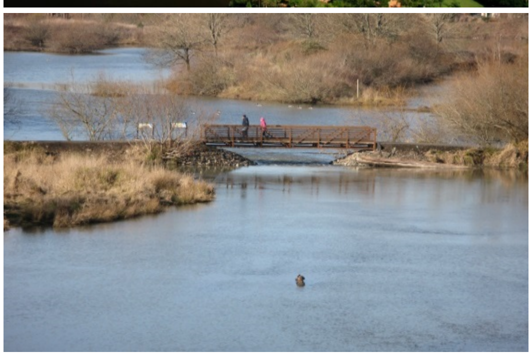
Socioeconomic Benefits of Habitat Restoration



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OHC-1
May 2017

Socioeconomic Benefits of Habitat Restoration

Giselle Samonte[1], Peter Edwards[2], Julia Royster[3], Victoria Ramenzoni[4], and Summer Morlock[5]

[1] Contractor with Earth Resources Technology, Inc.
NOAA Fisheries Office of Habitat Conservation
1315 East-West Hwy, Silver Spring, MD 20910

[2] Contractor with The Baldwin Group, Inc.
NOAA National Ocean Service, Office for Coastal Management
1305 East-West Highway, Silver Spring, MD 20910

[3] NOAA Fisheries Office of Habitat Conservation
1315 East West Highway, Silver Spring, MD 20910.

[4] Harte Research Institute for Gulf of Mexico Studies
Texas A&M University-Corpus Christi
6300 Ocean Drive, Corpus Christi, TX 78412

[5] NOAA Budget Office, Department of Commerce
1401 Constitution Ave. NW, Washington D.C. 20230

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U.S. Department of Commerce
Wilbur L. Ross, Jr., Secretary

National Oceanic and Atmospheric Administration
Benjamin Friedman, Acting NOAA Administrator

National Marine Fisheries Service
Chris Oliver, Assistant Administrator for Fisheries

Recommended citation:

Giselle Samonte, Peter Edwards, Julia Royster, Victoria Ramenzoni, and Summer Morlock. 2017. Socioeconomic Benefits of Habitat Restoration. NOAA Tech. Memo. NMFS-OHC-1, 66 p.

Copies of this report may be obtained from:

Office of Habitat Conservation
National Oceanic and Atmospheric Administration
1315 East-West Highway, SSMC 3, 14th Floor
Silver Spring, MD 20910

Or online at:
http://spo.nmfs.noaa.gov/tm/
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Acknowledgments

The authors acknowledge the NOAA Restoration Center Staff for their review specifically Carl Alderson, Mary Andrews, Matthew Bernier, Steven Block, Daphne Boothe, Megan Callahan-Grant, Terry Heatlie, Polly Hicks, Megan Hilgart, Eric Hutchins, Lehto Jason, Marti McGuire, Lauren Senkyr, Jim Turek, Dan Van-Nostrand, Lani Watson. Megan for Brockway for input on the NOAA Restoration Center Database; Renee King and Mike Peccini for the maps.

Dr. Rita Curtis, NOAA Fisheries Science and Technology, for support on the IMPLAN software.

Ms. Frances Pflieger for technical editing.

Executive Summary

The ability to quantify the economic output and socioeconomic benefits of restoration projects is critical to better understand the short and long-term values of these projects to local communities. The findings in this study, and future similar studies, are important to increase the understanding of the role of green jobs in the economies of local communities, as well as the long-term ecosystem services the restoration projects provide, including reduction of damage to life and property.

NOAA received $167 million dollars from the American Reinvestment and Recovery Act (also referred to as the Recovery Act or ARRA) of 2009 to restore coastal areas throughout the country. The primary goals were to restore habitats and stimulate economic growth. We collected and analyzed data from the 125 funded projects to examine their impact on local economies. Federal financial and technical assistance was provided to 'ready-to-go' (shovel-ready) projects that met NOAA's mission to restore marine and coastal habitats. The NOAA Restoration Center helped the communities by removing fish passage barriers, restoring hydrologic reconnection to tidal wetlands and floodplains, rebuilding native oyster populations, and controlling invasive species to prevent loss of coral reef habitat. The ARRA projects restored a range of critical habitat types, including rivers, wetlands, and shellfish and coral reefs.

