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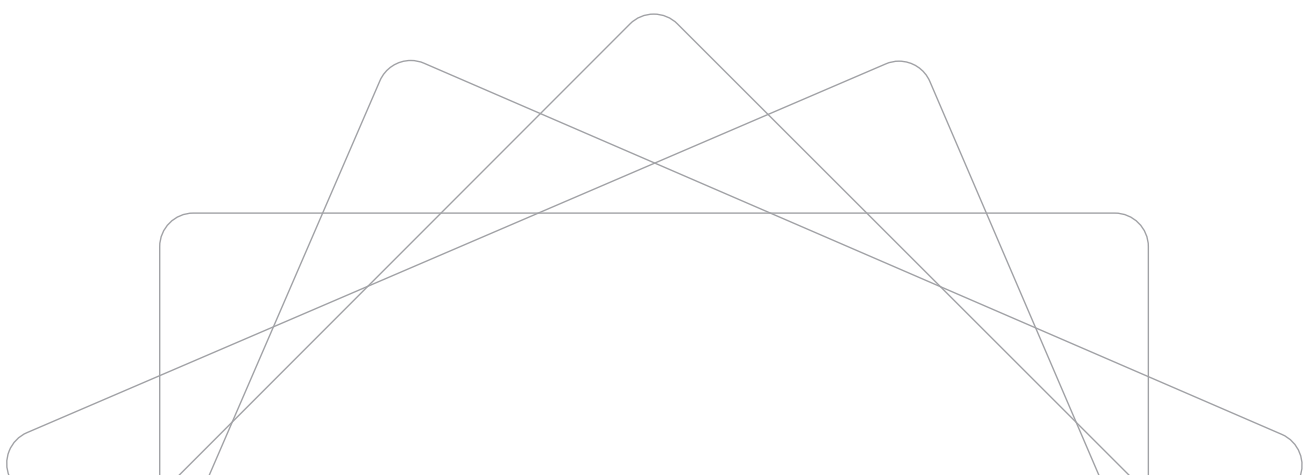
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ABT THOUGHT LEADERSHIP PAPER

Estimating the Change in Ecosystem Service Values from Coastal Restoration

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Introduction

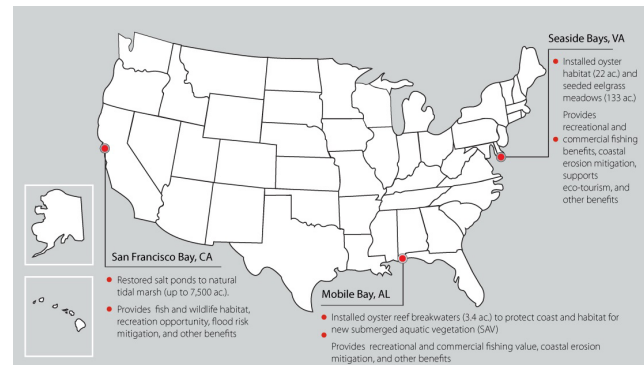
Coastal ecosystems are highly productive, yet vulnerable, natural resources. Healthy tidal wetlands, salt marshes, submerged aquatic vegetation, oyster reefs, and other habitats provide vital goods and services, from fisheries production to recreation opportunities and wildlife habitat. Goods and services from healthy habitats support the livelihoods, experiences, and resilience of coastal communities. Over the past century, however, human development pressures, natural disasters, and other factors have contributed to dramatic declines in the health and extent of the United States' wetlands, marshes, and submerged habitats. For example, while wetland loss rates are now slower than the historic rates of destruction during the 1950s-1970s, an estimated 62,300 acres of wetlands were lost in the conterminous United States between 2004 and 2009 (Dahl, 2011). The fundamental premise of coastal habitat restoration is to reverse the impacts of ecosystem stressors and return damaged habitats to a state that mirrors natural conditions. Resulting improvements to coastal environments include increased primary production, a more natural tidal pattern, better water quality, larger fish and wildlife populations, among others. Restoration thus presents an opportunity to ensure the long-term health of coastal ecosystems. Because 39% of Americans live in coastal counties (NOAA/NOS, based on 2010 data), restoration is also an opportunity to ensure the vitality of coastal communities nation-wide.

