Methods and Measures for Characterizing Restoration Effectiveness

SHC Research Area 9.1

Presented by Susan Yee

Gulf Ecosystems Measurement and Modeling Division

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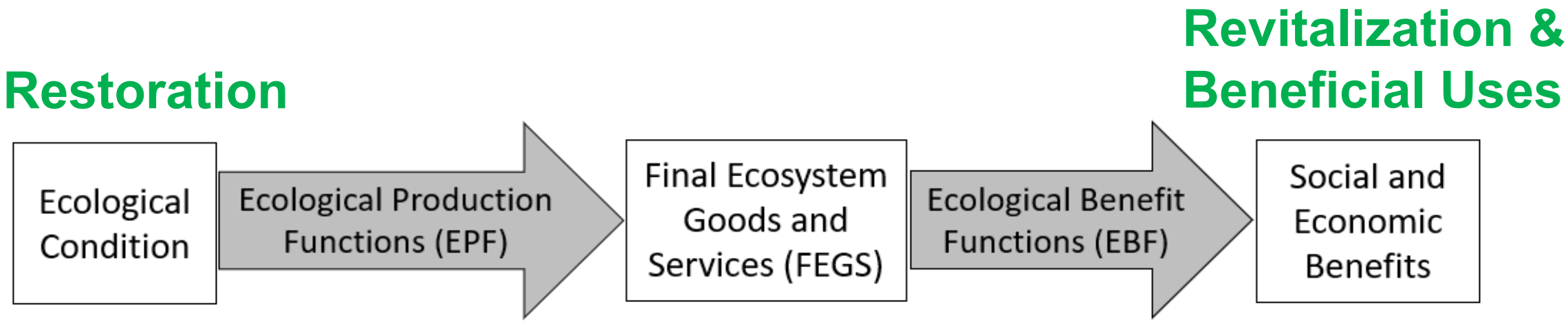
Output Statement

- Work with partners to refine existing or develop new approaches that can be used to assess restoration effectiveness and to measure changes in ecological condition and associated beneficial uses

Conceptual Research Framework

- Strong focus on linking restored ecological condition to social and economic benefits via ecosystem services



Why FEGS?

Final Ecosystem Goods and Services (FEGS)

"[biophysical] components of nature, directly enjoyed, consumed, or used to yield human well-being" *(Boyd & Banzhaf 2007)*

Final Ecosystem Good or Service

Charismatic bird species

What?

Environmental Context

Mangroves

Where?