Key results:

- Restored 25,584 acres of habitat, opened 677 miles of stream for fish to reach spawning habitat, and removed 433,397 tons of debris from coastal habitats.

- Expended $154.1 million dollars on projects to generate $260.5 million dollars annually.

- Contributed value added of $143.7 million dollars in new or expanded economic activity nationwide.

Recovery Act restoration activities supported thousands of jobs, specifically:

- Restoration activities supported a total of 2,280 jobs. Examples of direct jobs include environmental consultants, engineers, construction workers, geologists, project managers, fishermen, biologists, and divers.

- Supported on average 15 jobs per million dollars spent. Labor-intensive restoration—like building oyster reefs and invasive algal specie removal may have a 30 jobs per million ratio due to the significant manual labor component.

Socioeconomic benefits of healthier rivers and coastal habitats:

- There are additional benefits from restored ecosystem services such as; storm and erosion protection, carbon sequestration as well as other non-market economic benefits derived from habitat improvements. Also referred to as "co-benefits." Some of our ARRA project partners measured these socioeconomic benefits.

- Restored wetlands and stabilized shoreline along the south shore of Muskegon Lake, Michigan will generate a $12 million dollar increase in property values, up to $600,000 dollars in new tax revenue annually, and more than $1 million dollars in new recreational spending with nearly 65,000 additional visitors annually over 15 years. The total value generated is nearly six times the initial investment.

- Sixty acres of restored freshwater tidal marsh and improved passage to 15 miles of high-quality habitat for chum, coho, threatened Chinook salmon in Washington's Skagit Delta, are expected to generate an estimated $21 million dollars in economic benefits by reducing the risk of flood damage and drainage maintenance costs over 50 years.

- Restored urban wetlands in Huntington Beach, California generated carbon storage and sequestration benefits of $130,000 dollars per year over 50 years. The restoration investment also increased the extent of open water wetlands in the region, enhancing space and aesthetics as reflected in increased residential property values of $36.3 million dollars.

In terms of economic growth, the 2,280 jobs supported through ARRA funding signify a valuable contribution to our nation's restoration economy[1] that may have a long-lasting effect in local economies. This study determined that habitat restoration projects supported, on average, 15 jobs per million dollars spent for restoration projects, and 30 jobs per million dollars invested in labor intensive restoration projects. It also determined that aside from immediate ecological and economic benefits, coastal restoration projects can provide significant long-term benefits through the rehabilitation and strengthening of the ecosystem services restored areas provide.

[1] The broad definition of Restoration Economy includes both the built and natural environment (Cunningham, 2002). Restoration economy in this report refers on economic activity relating to ecological or habitat restoration.

1. Introduction

In 2009, NOAA's Restoration Center[2] (RC) received $167 million[3] through the American Recovery and Reinvestment Act of 2009 (ARRA) to restore coastal habitats and help stimulate our nation's economy by supporting thousands of jobs. As a result of a very competitive solicitation and selection process, the RC awarded 50 cooperative agreements supporting the implementation of 125 restoration projects throughout the United States (Figure 1). Federal financial and technical assistance was provided to 'ready-to-go' (shovel-ready) projects that met NOAA's mission to restore marine and coastal habitats.