Improved ecosystem conditions support economically valuable activity in coastal communities. Economists have demonstrated that improved habitats generate value for households and industry (Barbier et al., 2011). Restoration investments also generate short-term community benefits like job creation and regional economic activity (Mather Economics & The Walton Family Foundation, 2012; U.S. Fish and Wildlife Service, 2014). Despite research that shows the value of healthy ecosystems, and the clear need for restoration given ongoing and nation-wide coastal degradation, coastal

restoration funding remains slim (e.g., Bagstad, Stapleton, & D'Agostino, 2007; Holl & Howarth, 2000; Thom et al., 2005). Slim funding reflects an apparent gap between scientific knowledge of the value of coastal ecosystems and consequent policy decisions to prioritize investments in coastal restoration (e.g., Barbier, 2013). Policies to address this gap may benefit from studies expressing the economic value of specific restoration projects and the tangible ecosystem services they generate.

The purpose of this study is to help bridge the gap by assessing the potential economic value of long-lasting environmental benefits provided by recent coastal restoration projects (tidal marsh, eelgrass, and oyster reefs). The analysis demonstrates the value of restoration relative to the initial restoration investments, based on three projects designed to provide short-term economic stimulus under the American Recovery & Reinvestment Act: San Francisco Bay tidal marsh restoration, Virginia Seaside Bays oyster and eelgrass restoration, and Mobile Bay oyster reef breakwater installations (*Exhibit 1*).

Exhibit 1. Map of Case Study Sites



Results of this study demonstrate that each project generates economic benefits by improving and enhancing a variety of ecosystem goods and services (e.g., enhanced flood protection, recreational amenities, commercial and recreational fishing). These benefits may produce long-term value in excess of the initial investment cost, as found for two of the three projects Abt Associates (Abt) analyzed in this study (*Exhibit 2*).

Exhibit 2. Economic Benefits of Coastal Ecosystem Restoration at Three Sites (\$2013)

	NOAA/ARRA FUNDING (1)	ECONOMIC OUTPUT (2)	ECOSYSTEM TPV(3)	ECOSYSTEM BENEFIT TO COST RATIO (3)
San Francisco Bay Salt Ponds	\$8.27 million	\$8.07 million	\$6.89-\$220 million	0.8:1 to 27:1
Virginia Seaside Bays	\$2.35 million	\$2.57 million	\$34.9-\$84.8 million	14:1 to 36:1
Mobile Bay, Alabama	\$3.18 million	\$3.46 million	\$183,000-\$337,000	0.06:1 to 0.1:1

Sources: (1) NOAA; (2) Coyle (2013)—A separate study not part of this analysis; (3) Calculated over 40 years post-restoration, Abt Associates (this analysis).

Exhibit 2 compares the estimated long-term ecosystem service benefits to construction spending and short-term economic output. The table reports NOAA/ARRA funds awarded for initial construction costs (“NOAA/ARRA Funding”), a separate study’s (Edwards, Sutton-Grier, & Coyle, 2013) estimates of the short-term economic activity following the dispersion of construction spending throughout the regional economy (“Economic Output”), and our estimates of the total present value (TPV) of each restored habitat’s long-term ecosystem service provision (“Ecosystem Total Present Value”). Economic output and ecosystem TPV are complementary measures of value-added from the one-time spending on restoration. Economic output studies model the secondary spending which one-time restoration expenditures (e.g., laborer’s wages and payments to materials suppliers) make possible by injecting new money into an economy (Edwards, et al., 2013). Because these effects eventually dissipate and are tied only to construction activity, they omit the value of services which the restored ecosystem provides.

Notably, the upper bound estimates of ecosystem service benefits alone often far exceed construction costs. For example, two of the three ecosystem benefit-to-cost ratios indicate that, by enhancing and restoring ecosystems, restoration spending generates highly favorable gross returns. Short-term economic output, on the other hand, provides smaller return given the same construction cost.

“Notably, the upper bound estimates of ecosystem service benefits alone often far exceed construction costs.”

