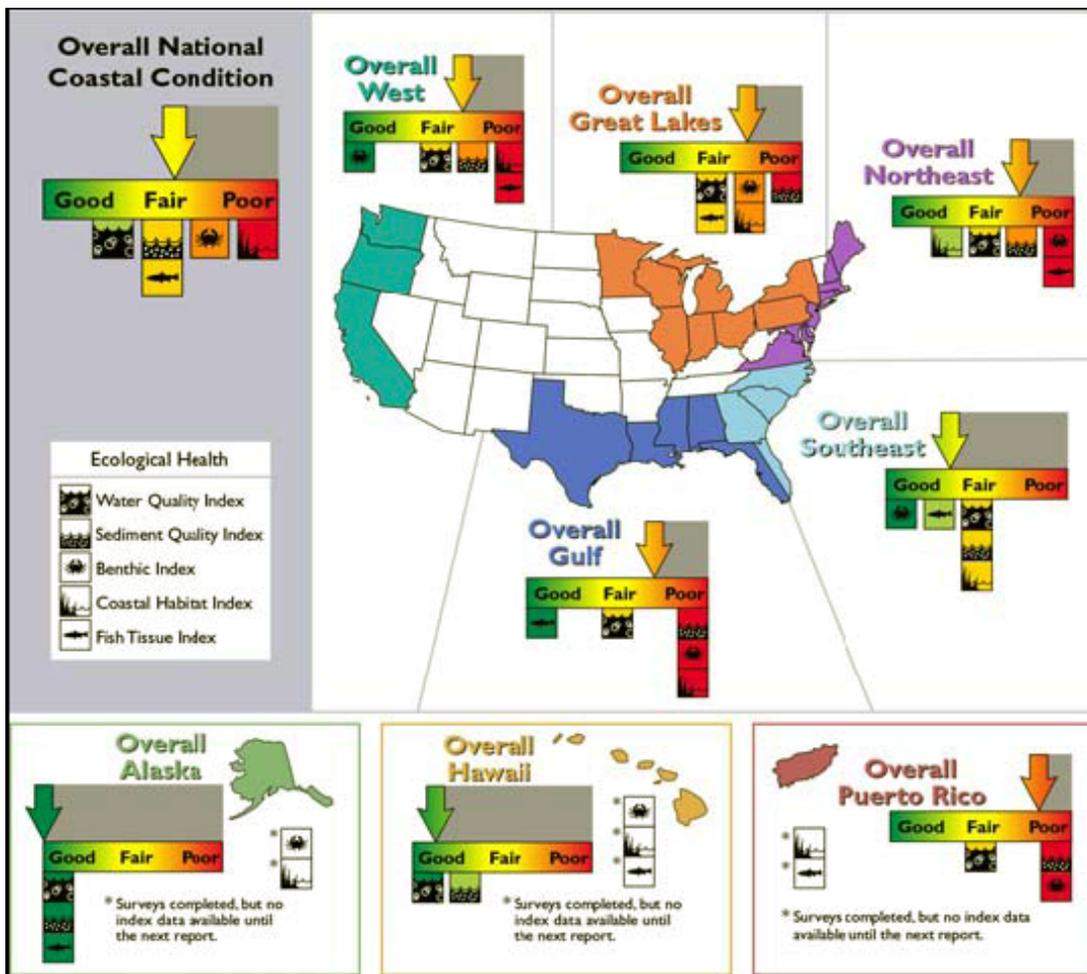
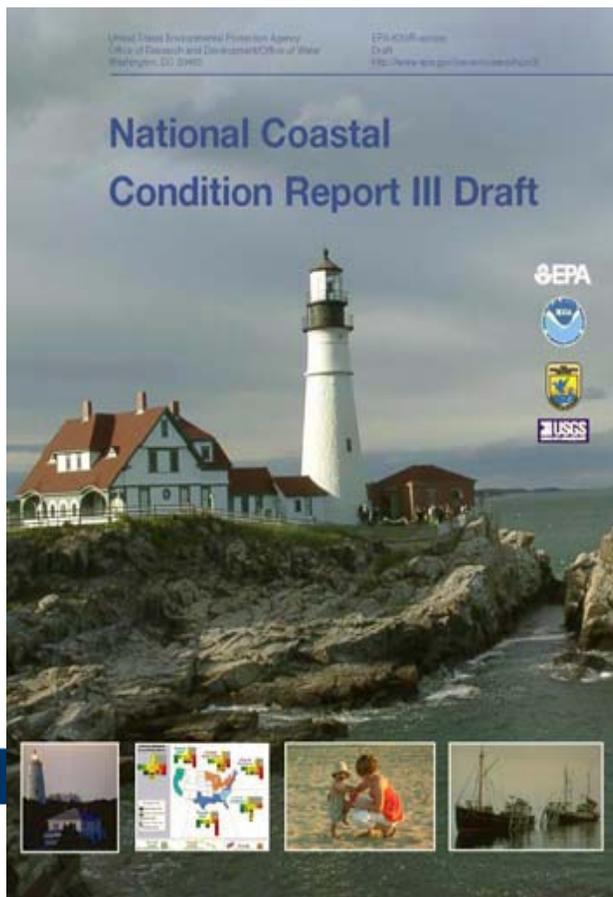
## Highlights of the Multiyear Plan