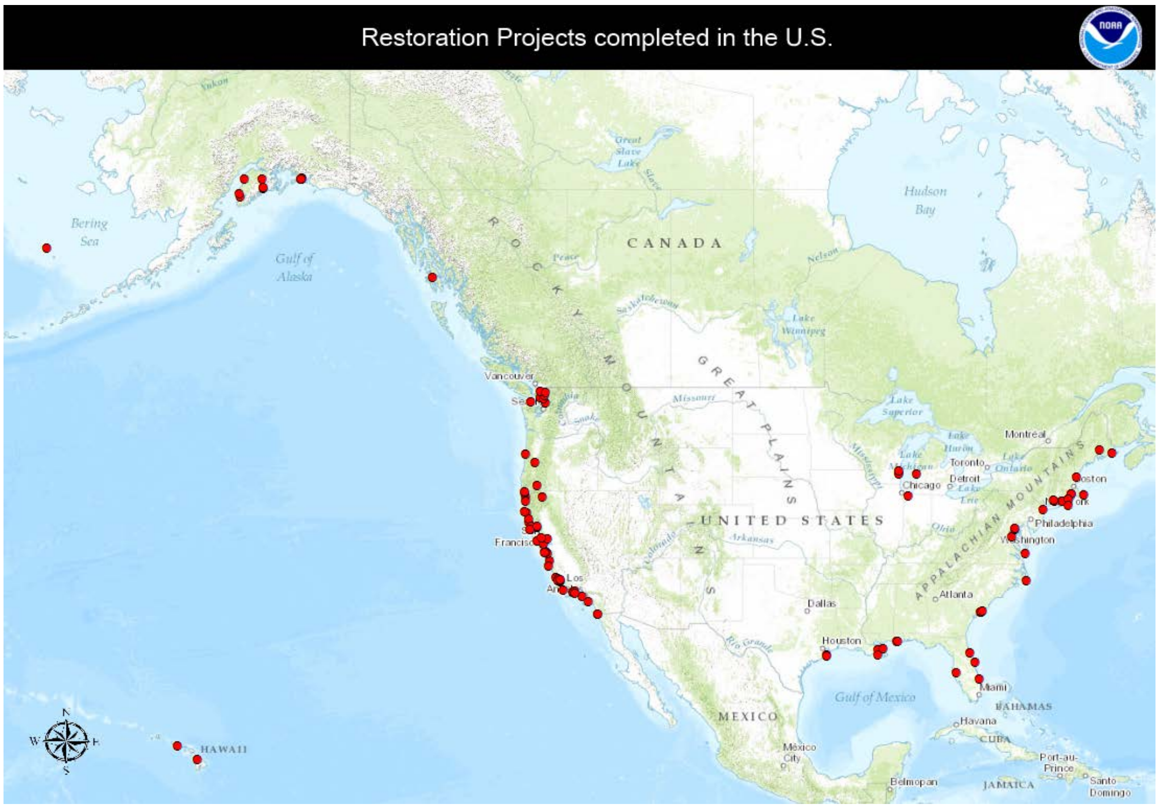

Figure 1. American Recovery and Reinvestment Act project sites.

The RC provides funding and technical assistance to restoration projects and supports socioeconomic research to understand the long-term benefits of restoration. Restoration benefits can exceed ecological outputs and have important socioeconomic benefits (Figure 2). In order to better understand the impact of restoration and how to

[2] The RC is the primary office within NOAA tasked with implementing on-the-ground projects to restore our nation's coastal, marine, and migratory fish habitats. The RC is within the National Marine Fisheries Service in the Office of Habitat Conservation.

[3] http://www.habitat.noaa.gov/restoration/programs/recoveryact.html

gain local stakeholder support, studies exploring the socioeconomic benefits of restoration are important.

In 2012, results of a peer-reviewed interim study on the job benefits of 44 of NOAA's ARRA habitat restoration awards were published in *Marine Policy*.[4] The study highlighted 1,409 jobs were supported within 18 months of the projects' start dates. This study determined that habitat restoration projects generate, on average, 17 jobs per million spent, which is similar to other conservation industries such as parks and land conservation. Even though projects were still underway and expenditures were not final when the article was published, the study successfully highlighted the value of restoration funds to economic growth.

The current study provides an analysis of 47 completed ARRA awards. This study examines the economic impact of restoration expenditures by exploring the number and range of jobs that were supported across different project types. Four main types of activities were conducted: (1) fish passage restoration, (2) hydrological reconnection, (3) shellfish reef placement, and, (4) coral reef restoration. In addition to economic impacts, the study examines the long-term ecosystem services benefits of ARRA restoration activities. Examples of ecosystem services that directly benefit people include food, recreation, and storm protection. Other ecosystem services are less tangible, such as habitat's role in absorbing carbon from the atmosphere. Coastal habitats are important beyond harvesting fish and other coastal products. The longer-term benefits of the restored ecosystem services enhance the social and economic contributions of healthy habitat.

