

Getting the most from restoration
investments: assessing site-
dependent costs, benefits, and risks

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What is the question?

Choice of economic technique depends on goals

Method	Main Purpose
Cost-Benefit Analysis	Demonstrate net social benefits (e.g., of regulation)
Cost-Effectiveness Analysis	Achieve / Demonstrate best program performance
Impact Assessment	Gain support from decision makers
Behavioral Modeling	Formulate effective policy

Major limitations to monetizing ecosystem service benefits

1. Data / knowledge gaps limit which services can be monetized
2. Many ecosystem services have been valued in ways that are *insensitive* to ecological condition
3. Valuation has a *missing variables* problem – i.e., often cannot capture regional variations due to service scarcity, public needs, etc.

How can economics support restoration prioritization?

1. Benefits of Successful Restoration
2. Costs of Treatment
3. Probability of Successful Restoration

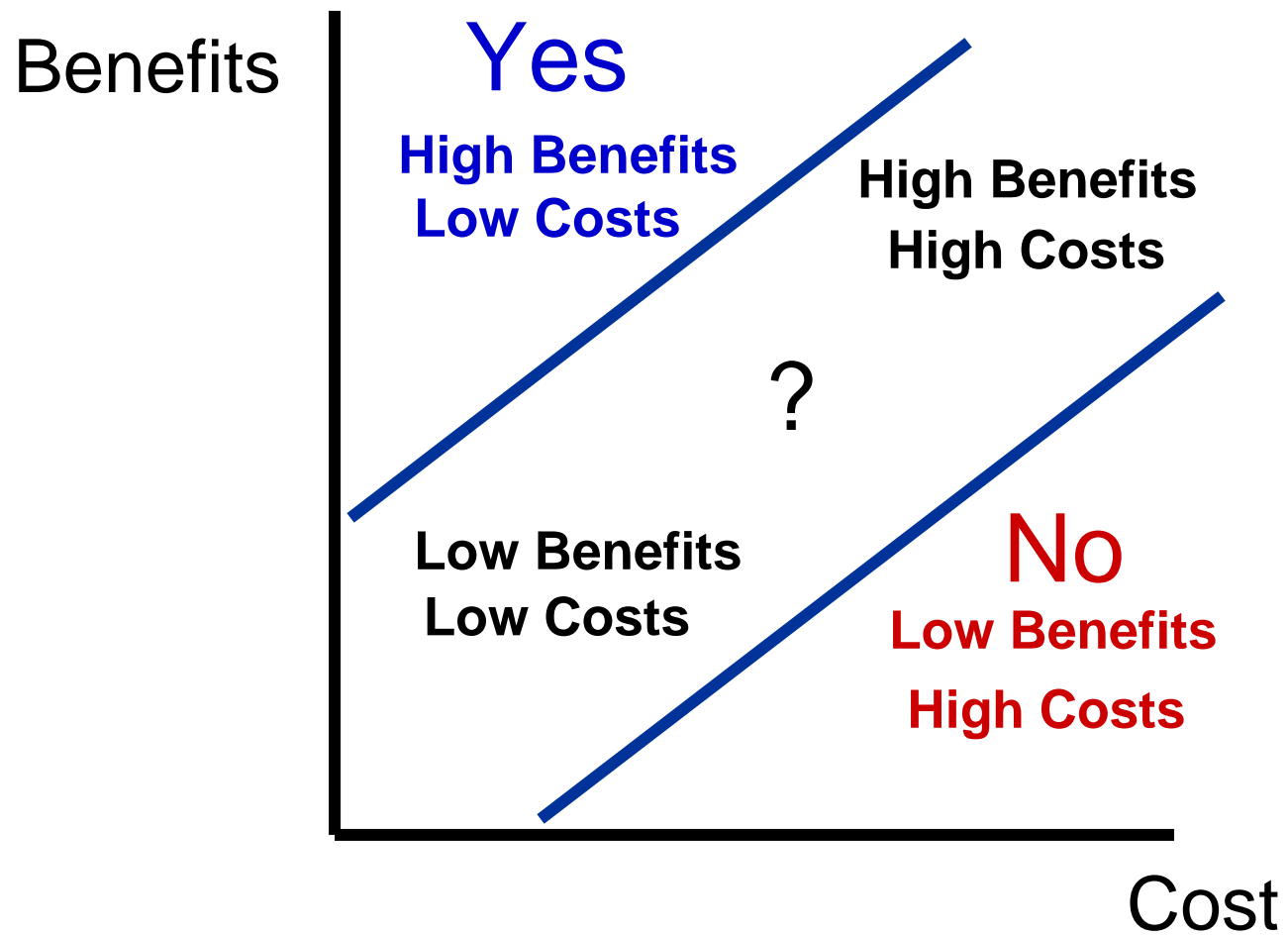
Risk-Adjusted Benefits

Cost -
Effectiveness =

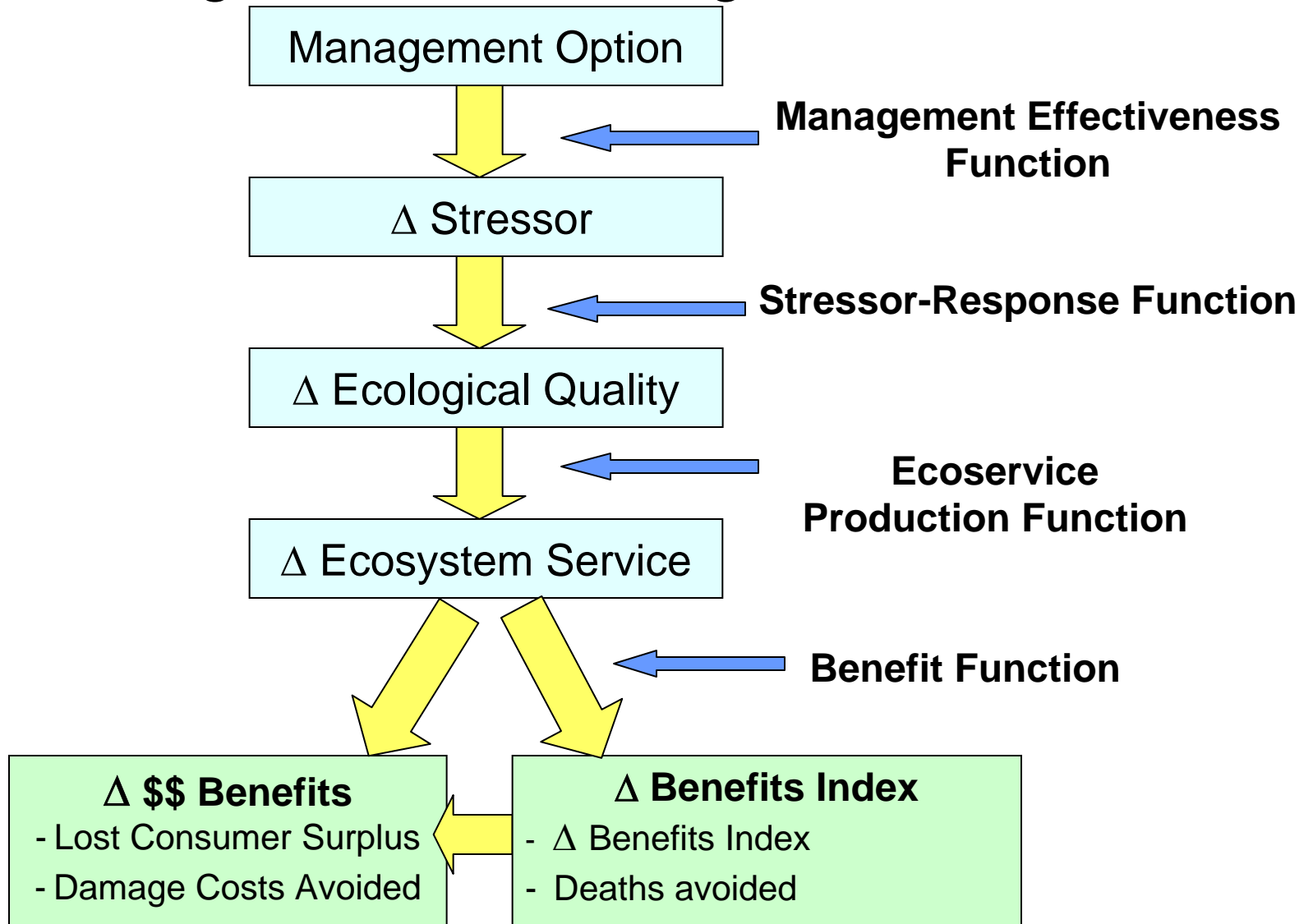
$\Delta\text{Benefits} * \text{Probability of Success}$