Beneficiary

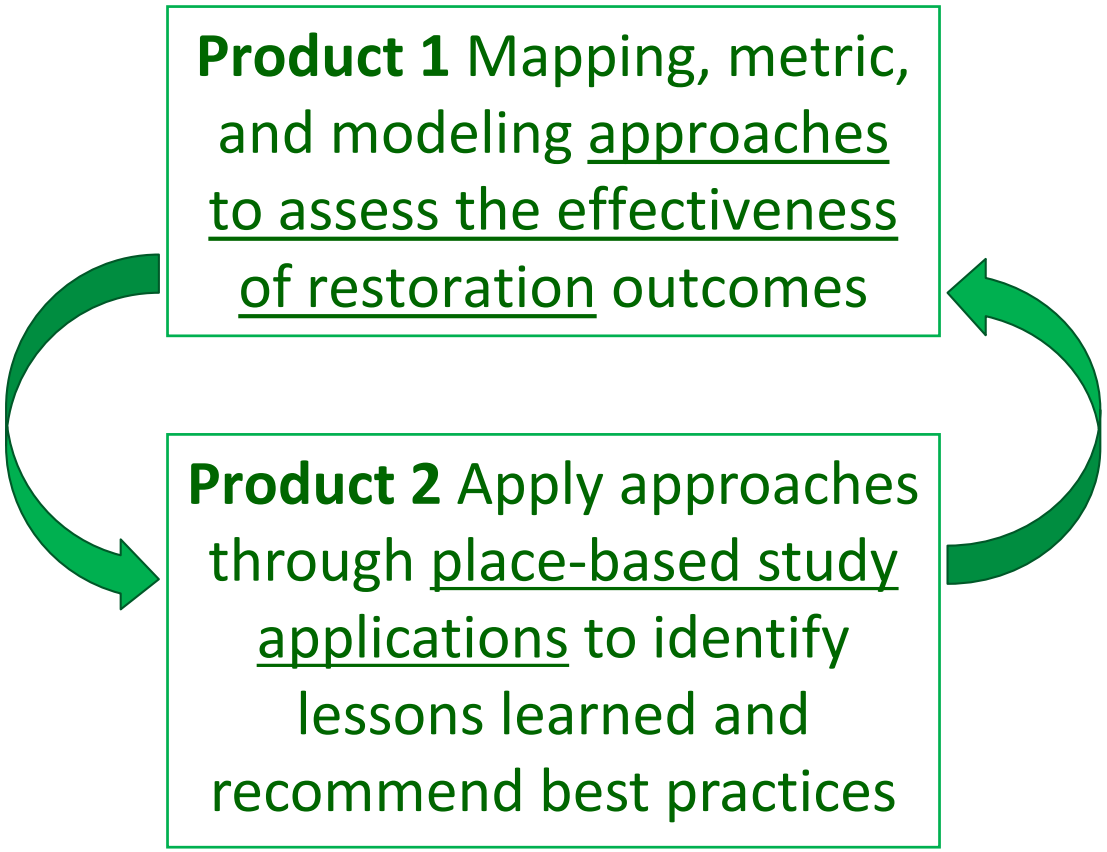
Recreational Birdwatchers

Who?

Partner Needs

- Measures that integrate across the different goals of remediation, restoration, and revitalization, and across biophysical, social, and economic axes, including resilience
- Approaches to simplify ecosystem services assessment, including cumulative assessment, mapping, and demonstrations
- Methods to project what levels of condition are needed to ensure restoration of critical ecosystem function and services, and monitor progress over space and time
- Evidence of the benefits of restoration projects

Research Approach



- Co-development of P1) approaches with P2) place-based studies helps ensure partner needs are understood, methods are usable and transferable, and methods integrate with existing partner approaches
- Having separate products addresses partner requests for both P1) generic guidance as well as P2) site-specific examples that demonstrate credibility

Product 1: Approaches to evaluate restoration effectiveness

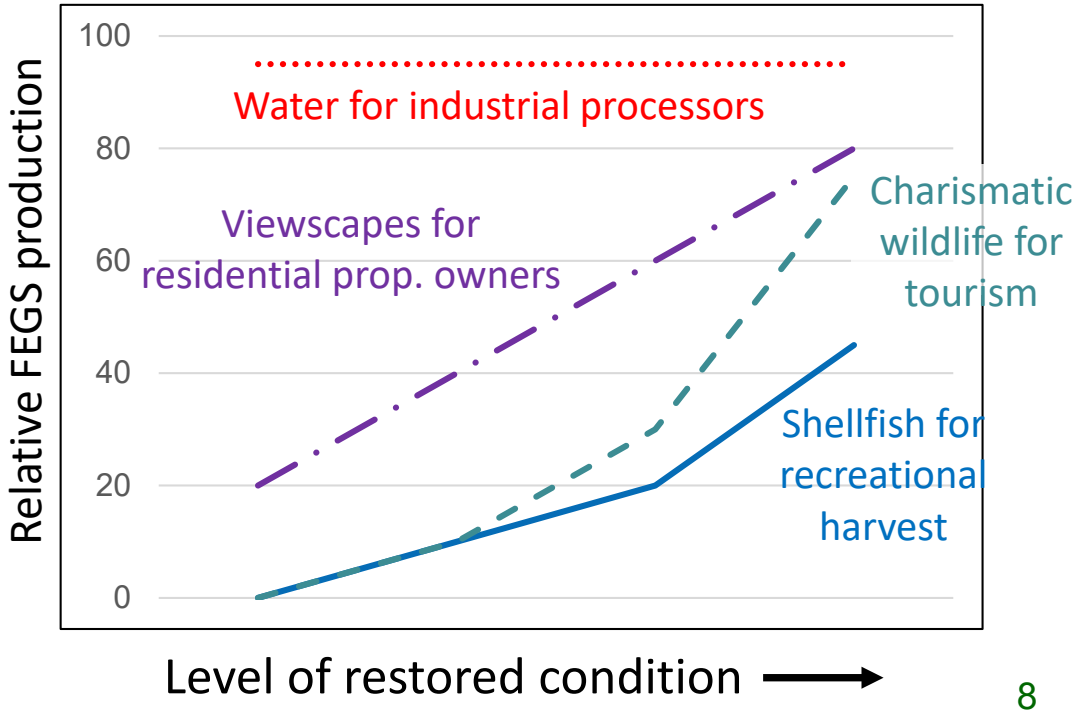
Element 1. Review current practices for restoration effectiveness, particularly ecosystem services, including relevance for contaminated sites