Not accounting for ecosystem benefits may, therefore, lead to incomplete conclusions about restoration benefit-to-cost ratios. Our study demonstrates that ecosystem service benefits are a potentially significant aspect of the restoration “story;” omitting their values may lead to inefficient allocation of restoration funds. By extension, coastal policy that accounts for ecosystem service benefits in addition to costs and short-term economic impact will represent a more complete picture, and may lead to greater support for coastal restoration investment

Ecosystem service benefits, however, depend on site-specific factors such as ecosystem type, geographic location, baseline conditions, restoration success, and assumptions about the future duration of benefits. Across the three case study projects, Abt finds that restoring habitats near socioeconomically-disadvantaged communities may also be able to provide environmental justice benefits. Because our analysis rests on accepted economic approaches and employs existing data, our analysis demonstrates a restoration valuation methodology that can be readily generalized and applied to other projects.

The remainder of this summary presents the case study projects, provides a synopsis of our valuation methods, and discusses the estimated economic value of benefits in context of coastal policy.

Methods

General Approach

Ecosystem goods and services produced by restored coastal habitats are inputs to economic activity and thus can offer real economic value to surrounding and distant communities. Coastal habitats provide society with directly consumable products (e.g., commercial fish harvests), support cultural activities (e.g., wildlife viewing and science education), and regulate and support the basic environmental processes (e.g., carbon sequestration and primary production) (Millenium Ecosystem Assessment, 2005).

We began this study by assessing the potentially-restored goods and services at each restoration site, and then used available monitoring data, environmental impact statements, and findings from prior ecological studies to estimate changes in ecosystem services at the site (*Exhibit 3*). The full effect of a restoration action may take decades to develop, but our case study projects were only very recently completed (less than five years prior to our study). To project long-term changes (and thus long-term economic benefits), we developed site-specific restoration trajectories to extrapolate available short-term restoration results over a 40-year period. Using available restoration site monitoring data, models and data from reference sites and scientific literature, we developed site-specific restoration trajectories. We next compared ecosystem service endpoints (i.e., vegetation density, oyster density, and others) before restoration to those throughout the restoration trajectory and used economic models to estimate the value of the change in services at each year. We discounted all values to present-day, for comparison to initial restoration investment.

We estimated economic values using a suite of market and nonmarket valuation approaches. For goods and services that are bought or traded in markets (e.g., increased fish catch), we used

market-based approaches to estimate the value of these additional services. For nonmarket good and services, we used benefit transfer, a commonly-applied technique that involves adapting research found in the literature on the benefit value of similar projects and involving similar policy questions. Changes in individual households' willingness to pay (WTP) for goods and services served as our unit measure of non-market social benefits, such as aesthetic, recreational and non-use values.

Exhibit 3. Summary of Ecosystem Service Valuation at Case Study Sites.

BENEFIT	RESTORATION PROJECT		
	SAN FRANCISCO	VIRGINIA SEASIDE BAYS	MOBILE BAY
Aquatica Habitat			
Biodiversity	\$	\$	●
Threatened & Endangered Species	\$	○	○
Commercial Fishing	\$	\$	\$
Recreational Fishing	\$	\$	\$
Subsistence and Artisanal Fisheries	●	●	●
Coastal Resiliency			
Erosion Mitigation	○	\$	●
Flood Protection/Storm Buffering	\$	○	○
Life-Supporting Services			
Carbon Cycling	\$	\$	\$
Nitrogen Cycling	○	\$	\$
Primary Production	\$	\$	○
Food Web Dynamics	\$	\$	\$
Cultural Enhancements			
Bird Watching	\$	●	○
Trail and Water Uses	●	●	○
Other Recreation	●	●	○
Existence/Non-Use Values	\$	\$	●
Aesthetic Appreciation	\$	●	○

○ = No change in the service/Service is not relevant to the site.

● = Provides or enhances the service; effect is qualitatively assessed in this analysis.

\$ = Provides or enhances the service; effect is quantified and monetized in this analysis.

Finally, because coastal managers may be concerned with making not only economically-defensible choices about restoration, but also about making choices that benefit a diversity of stakeholders, we conducted screening-level environmental justice analyses and identified the potential types of stakeholders who may benefit from a given coastal restoration investment. Our environmental justice analyses follow U.S. EPA guidelines (U.S. EPA, 2013).