Costs of Treatment

Cost-Effectiveness Analysis

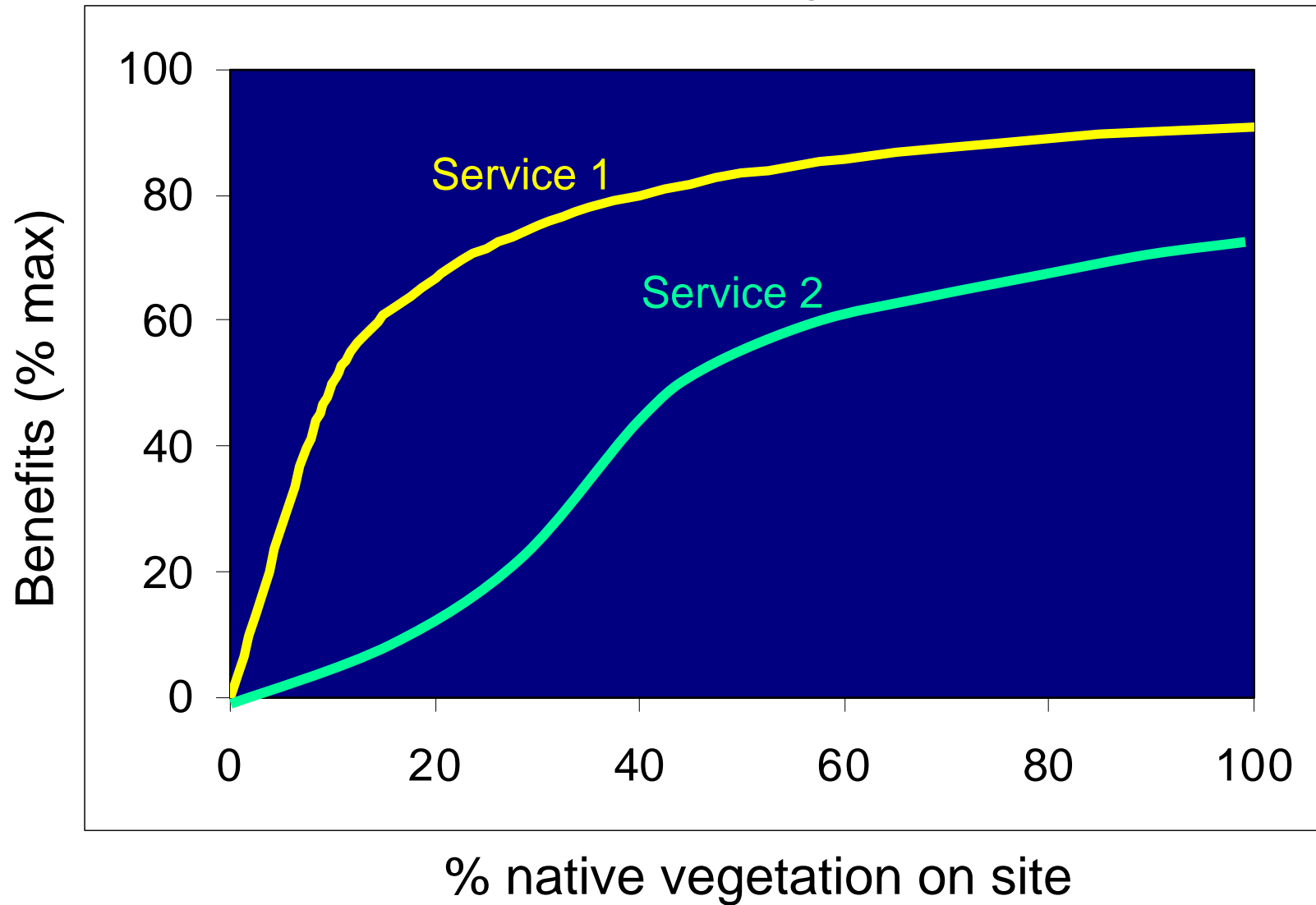


The Challenge: Relating