- Review restoration planning literature to identify to what degree FEGS are currently included
- Summarize potential methods to measure and estimate FEGS
- Evaluate relevance of methods under special considerations for contaminated sites

Product 1: Approaches to evaluate restoration effectiveness

Element 2. Develop approaches to quantify and communicate what levels of restoration are needed to achieve desired levels of ecosystem services

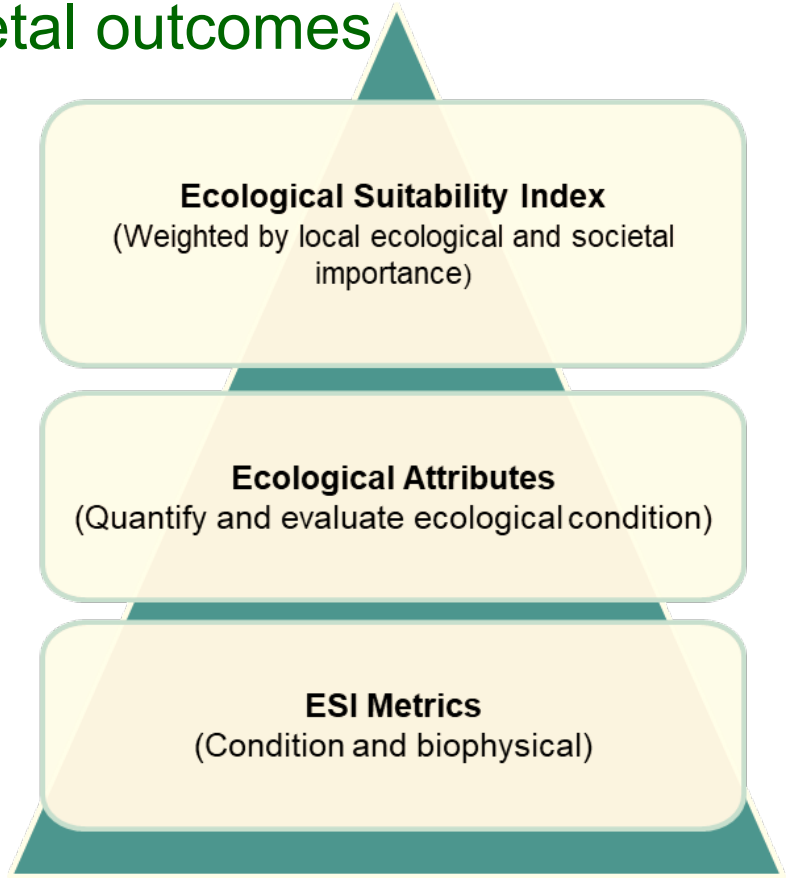
Framework	Process
What FEGS are relevant?	Identify and prioritize FEGS with stakeholders
How will we measure them?	Identify FEGS metrics and indicators, and the biophysical attributes that provide them
What FEGS could we have?	Establish potential availability under a range of bio-physical conditions using maps & models
What FEGS do we want?	Evaluate co-benefits and tradeoffs
How do we get there?	Identify restoration actions



Product 1: Approaches to evaluate restoration effectiveness

Element 3. Develop innovative measures of restoration success that integrate habitat suitability with potential ecological and societal outcomes

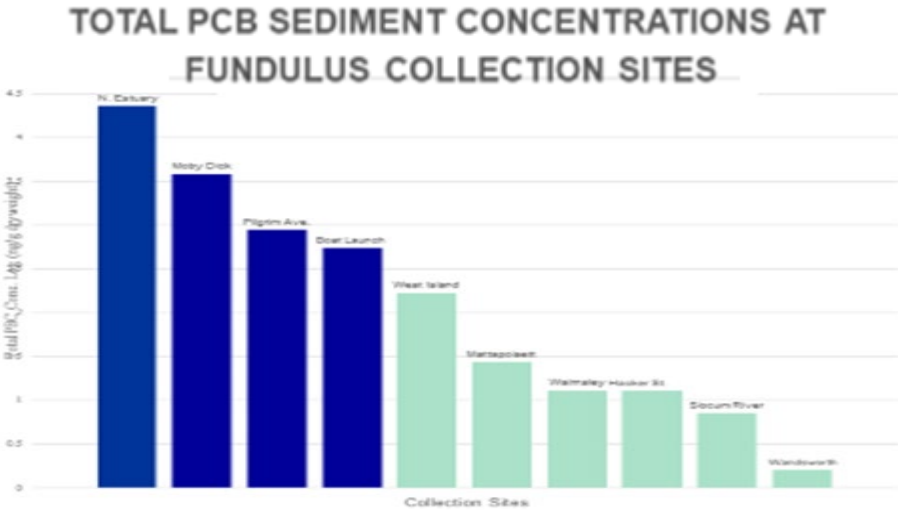
- Review existing approaches for prioritizing restoration, and potential ecological and social outcomes
- Identify indicators for linking habitat suitability to ecological and social outcomes
- Identify environmental parameters that could be restored to maximize benefits