## ***Where are we headed and why?***

- We depend upon ecosystem services for our health, our well-being, and our economy.
- We know how to do better manage, even today.
- 15 of 24 ecosystem services are in decline worldwide.
- Ecological risks are currently managed in piecemeal fashion, i.e., by single media, single stressor, at one scale of analysis.
- Decisions affecting ecosystem services often require trade-offs.
- A proactive systems-approach shows promise for enhancing the resilient, long-term supply of services.
- Innovative use of new ecological knowledge can inform governance, laws, and policies; can spur innovations in private sector; and can increase the nation's effective environmental protection budget.

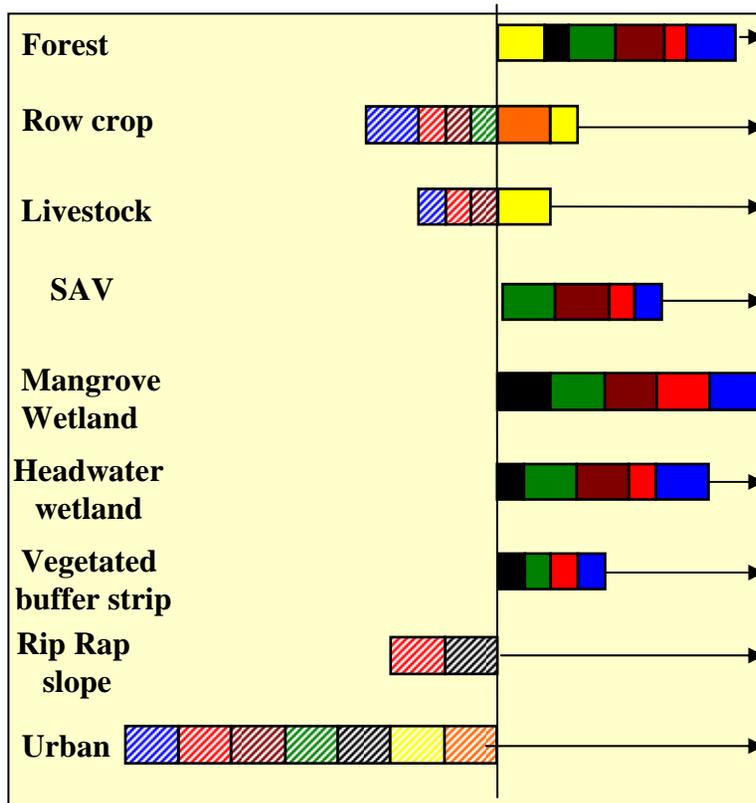
## Trends in ecosystem services for coastal areas are assessed in light of population growth and climate change

Services include: storm surge/ flood protection, nutrient cycling, fisheries, recreation, and resilient human communities

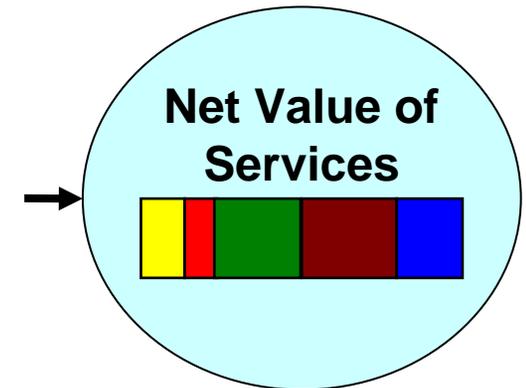
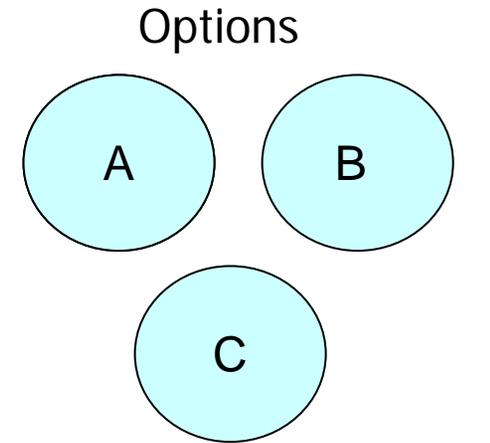