Resource Changes to Benefits



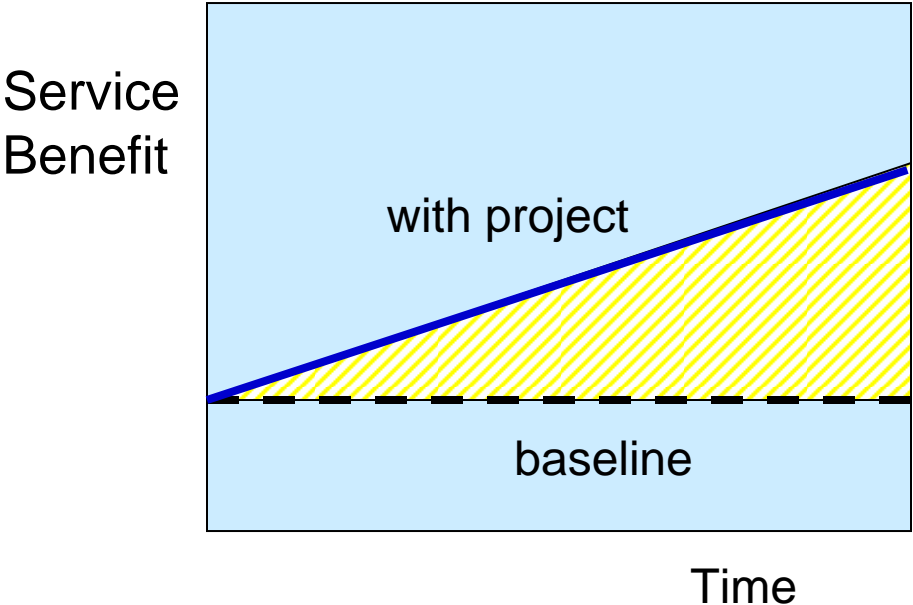
How are benefits supplied through restoration?