Product 1: Approaches to evaluate restoration effectiveness

Element 4. Develop innovative genomic approaches to measure restoration success in terms of ecological condition

- Evaluate usefulness of genetic diversity as a time and cost-effective proxy for biological diversity
- Genetic changes have been associated with chemical exposures, allowing potential causal inferences between recovery and remediation
- Pilot study to characterize fish population genetics using SNP loci along contamination gradient from pristine to heavily polluted



Condition Gradient

Product 1: Approaches to evaluate restoration effectiveness

Element 5. Identify measures to retrospectively evaluate benefits from restored sites

- Identify common indicators of pre- and post-restoration monitoring in remediated sites
- Compare monitored indicators to goals that the restoration project is attempting to address
- Also evaluate adequacy of indicators over time-frame of restoration monitoring

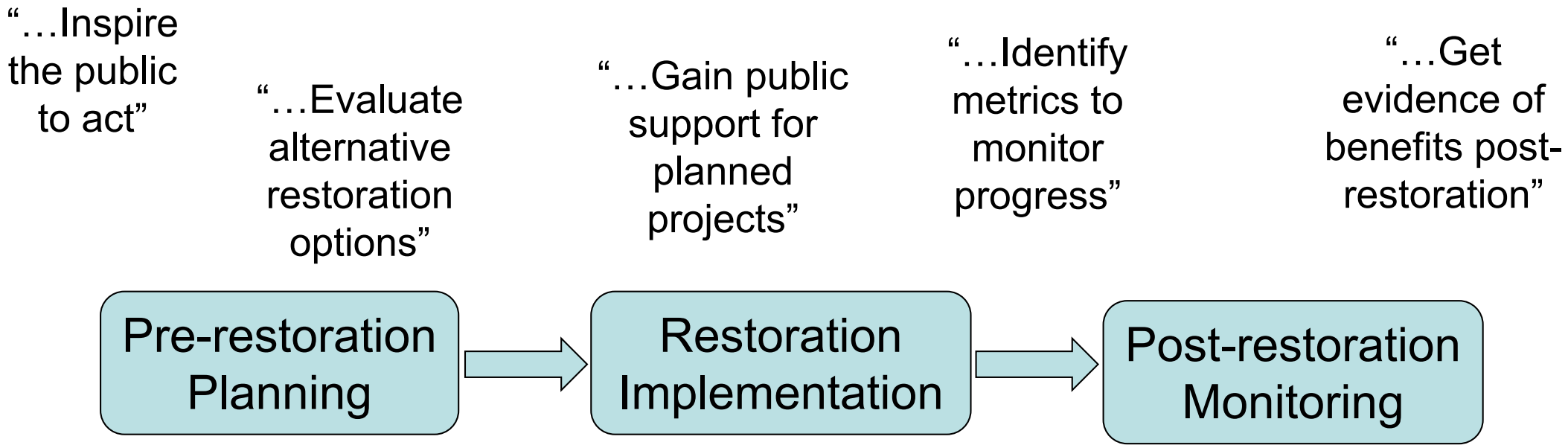
Product 2: Demonstrations and Lessons Learned

- Apply and evaluate methods and metrics from Product 1 to inform ongoing restoration decisions in place-based studies
- Coordination among studies will allow evaluation and identification of methods that are useful locally but broadly transferable
- Studies include both remediated sites and reference locations to validate approaches, covering a variety of ecosystems




Product 2: Demonstrations and Lessons Learned

- Studies cover a variety of stages in the restoration decision process
- Methods tailored to reflect partner goals specific to each study



Product 2: Demonstrations and Lessons Learned

Partner Goal: Inspire the public to act

Massachusetts Bay Estuaries

Develop restoration targets for embayment conditions for salt marsh, seagrass, and intertidal flats and inspire local action to achieve targets

Chesapeake Bay Watershed

Motivate increased implementation of Best Management Practices that restore forest, grassland, and wetlands in the upstream watershed