Case Studies

Following the United States' recent economic recession, environmental agencies and other groups started to use coastal restoration to "... create work to support new jobs and provide income to local contractors and other industries" (U.S. Fish and Wildlife Service, 2014). In particular, using funds provided by the American Recovery and Reinvestment Act (ARRA), the National Oceanographic and Atmospheric Administration (NOAA) allocated in 2009, \$167 million for 50 coastal and marine habitat restoration projects. These projects were targeted to create employment benefits in the short-term while achieving long-term environmental value. Subsequent research has demonstrated that the investments created an average of 17 jobs per \$1 million invested (NOAA, 2013).

We applied our ecological and economic assessment methods to three of the NOAA-ARRA projects. We selected these projects because they represent a variety of the United States' coastal ecosystems and surrounding communities, and maintained post-implementation habitat monitoring records that are needed for estimating changes in ecosystem service provision. At each site, we took into account key site-specific considerations, datasets, and valuation functions relevant to the individual project.

San Francisco Bay, California

San Francisco Bay is the largest estuary on the Pacific coast of North America, yet more than 90 percent of its historic wetlands have been converted to agriculture, urbanization, and commercial salt production (Goals Project, 1999). As part of regional efforts to reverse this habitat loss, federal, state, and local groups are engaged in collaborative efforts to convert South San Francisco Bay's salt production ponds back to their original state as ecologically-productive tidal marshes. Since 1994, federal and state agencies have purchased tracts of estuary baylands now totaling over 27,000 acres.



Photo Courtesy of Doc Searls/Flickr

The current phase of tidal marsh restoration, funded in part by a \$7.6 million NOAA-ARRA grant, is called the South San Francisco Bay Salt Pond Restoration Project (SBSPRP) and is designed to convert up to 7,500 acres of commercially-productive salt ponds to tidal marsh. Ecosystem monitoring shows that within just three years of commencing restoration activity at sites funded by the NOAA-ARRA program, individual restored ponds (approximately 1,513 acres) are beginning to provide vegetated marsh habitat and to support a different mix of bird, fish, and shellfish species, including threatened, endangered, and iconic species.

Abt applied a variety of ecosystem valuation approaches to estimate the total present value of the ecosystem service flow, using changes in salt marsh topography and plant density as indicators of wetland maturity and habitat quality.

We estimated changes in total nonmarket value of the overall salt marsh habitat (including recreational use, biodiversity support, size of the project, and other features) using a benefit transfer from existing wetland valuation studies. In addition, we estimated the value of changes in specific ecosystem services provided by wetlands, including commercial and recreational fish populations, carbon sequestration, marginal changes in flood risk, etc.

Restoration Activity
Restored natural tidal influence to industrial salt ponds, reverting to original salt marsh
Habitat Quality Indicators
<ul style="list-style-type: none"> • Presence of tidal influence • Marsh topography and sediment accumulation • Vegetation establishment and vegetation cover • Plant species mix
Ecosystem Goods and Services (Summary)
<ul style="list-style-type: none"> • Commercial seafood harvests • Recreational fishing • Supporting services (primary production, food web effects, etc.) • Carbon cycling • Cultural benefits
Valuation Methods
<ul style="list-style-type: none"> • Function-based benefit transfer from studies and meta-analyses of total WTP • Trophic transfer models of fish production and market valuation

Seaside Bays of Virginia

Virginia’s Seaside Bays include a variety of shallow coastal ecosystems, including submerged eelgrass meadows and oyster reefs. These habitats were once substantially present throughout the temperate zone and contributed important economic value. However, like many temperate estuaries of the United States, they experienced sharp declines in the last century due to habitat loss, natural disasters and over-harvesting.

With a \$2.2 million NOAA-ARRA award, the project partners (including The Nature Conservancy, the Virginia Institute of Marine Science, Virginia Marine Resources Commission, and Virginia Coastal Zone Management Program) constructed functional oyster reefs at 14 sites; planted eelgrass seeds in the non-vegetated bottom of four bays; and deployed adult bay scallops as spawning stock in the restored eelgrass beds to support reintroduction of a self-sustaining bay scallop population.