Benefits / Damage Curve

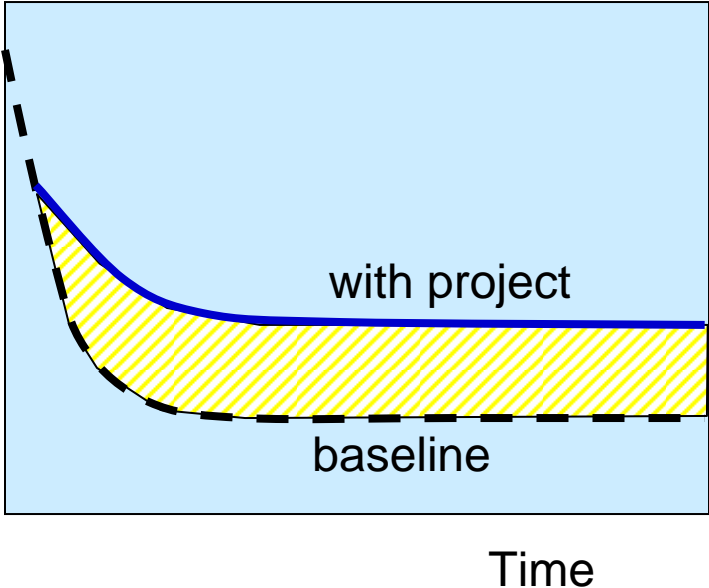


Demonstrating Change Relative to Baseline

Static Baseline



Declining Baseline

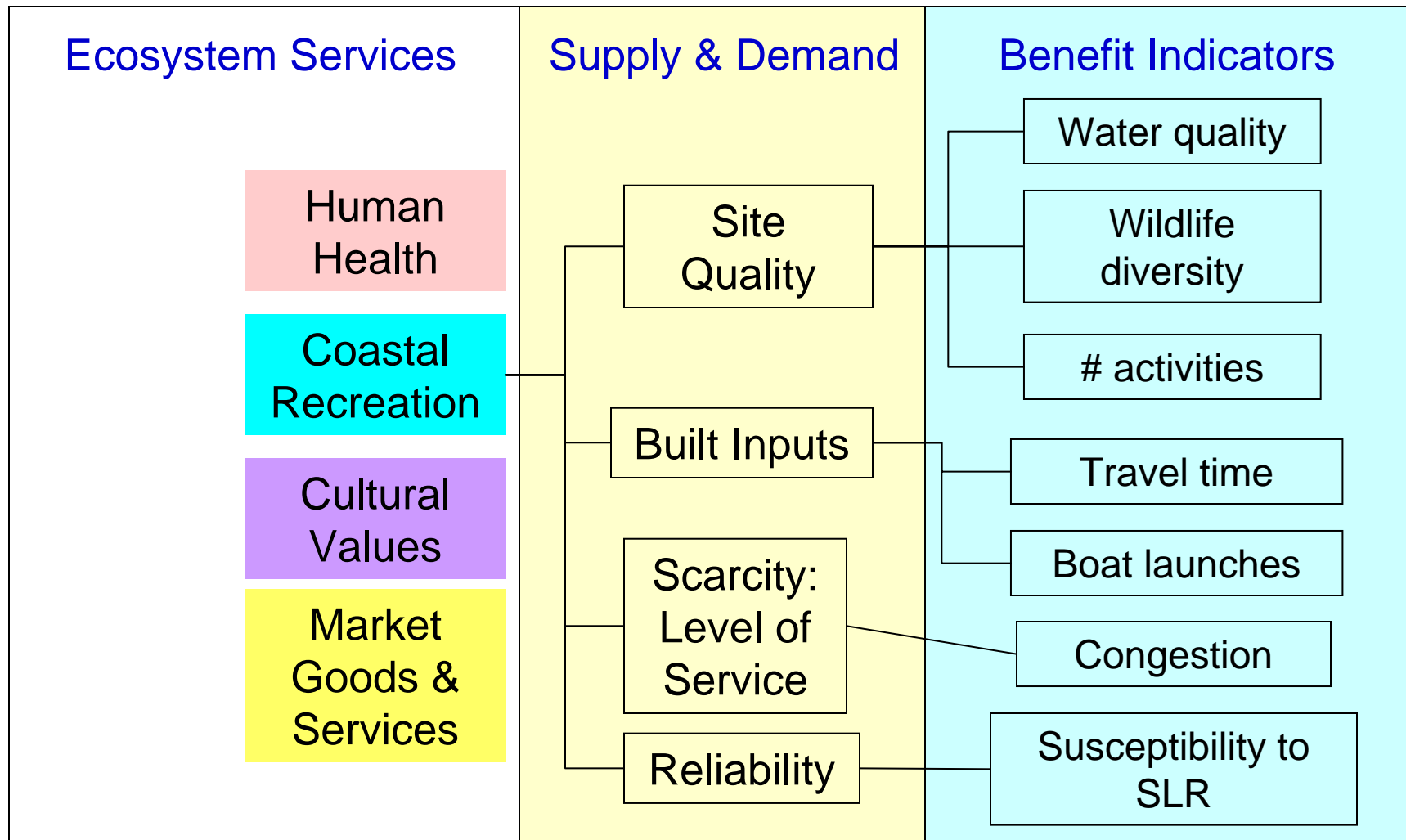


What needs to be measured to assess relative benefits produced?

- Quantity
 - Quality
 - Reliability
- } Δ Ecological Conditions
- Complementary Inputs
 - Scarcity / Supply vs demand
 - Substitutability
- } Δ "Market" Conditions