# End Product

## Relative Ecosystem Services Within an Ecosystem District



Scaling and Aggregation Under Alternative Management Scenarios

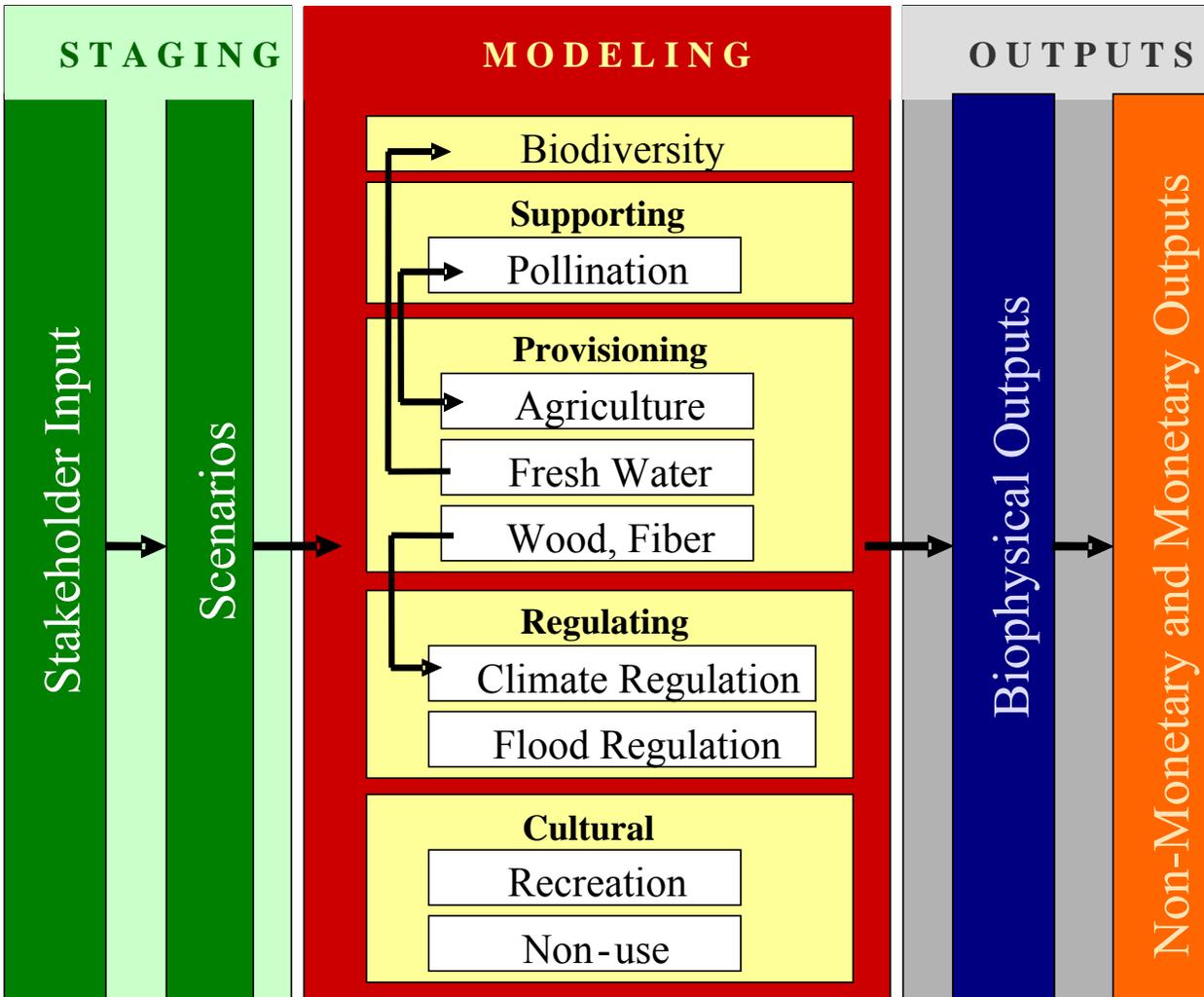