Healthy, mature habitats are able to provide more and higher-quality services than partially-restored ecosystems. Abt used eelgrass shoot density and restored area as indicators of eelgrass habitat quality, and oyster population size, age structure, and reef area as indicators of oyster reef habitat quality. We separately estimated changes in total present value of goods and services from eelgrass and oyster reefs. For eelgrass, we estimated total nonmarket value of ecosystem services provided by eelgrass restoration using existing studies

of households' willingness to pay to protect an eelgrass habitat similar to the case study (Johnston, Grigalunas, Opaluch, Mazzotta, & Diamantedes, 2002; Mazzotta, 1996). In addition, we estimated the value of eelgrass in protecting shorelines from coastal erosion. For oysters, Abt estimated individual values for increased carbon and nitrogen sequestration, market values for commercial fin fish landings, and recreational benefits of increased fin-fisheries at reefs (relative to bare sediment). The oyster reefs will be managed as sanctuaries with no oyster harvesting, but the reefs may provide non-monetizable value as "seed" (larval oyster) stock to nearby reefs.

Restoration Activity
<ul style="list-style-type: none"> • Constructed oyster reefs • Planted eelgrass meadows • Tested bay scallop spawning stock program at a demonstration site
Habitat Quality Indicators
<ul style="list-style-type: none"> • Oyster density • Eelgrass coverage and shoot density • Scallops not quantifiable given available data
Ecosystem Goods and Services (Summary)
<ul style="list-style-type: none"> • Commercial seafood harvests • Recreational fishing • Supporting services (primary production, food web effects, etc.) • Carbon and nutrient cycling • Cultural benefits
Valuation Methods
<ul style="list-style-type: none"> • Function-based benefit transfer from studies and meta-analyses of total WTP • Recreational travel cost models • Function-based benefit transfer from hedonic property value studies • Value transfer

Mobile Bay, Alabama

Mobile Bay, part of Alabama's Gulf Coast shoreline, is an estuary of national significance. It supports a diversity of nationally-important bird, fish, and wildlife species, and provides Fish and Wildlife Service-designated critical habitat areas for the piping plover (Mobile Bay National Estuary Program, 2008). However, changes in sedimentation patterns and salinity and increased use of shoreline armoring have altered wildlife habitats, exacerbated shoreline erosion, and reduced the Bay's resiliency during severe storms.



A \$2.9 million grant from NOAA-ARRA to the Nature Conservancy (TNC) funded installation of "living shorelines" along several stretches of Mobile Bay coastline to provide oyster, other shellfish, and fin-fish habitats and create protective coastal breakwaters to provide shoreline stabilization and resiliency. In addition to enhancing the ecological health and resiliency of Mobile Bay marine habitats, the project was also designed to provide long-term fishery-related jobs for Mobile and Baldwin Counties. In total, 3.4 acres (1.6 miles) of oyster reef breakwaters were installed and now protect 31 acres of coastal habitat potentially suitable for new submerged aquatic vegetation (SAV) growth.

Oyster reef acreage served as this case study’s habitat quality indicator. Abt estimated the value of increased ecosystem service flow based on several oyster reef functions: carbon and nitrogen sequestration, commercial and recreational fin fishery production, and coastal erosion mitigation. While this project is expected to produce ecosystem service benefits valued at lower than project cost, a variety of factors limited our ability to assess the full value of potential ecosystem services, including poor data availability. Further, natural environmental circumstances (e.g., hurricanes that amplified the effects of predation and poor water quality) dampened the pace of initial recovery at some sites.

Restoration Activity
<ul style="list-style-type: none"> • Constructed oyster reef shoreline breakwaters
Habitat Quality Indicators
<ul style="list-style-type: none"> • Oyster density and maturity at constructed reeds • Protected shoreline area
Ecosystem Goods and Services (Summary)
<ul style="list-style-type: none"> • Commercial seafood harvests • Recreational fishing • Supporting services (primary production, food web effects, etc.) • Carbon and nutrient cycling • Cultural benefits
Valuation Methods
<ul style="list-style-type: none"> • Function-based benefit transfer from studies and meta-analyses of total WTP • Fisheries production enhancement models and market valuation

Summary of Results

Among the many different types of benefits expected at each site, the three restoration projects will together help to enhance coastal biodiversity (all projects); protect threatened and endangered species (San Francisco Bay); provide nursery, habitat, and increased production of regionally-important fish and shellfish species targeted in commercial and recreational fisheries (all projects); provide nitrogen (Virginia Seaside) and carbon sequestration capacity (San Francisco Bay; Virginia Seaside); enhance opportunities for coastal recreation and tourism (all projects); and may provide real estate benefits by mitigating coastal erosion (Virginia Seaside; Mobile Bay) and providing marginal flood protection benefits to homes in coastal floodplains (San Francisco Bay).