Benefits index

Conceptual models of what contributes to value

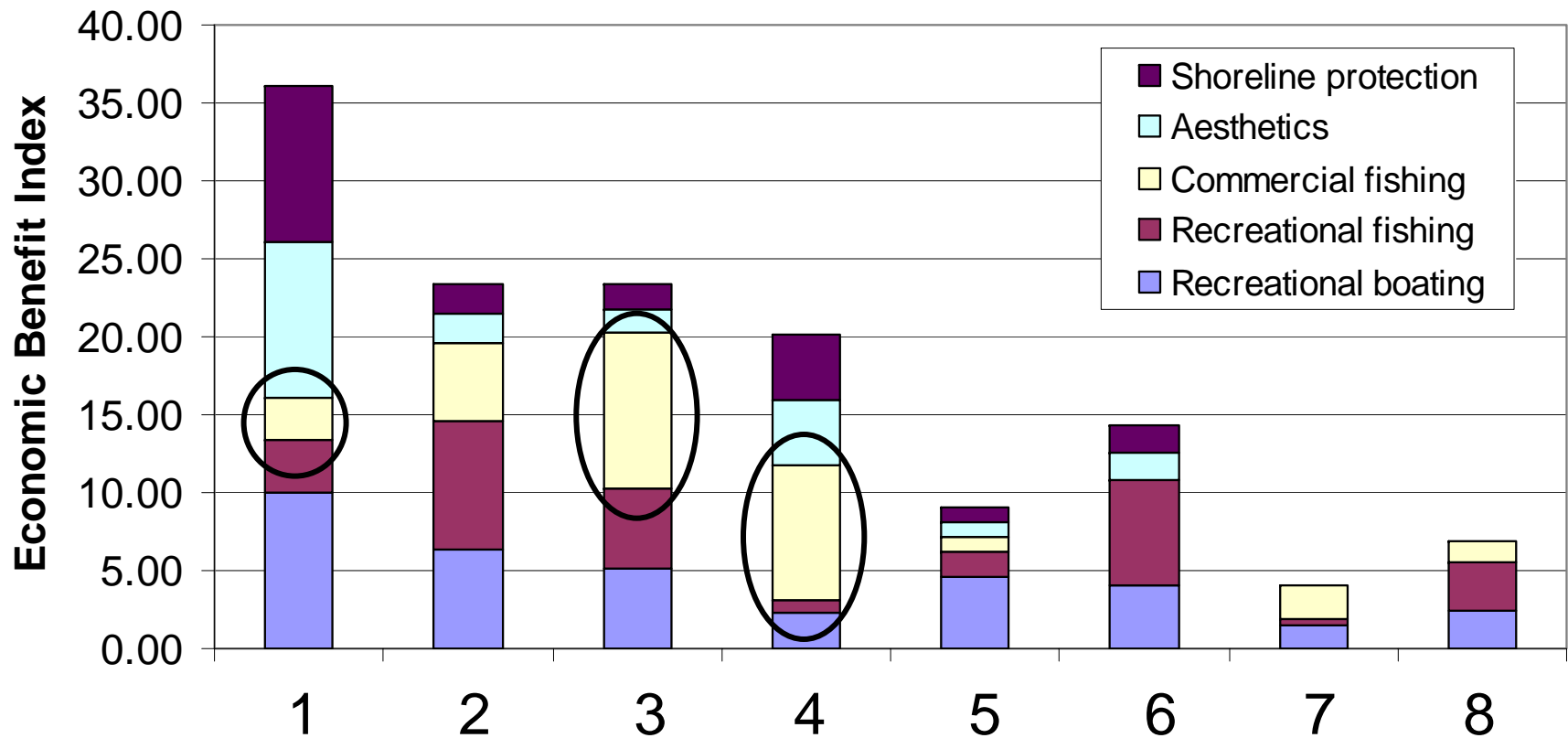


Supply of alternate recreational fishing grounds by site (scarcity index)