Management Option X

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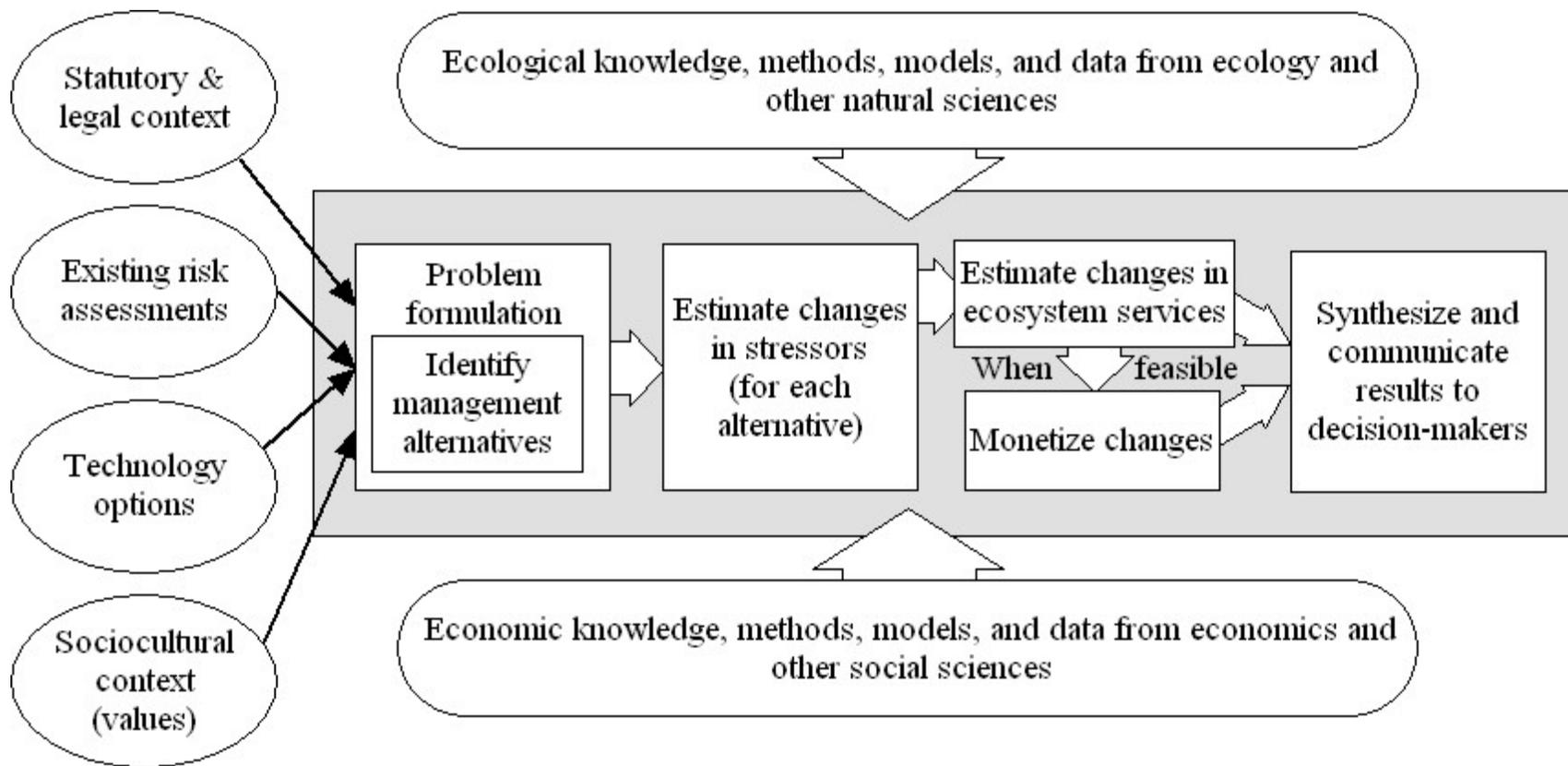
## *Keeping the End in Mind*