“Coastal improvements will generate substantial long-term economic value to coastal communities through improvements in ecosystem services.”

Our report suggests that coastal improvements will generate substantial long-term economic value to coastal communities through improvements in ecosystem services. As described previously, these long-term ecosystem service benefits are separate from the short-term employment benefits that were a primary motivation of the ARRA program. However, our case studies show that restoration investment—in terms of initial construction costs—provides a variable return on investment. For every \$1 invested in construction costs, the examined projects each produce between \$0.06 and \$36 in total long-term ecosystem service benefits. In other words, some, but not all, projects can be expected to demonstrate favorable benefit-to-cost ratios.

These ratios exclude any long-term operation and maintenance costs (i.e., maintaining existing levees in San Francisco Bay), and exclude both leverage and multiplier effects of the economic activity stemming from the improved ecosystem services (see, however, a report which does: U.S. Fish & Wildlife Service, 2014).

Leverage describes the additional coastal restoration resources obtained as new organizations provide funding and support to sustain or build on the initial restoration projects. Multiplier effects of economic activity capture the ripple effect of wages, subsequent purchases, and tax revenue generated by public and private spending on labor and construction costs of restoration.

Major Conclusions

Abt draws several major conclusions from comparative analysis across the three case studies:

Coastal habitat restoration enhances a wide range of valuable ecosystem goods and services. Restored salt marshes, sub-tidal meadows of eelgrass and other submerged aquatic vegetation, and oyster reefs provide fish and shellfish habitat and new recreational opportunities, protect coastal homes from shoreline erosion, mitigate climate change by storing carbon, enhance biodiversity, and help maintain coastal community character by supporting traditional and novel resource-dependent industries.

Coastal restoration investments can help address environmental injustices and support robust regional economies. Many people living in coastal communities will benefit from ecological improvements. However, coastal restoration can provide targeted benefits to some groups in particular, such as small businesses, resource-dependent industries, and traditionally under-privileged households.

For example, when disadvantaged households stand to gain more from restoration than the average household within the community, restoration activity may help address environmental injustices (e.g., because a large portion of minority residents are employed in resource-dependent jobs that benefit from restoration, or because low income homeowners are less likely to purchase flood insurance coverage and thus benefit greatly from reduced flood risk). Abt observed this trend in two of the case studies we examined (Virginia Seaside; Mobile Bay).

Ecosystem service benefits are highly site-specific, but coastal resource planners can readily account for site features in the applied valuation of coastal resources. Accounting for a variety of project and site features is important, because no single feature guarantees success or value. While services valued on a per-area basis accrue approximately proportional to project size and quality (for example, Grabowski et al., 2012), synergistic effects from nearby ecological resources; the habitats recovery pace; the type of services affected by restoration, and the characteristics of populations who benefit from restoration also contribute to coastal restoration values. Further, many service values are both non-linear and habitat-specific. For example, flood protection benefits do not scale linearly with project size: in the South San Francisco Bay case study, we account for flood protection values only after project reaches a large size. Finally, projects like the Mobile Bay oyster reef restoration provide non-monetary benefits to society that should not be omitted during decision making, including benefits to infrastructure protection, “knowledge capital” generation, and employment.

A more comprehensive study would evaluate additional, previous, or ongoing coastal restoration projects to (1) provide a more robust assessment of the net benefits achieved by these types of projects and (2) help analysts better understand the factors leading to project success in terms of ecosystem benefit contribution. As part of a more comprehensive study, Abt recommends obtaining longer-term monitoring data at the projects we examined in this report to strengthen post-restoration evaluations and benefit assessments, particularly regarding the rate of accumulation and duration of benefits over time. Additionally, up-front restoration costs (e.g., Exhibit 2) at some projects may be followed by periodic maintenance costs that communities must incur to sustain restored ecosystems. As these costs become known, benefit to cost ratios could be adjusted to more completely reflect the long term.