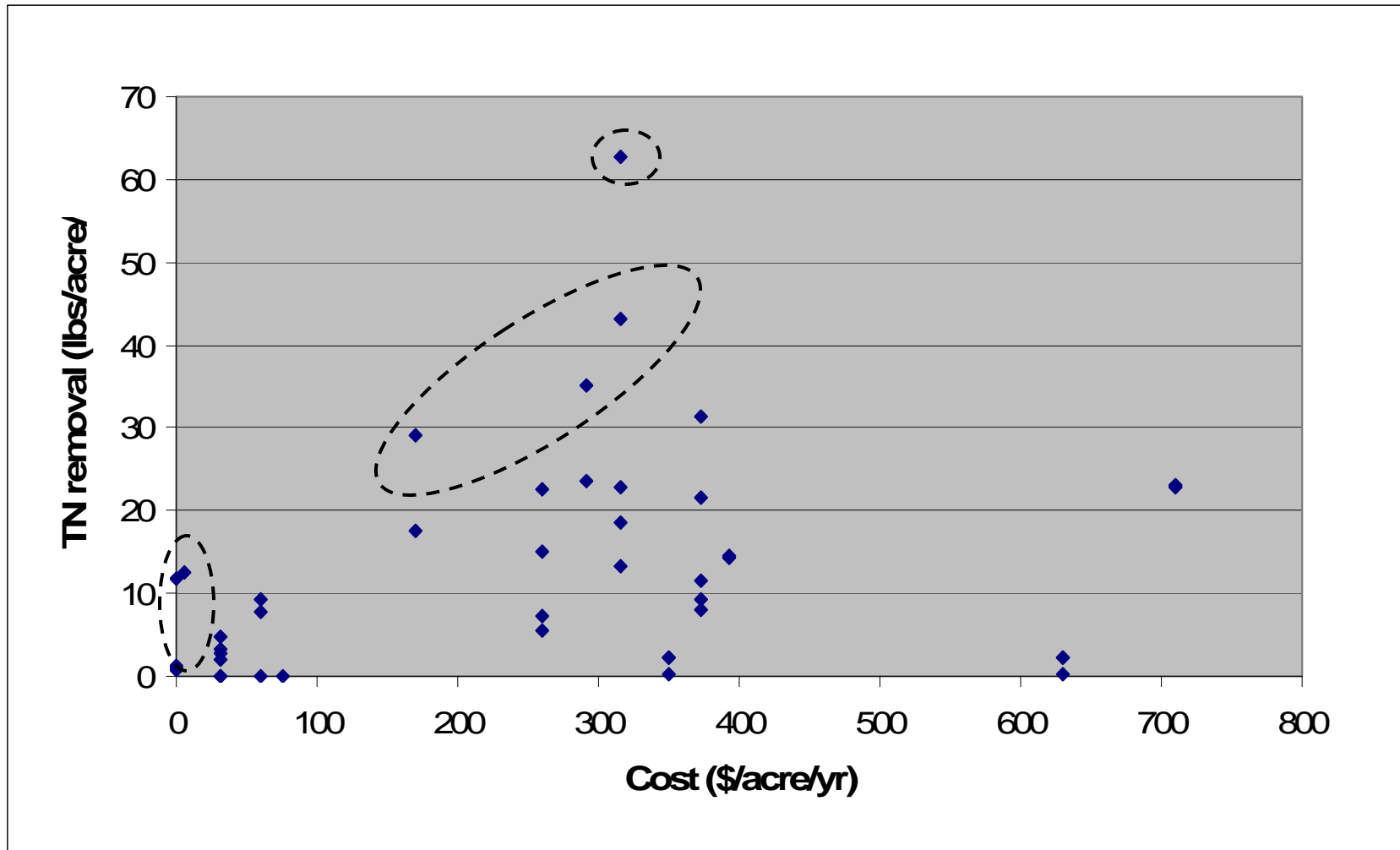
	Recreational fishing area within 1 mile	Total recreational fishing area within 10 miles	Recreational fishing area w/in 1 mi as % of total area w/in 10 mi
Barren	0	10,548.50	0%
Holland	0	21,213.60	0%
Hoopers	1,217.30	11,209.10	10.86%
James	1,926.00	9,673.50	19.91%
Little Deal	746.5	9,300.80	8.03%
Ragged	0	7,563.00	0%
Smith	759.6	23,066.00	3.29%
South Marsh	0	21,519.00	0%