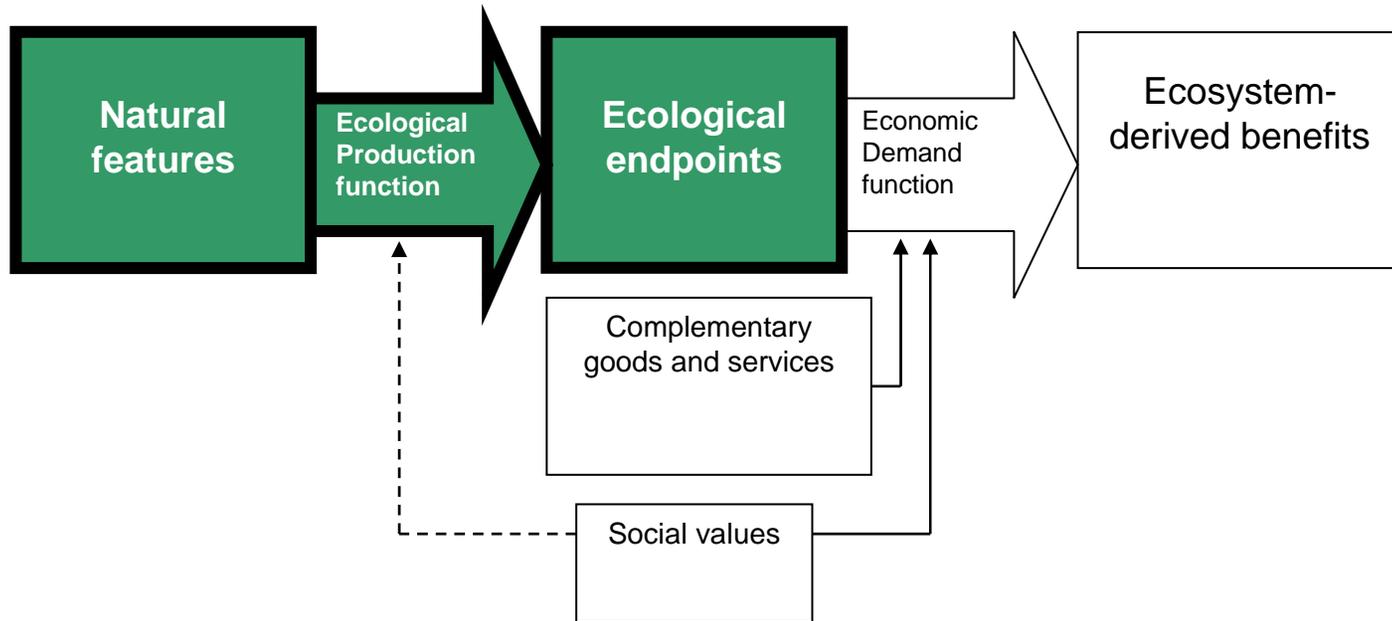
- **Effective Decision Support**
  - Information/models/mechanisms..... to help local, watershed, state, regional and national managers make environmental management choices based on gains and losses of ecosystem services.
  - Timing—72 existing DS systems, considerable ground work to do, later development