In general, by re-assessing project benefits as more data become available, we can better evaluate uncertainty in the current ecological and economic benefit projections.

Finally, extending the restoration valuation framework developed in this report to a wider variety of coastal restoration projects would broaden the understanding of how limited restoration resources could be more optimally distributed across potential projects. Enhanced understanding of restoration accomplishments across individual projects—especially if reported using consistent metrics that stakeholders respond to, such as the economic value of ecosystem improvements and returns on restoration investments—could promote greater allocation of funding to restoration overall.

References

- Bagstad, K. J., Stapleton, K., & D'Agostino, J. R. (2007). Taxes, subsidies, and insurance as drivers of United States coastal development. *Ecological Economics*, 63(2-3), 285-298. doi: <http://dx.doi.org/10.1016/j.ecolecon.2006.09.019>
- Barbier, E. B. (2013). Valuing Ecosystem Services for Coastal Wetland Protection and Restoration: Progress and Challenges. *Resources*, 2(213-230).
- Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*, 81(2), 169-193.
- Dahl, T. E. (2011). Status and Trends of Wetlands in the Conterminous United States 2004 to 2009 (pp. 108). Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.
- Edwards, P. E. T., Sutton-Grier, A. E., & Coyle, G. E. (2013). Investing in nature: Restoring coastal habitat blue infrastructure and green job creation. *Marine Policy*, 38(0), 65-71. doi: <http://dx.doi.org/10.1016/j.marpol.2012.05.020>
- Goals Project. (1999). Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project (pp. 1-209 (plus appendices)). San Francisco, CA: U.S. Environmental Protection Agency /S.F. Bay Regional Water Quality Control Board.
- Grabowski, J. H., Brumbaugh, R. D., Conrad, R. F., Keeler, A. G., Opaluch, J. J., Peterson, C. H., . . . Smyth, A. R. (2012). Economic valuation of ecosystem services provided by oyster reefs. *BioScience*, 62(10), 900 - 909.
- Holl, K. D., & Howarth, R. B. (2000). Paying for Restoration. [Article]. *Restoration Ecology*, 8(3), 260-267. doi: 10.1046/j.1526-100X.2000.80037.x
- Johnston, R. J., Grigalunas, T. A., Opaluch, J. J., Mazzotta, M., & Diamantedes, J. (2002). Valuing estuarine resource services using economic and ecological models: the Peconic Estuary System study. *Coastal Management*, 30(1), 47-65.
- Mather Economics, & The Walton Family Foundation. (2012). Job creation from Gulf Coast wetlands restoration.
- Mazzotta, M. J. (1996). *Measuring public values and priorities for natural resources: an application to the Peconic Estuary Program*. Doctor of Philosophy, University of Rhode Island.
- Millenium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Washington, D.C.: Island Press.
- Mobile Bay National Estuary Program. (2008). State of Mobile Bay: A Status Report on Alabama's Coastline from the Delta to Our Coastal Waters (pp. 1-46). Mobile, AL.
- Thom, R. M., Williams, G., Borde, A., Southard, J., Sargeant, S., Woodruff, D., . . . Glasoe, S. (2005). Adaptively Addressing Uncertainty in Estuarine and Near Coastal Restoration Projects. *Journal of Coastal Research*(ArticleType: research-article / Issue Title: SPECIAL ISSUE NO. 40. Coastal Restoration: Where Have We Been, Where Are We Now, and Where Should We Be Going? / Full publication date: WINTER 2005 / Copyright © 2005 Coastal Education & Research Foundation, Inc.), 94-108. doi: 10.2307/25736618
- U.S. EPA. (2013). Draft technical guidance for assessing environmental justice in regulatory analysis (April 3, 2013 - Post-Internal Agency Review Draft ed., pp. 1-56).
- U.S. Fish and Wildlife Service. (2014). Restoration Returns: The contribution of partners for Fish and Wildlife Program and Coastal Program restoration projects to local U.S. economies (pp. 1-21).



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