Product 2: Demonstrations and Lessons Learned

Partner Goal: Evaluate alternative restoration options to promote revitalization

Iowa Agricultural Wetlands

Compare constructed wetland scenarios on ecosystem services and agricultural production

East Mount Zion Remediated Grassland

Compare native grass restoration options on capped landfill that best support community ecosystem services priorities

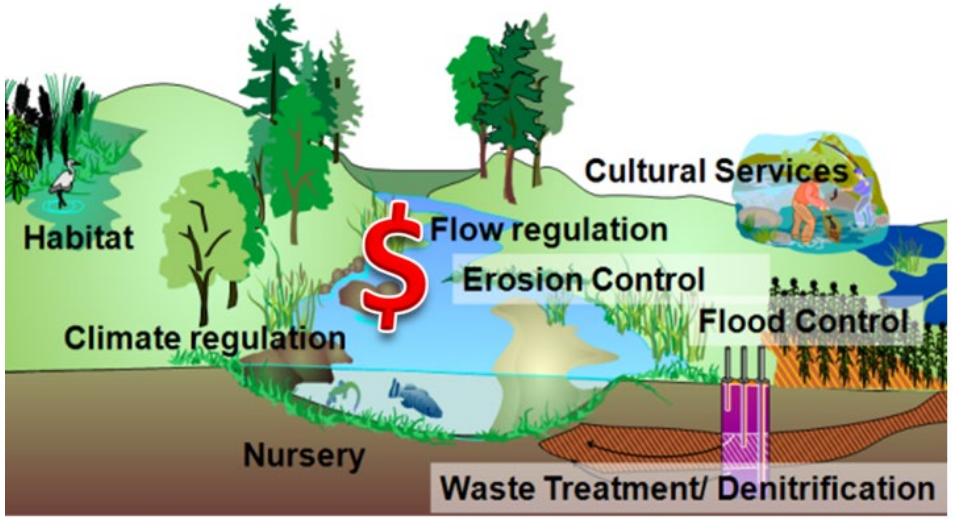
Product 2: Demonstrations and Lessons Learned

Partner Goal: Communicate potential benefits of planned restoration projects to gain public support

Mobile Bay Estuary

Quantify potential benefits of planned restoration projects in the watershed

Yakima River Floodplains



Quantify potential benefits of large river restoration to support related green infrastructure and contaminated site cleanup decisions

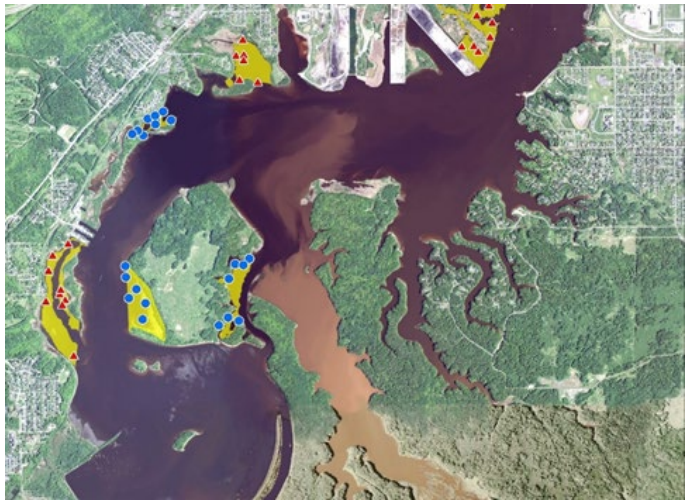
Product 2: Demonstrations and Lessons Learned

Partner Goal: Identify metrics to monitor progress toward restoration goals

Pacific Northwest Tidal Wetlands

Identify metrics to measure beneficial uses from restored wetlands

St. Louis River Estuary



Develop metrics to evaluate large-scale benefits to fish and recreational fishing from small-scale restorations

Product 2: Demonstrations and Lessons Learned

Partner Goal: Communicate evidence of benefits post-restoration toward goals

East Coast Superfund Sites

Quantify changes in genetic diversity in response to superfund cleanup and habitat restoration

Great Lakes Areas of Concern

Communicate ecological benefits of completed restoration projects to the public

Anticipated Impacts

- Links beneficial use restoration goals to meaningful metrics of ecosystem function and services
- Partners can use approaches to identify and quantify ecosystem services, identify targets, and monitor outcomes
- Helps identify why restoration is or isn't achieving beneficial use goals
- Facilitates communication of restoration in terms of goals that are meaningful and relevant to stakeholders