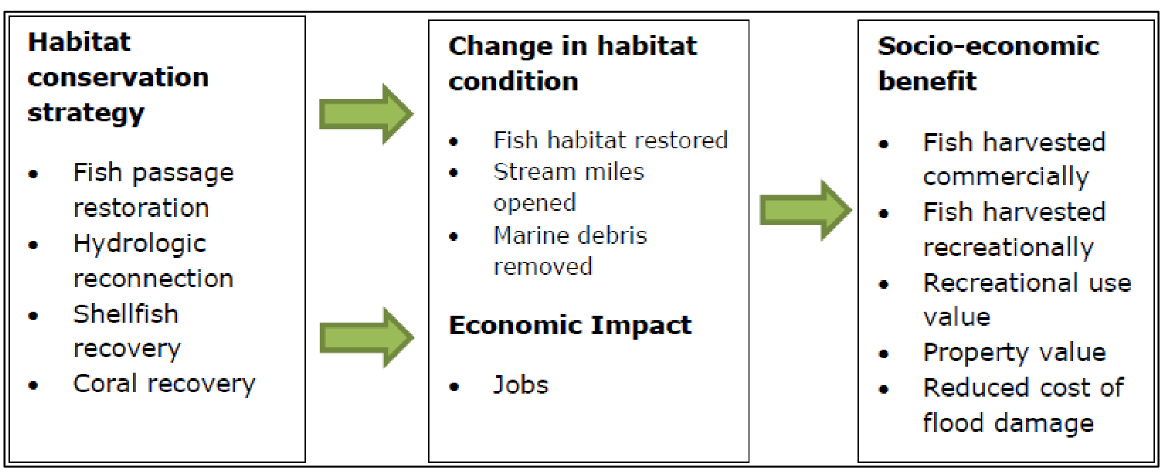

Figure 2. Linking habitat conservation strategy to socioeconomic benefits.

[4] Edwards, P.E.T., et al. 2012. Investing in nature: Restoring Coastal Habitat, Blue infrastructure, and Green Job Creation. *Marine Policy*, 38:65-71.

2. Methods

2.1. Economic impact

The information presented here is based on an analysis of the data collected from 47 ARRA financial awards covering seven geographic regions (Northeast, Northwest, Southeast, Southwest, Pacific Islands, Alaska and Great Lakes) in 22 states; see Appendix I for a full list of projects included in the study.[5] ARRA award recipients were required to report project expenditures by North American Industry Classification System (NAICS) codes. The NAICS is a standardized system used by federal statistical agencies to classify business establishments. It allows agencies to collect, analyze, and publish expenditure information in a uniform way. The requirement for award recipients to report expenditures by NAICS codes allowed NOAA to assess economic impacts of the ARRA habitat restoration expenditures by conducting Input-Output analyses.

The Input-Output analysis framework is a widely used economic method used to explore the interdependence between industries and an economy. It allows the RC to better understand the impact of new green jobs[6], and the effects throughout an economy. This analysis of restoration funds was completed using the Impact Analysis for Planning (IMPLAN) economic impact model. IMPLAN is widely used and professionally accepted by universities and government agencies to estimate the economic impacts of investments. IMPLAN contains regional economic data from various sources including the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the U.S. Census Bureau. The 440 industry sectors used by IMPLAN are the basis of this ARRA economic impact study.

Data analyzed in this technical memorandum is derived from progress reports and NOAA's Restoration and Conservation Database (RCDB) information, which includes narratives of the work completed, descriptions of how the funds were spent during the reporting period, expenditures by NAICS codes, and ecological performance measures. The expenditures used for this analysis represent the total amount of NOAA funds spent to complete the 47 projects included in this study. While most of these projects received additional funding from non-profits, private organizations, or state or local governments, the economic impact analyses presented include only money received from the federal government through the ARRA award. We identified the county (or counties) where each project took place from the IMPLAN database and recorded the expenditures of that project according to specific labor categories or sectors per the IMPLAN regional economic models. The expenditures used for this analysis represent a project's cumulative NOAA expenditures during the NOAA award period.

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[5] ARRA projects in the U.S. Territories, U.S. Virgin Islands, and Commonwealth of the Northern Mariana Islands were not included due to the unavailability of IMPLAN geographic economic data required to include them in the analyses.

[6] The U.S. Bureau of Labor Statistics' definition of green jobs includes (1) jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources and (2) jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources (http://www.bls.gov/green/#definition).