Modified from MEA by Taylor Ricketts, Natural Capital Project

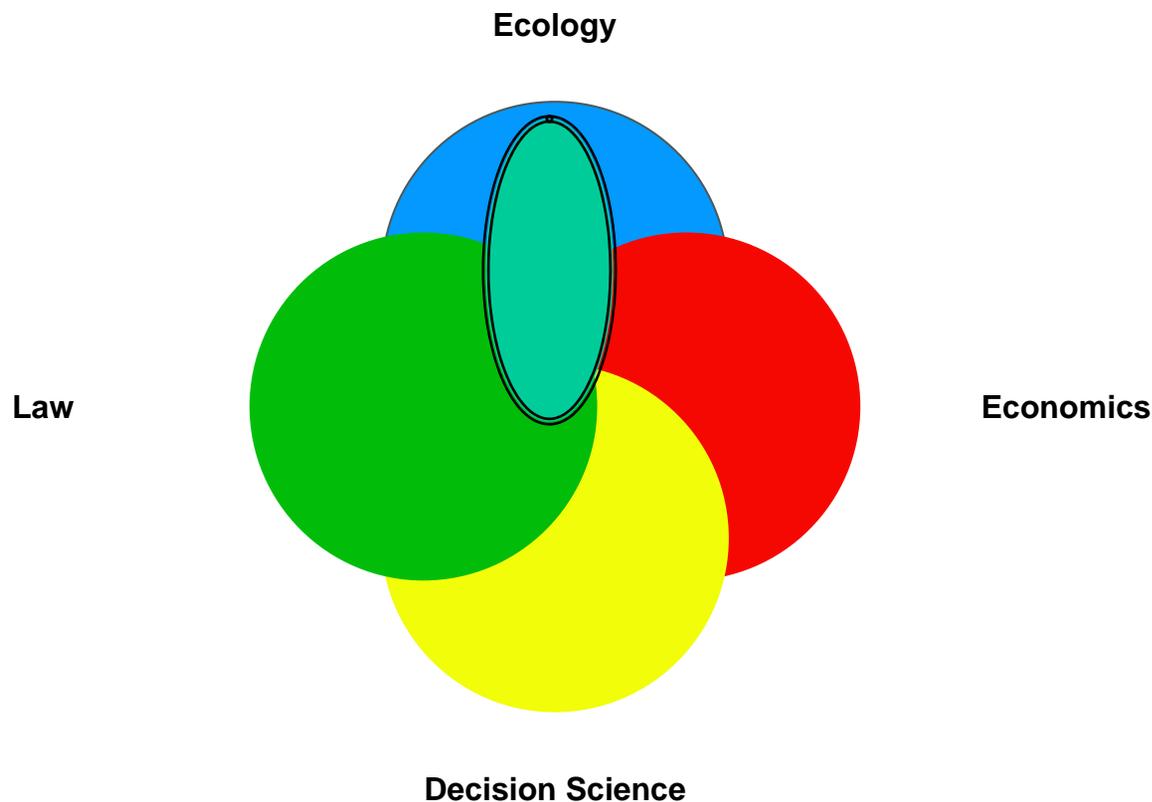
# Building on Strengths of Economic Analysis and ERA





Wainger and Boyd

## *Transdisciplinary Approach to Conserving Ecosystem Services*



## ***ERP Elements: a three pronged approach to research on ecosystem services***

- **Pollutant-based research**
  - How does a regulated pollutant affect, positively and/or negatively, the suite of ecosystem services at multiple scales?
- **Ecosystem-based research**
  - How does the suite of ecosystem services provided by a single ecosystem type change under alternative management options at multiple scales?
- **Place-driven research**
  - How does the suite of ecosystem services for within a defined area change under alternative management options/drivers?

## ***Expected Balance of ERP***

- **Core Capabilities—Best use of talent we have.**
- **A Futures Vision—Where will the Agency and Science be going?**
- **Demonstrate Relevance—real world applications.**
- **Satisfy the Requirements of Government.**
- **Integrate Across All of ORD**
  
- **PICK 5!!!!**



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# ***Coordination and Partnerships!***

Projects and Long term Goals →		Eco-system Specific Studies: LTG 4--23%		Community Based Demonstration Projects: For National, Regional, State and Local Decisions (includes Nitrogen and Wetlands services) LTG 5—28%				Theme Leads
	Cross Program Themes and Research Objectives	Wetlands (19%)	Coral Reefs (4%)	Willamette (5%)	Tampa Bay (7%)	Mid-West (7%)	Coastal Carolinas (9%)	
Inventory, Map, and Forecast Ecosystem Services at multiple scales (National Atlas) LTG 2 38%	Landscape Characterization and Mapping (10%)	Ric Lopez	Anne Neale	Don Ebert	Taylor Jarnagin	Megan Mehaffey (New Hire in the future)	Deb Chaloud	Anne Neale
	Inventory and Monitoring of Services (21%)	Jack Kelley	Bill Fisher	Spence Peterson	John Macauley	Joe Flotemersch	Darryl Keith	Mike McDonald
	Modeling for Scenarios and Forecasting for different management options (7%)	Brenda Rashleigh	Susan Yee	Bob McKane	Sandy Rimondo	Russ Kreis	Steve Kraemerr	John Johnston
Integration, Decision Support and Outreach LTG 1 8%	Ecosystem Services and Human Health (2%)	Kevin Summers	Kevin Summers	Steve Klein	Lisa Smith	Betsy Smith	Deb Mangis sending name	Laura Jackson
	Valuation of Ecosystem Services (2%)	Chuck Lane	Dan Campbell & Suzanne Ayvazian	Dennis White	Sharon Hayes	Alex Macpherson	Alex Macpherson	Sabrina Lovell
	Decision Support Platform Created to Integrate Findings from Entire Program (3%)	Tim Canfield	Pat Bradley	Dave Burden	Marc Russell	Vasu Kilaru	Drew Pilant	Ann Vega
	Outreach & Education to (1%)	Janet Nestlerode	Pat Bradley	Bill Hogsett	Jim Harvey	Brenda Groskinsky	Walt Galloway	Suzanne Marcy
Eco-system Specific Studies LTG 4	Wetlands (23%)				Janet Nestlerode	Chuck Lane		Steve Jordan
Pollutant Specific Studies LTG 3	Nitrogen (5%)	Steve Jordan	Jim Latimer	Bill Hogsett	Richard Devereaux	Ken Fritz	Brent Johnson	Jana Compton
Project Area Leads	Rick Linthurst And Iris Goodman	Mary Kentula/Virginia Engle	Bill Fisher	Dixon Landers	Marc Russell	Randy Bruins/ Betsy Smith	Dorsey Worthy	Rick Linthurst Iris Goodman
				Megan Mehaffey Place Based Coordinator				