Comparing Stacked Ecosystem Services

Different Decisions from Service Benefit Index vs.
Monetized Benefits



Cost Effectiveness Results



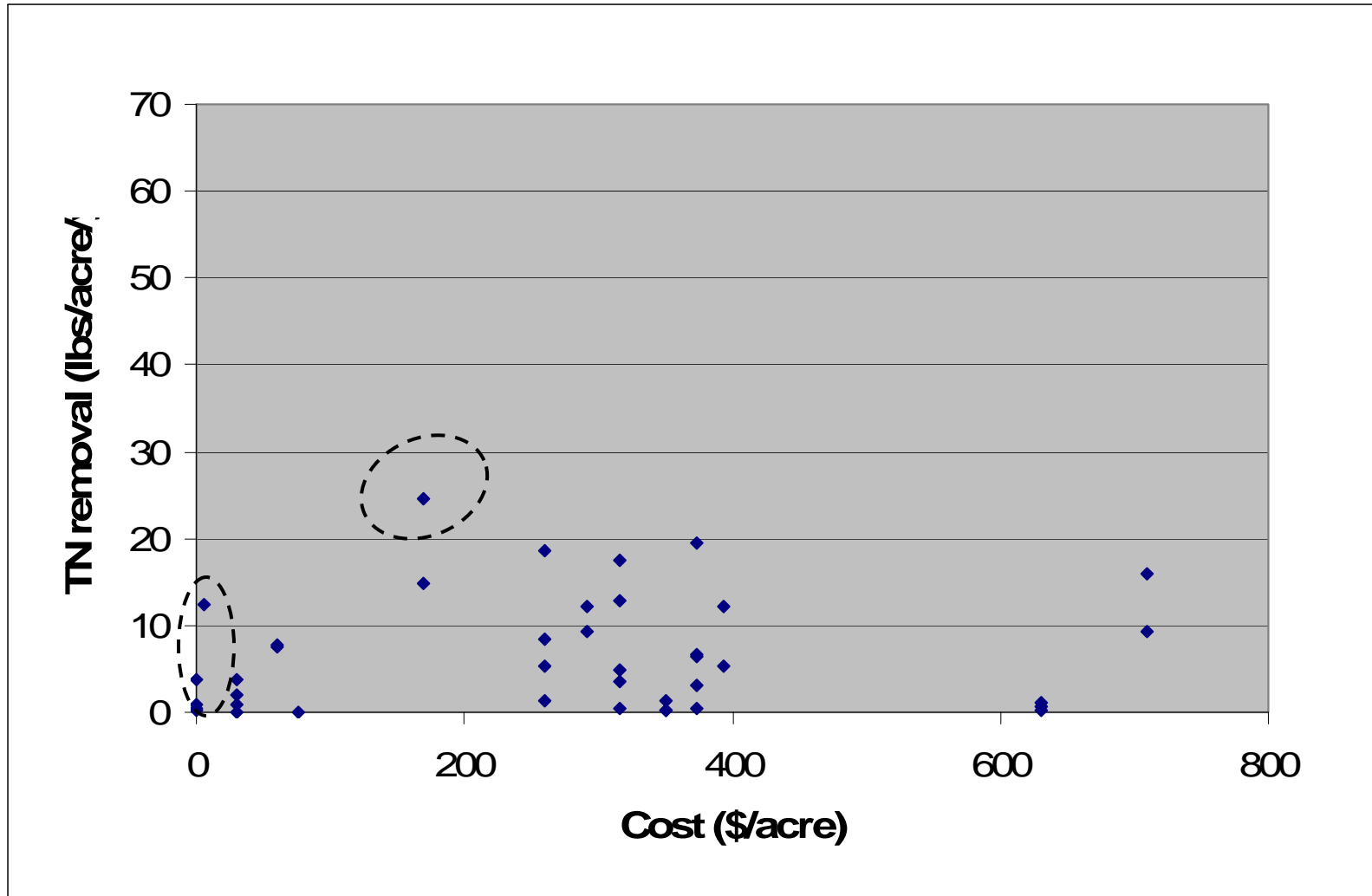
Incorporate Uncertainty of Response

Risk Weighted Benefits Inform Cost-Effectiveness



















$$\text{Cost-Effectiveness} = \frac{\text{Risk-Adjusted Benefits}}{\text{Costs}}$$

The numerator, *Risk-Adjusted Benefits*, is composed of two components: **Change in Benefits** multiplied by **Probability of Success**.

Risk-adjusted cost-effectiveness



Siting restoration to achieve goals

	Headwater Low Order Streams	Mid Watershed	High Order Streams / Floodplains
Streams			
Denitrification			
Floodwater and Sediment Reduction			
Aquatic biodiversity			
Wetlands			
Denitrification			
Floodwater and Sediment Reduction			
Aquatic biodiversity			



Function is likely to occur



Function may sometimes occur



Function may be difficult to attain

Key Aspects of Eco-Services Cost-Effectiveness Framework

1. Create *benefit* metrics that incorporate ecologic quality – when it matters
2. Assess service supply relative to demand to improve estimates of benefits
3. Adjust benefits for risk to capture varying likelihood of success
4. Improve decision-making by considering joint production of services