IMPLAN output estimates are measured in dollars, while an IMPLAN employment estimate includes both full- and part-time workers and is measured in annual jobs (Minnesota IMPLAN Group 2004). The analysis was conducted using 2012 dollars. "Jobs per million dollars spent" metrics were calculated for each project by multiplying the total employment estimate by $1 million then dividing by the project's expenditures. This calculation allows for comparison of employment among projects with different levels of expenditure and is a commonly reported metric for analyses of government spending.

In the context of the ARRA projects and job creation, direct jobs refer to employees who use their skills to restore the damaged coastal habitats. Indirect jobs are those that are created in the industries that supply the materials or services, such as lumber or concrete, needed to complete the projects. Induced jobs are created when the increase in demand resulting from restoration employees spending at local businesses (such as restaurants or hotels) necessitates more staff at those establishments. The results are presented by region: Northeast, Northwest, Southeast, Southwest, Pacific Islands, Alaska, and Great Lakes.

2.2 Characterization of habitats and restoration activities

Healthy habitats play an important role in our society and our economy. In helping communities restore coastal habitats, the NOAA Restoration Center applies four main types of habitat restoration activities (Table 1). This categorization was used in this analysis to summarize all study results. These approaches include removing fish passage barriers, restoring hydrologic reconnection to tidal wetlands and floodplains, rebuilding native oyster populations, and controlling invasive species to prevent loss of coral reef habitat.

Table 1. Restoration strategies and goals.

Number of projects under Restoration Center Strategies [1]	**Restoration Goal**
Fish Passage (39)	Improving access for migratory fish species such as salmon, and reducing hazards.
Hydrologic Reconnection (36)	Restoring the flow of water to coastal systems and floodplains.
Shellfish Recovery (6)	Construction of reef by using shell and rock to stabilize the shoreline and promote oyster colonization.

Number of projects under Restoration Center Strategies [1]	Restoration Goal
Coral Recovery (2)	Removal of coral reef smothering invasive algal species.
Other Strategy (42)	Marine debris removal.

[1]Numbers in parenthesis indicate the number of ARRA projects implementing corresponding restoration strategies across the 47 awards. Some ARRA projects implement more than one strategy.

The ARRA projects restored a range of habitat types, from riparian zones to oyster and coral reefs. Table 2 describes the broad categories of habitats. These habitat types are critical to the life cycles of many NOAA trust species or riverine and coastal species. Ecological performance measures monitored by each ARRA project included stream miles opened, habitat acres restored, and marine debris metric tonnage removed. Data for ecological metrics were derived from performance progress reports.

Table 2. Habitat types.

Habitat	General Description
Coral reef	Area strongly affected by coral colonies in shallow tropical/sub-tropical ocean environments.
Freshwater wetland	Wetlands without salt or tidal influence including forested, scrub-shrub.
Pond	Un-vegetated wetland area without salt or tidal influence.
Stream	Area associated with an active stream or river channel.
Water column	Any habitat where the quality or quantity of services gained through restoration does not depend on substrate.
Tidal wetland	Vegetated or sediment flats subject to tidal inundation.
Oyster reef/ shell bottom	Areas where habitat functions are strongly affected by presence of shell.
Submerged aquatic vegetation	Vegetated, mostly sub-tidal wetlands, commonly called sea grasses.

Habitat	General Description
Riparian zone (non-wetland)	Non-wetland habitats, adjacent to rivers or coastal shorelines, that either influence or are influenced by aquatic ecosystems.
Upland	Any habitat that is not flooded during part of the year/does not show the characteristics of wetland habitat.

2.3. Ecosystem services valuation

Broadly defined, ecosystem services are the benefits that flow from nature to people such as the production of fish, water purification, and coastal protection. A subset of the ARRA projects, conducted by our partners that received ARRA funding, measured the downstream effects of restoration, such as the socioeconomic benefits of healthier rivers and coastal habitats. The long-term socioeconomic benefits of restoration that were examined included commercial and recreational harvest, ecotourism, erosion prevention, flood protection, water quality, carbon sequestration, nitrogen sequestration, and habitat/species diversity.