<b>Research Activities</b>	<b>Applied Uses</b>	<b>Partners for implementation</b> <i>* = in progress, ** = potential</i>
LTG 2: Framework to <i>inventory and monitor</i> selected ecosystem services nationwide	Potential inclusion in <u>Report on the Environment</u> or <u>State of the Nations Ecosystems</u>	NEON ** ROE ** Heinz Center **
LTG 2: <i>Mapping</i> selected ecosystem services nationwide	ERP clients can see distribution for existing services, use in planning	National Geographic * USGS, Geography Div.*
LTG 2: <i>Modeling</i> key interactions among services; ecological production functions; tipping points	-- optimizing service “bundles” -- standards of practice -- expert knowledge for Decision Support Platform	Gund Institute for Ecological Economics * Natural Capital Project ** Smithsonian Institution *
<i>Matrix theme leads: <b>Cross-theme analyses</b> to identify emergent properties for <b>place-based</b>, <b>ecosystem-based</b>, and <b>pollutant-based</b> studies [LTGs 3,4, &amp; 5]</i>	--cross-scale issues & dynamics --test alternative methods --identify attributes that confer ecosystem resilience	Stakeholders * EPA Regions 5,7,8, 10* Other federal agencies * Non-gov’tl. organizations
LTG 1: <i><b>Valuation &amp; Tradeoffs</b></i> ■ Quantitative classification of services, spatial metrics ■ methods to depict trade-offs	-- foster interaction of “suppliers” & “users” -- foster investments to conserve, sustain services; foster markets	EPA’s National Center for Environmental Economics*
LTG 1: <i><b>Decision support</b></i> ■ Decision science ■ Behavioral theory ■ Business theory	-- participatory, deliberative decision-making -- engaging business community	World Resources Institute* Packard Foundation ** <b>4/8/2008</b>



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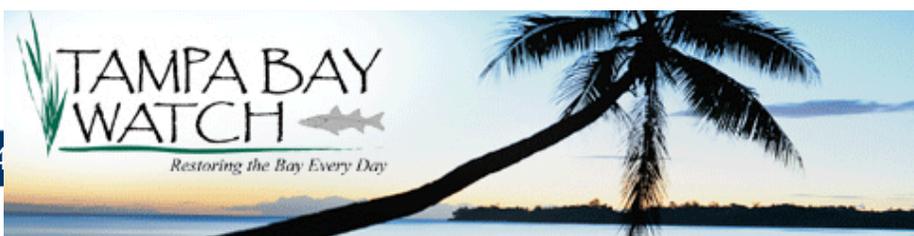
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# Tampa Bay Ecological Services Pilot Project Partners



...S.ORG · 1-800-423-1476



## ***In Conclusion***

- It is a human centric approach
  - Guided by valuation and well-being, not constrained by it
  - Required to increase the relevance of ecology to decision-making
- Transdisciplinary approach is the ideal
  - Should funds become available, Regional Centers would be established
- It is bigger than we alone can accomplish
  - Defining the whole, however, assists in knowing where to invest
  - New partnership approaches are essential
- ORD scientists will focus on the ecological production functions.
  - Quantifying trade-offs
  - Again, accepting the challenge of the trade-offs
- The implementation plans are next critical hurdle
  - ERP scientists are preparing these plans now
  - Plans describe the “how” and “when”



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