3. Results

3.1. Economic Impact

The effects on the local economy are categorized by direct, indirect, and induced cycles of spending, and can be measured in terms of jobs, labor income, value added, and output. Direct employment refers to people who will use their skills to restore and monitor damaged wetlands, shellfish beds, and coral reefs and reopen fish passages that boost the health and resiliency of coastal and Great Lakes areas. Indirect jobs are generated in industries that supply materials or services to support restoration project activities, such as suppliers who provide nursery plantings, lumber, or concrete, as well as miscellaneous professional services including the consulting of scientific, engineering, or legal services conducted in addition to direct jobs. Induced jobs are the result of expenditures by restoration project employees and businesses. For example, when workers at the restoration site go out to lunch, they are supporting induced jobs in local restaurants. By spending money locally on goods and services, project personnel support a wider variety of business, which in turn may stimulate demand for more employees in a wider variety of industries.

The total effect is reported here in terms of jobs, labor income, value added, and output (Table 3). ARRA restoration activities directly and indirectly supported 2,280 full- and part-time jobs. Labor income (including wages and salaries and benefits, as well as proprietors' income) from jobs directly or indirectly supported from the 125 ARRA projects was $115.8 million. The ARRA projects contributed $143.7 million to the U.S. economy in terms of value added. Counting direct, indirect, and induced impacts, the total monetary expenditures of $154.1 million resulted in $260.4 million in total output. This represents the total value of all goods and services produced by all of the industries within the study region.

Table 3. Economic impacts of ARRA restoration investment, 2012.

Economic Impact	Employment* (Number of jobs)	Labor Income** (US$ 2012)	Value Added*** (US$ 2012)	Output**** (US$ 2012)
Direct	1,462	76,562,613	79,485,944	154,088,144
Indirect	350	18,615,945	27,908,964	48,566,484
Induced	468	20,659,728	36,349,380	57,807,524
Total	2,280	115,838,287	143,744,288	260,462,152

Source: NOAA Restoration Center calculations using the IMPLAN modeling system.

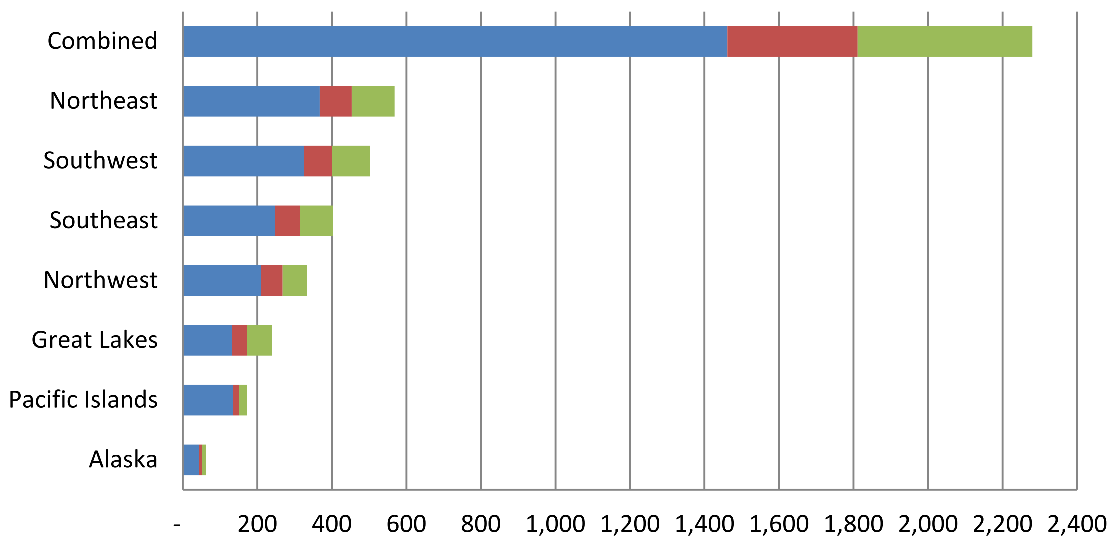
*Employment is defined as the number of payroll and self-employed jobs, including part time jobs.

**Labor income is defined as wages and salaries and benefits as well as proprietors' income.

*** This is the difference between an industry's total output and the cost of its intermediate inputs. It equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported). Value added consists of compensation of employees, taxes on production and imports less subsidies, and gross operating surplus.

**** Represents the total value of all goods and services produced by all of the industries within the study region.

Figure 3 also shows the employment effects of restoration activities. The analysis demonstrates ARRA funding directly supported 1,462 jobs. However, when accounting for local multipliers, 2,280 jobs were supported.

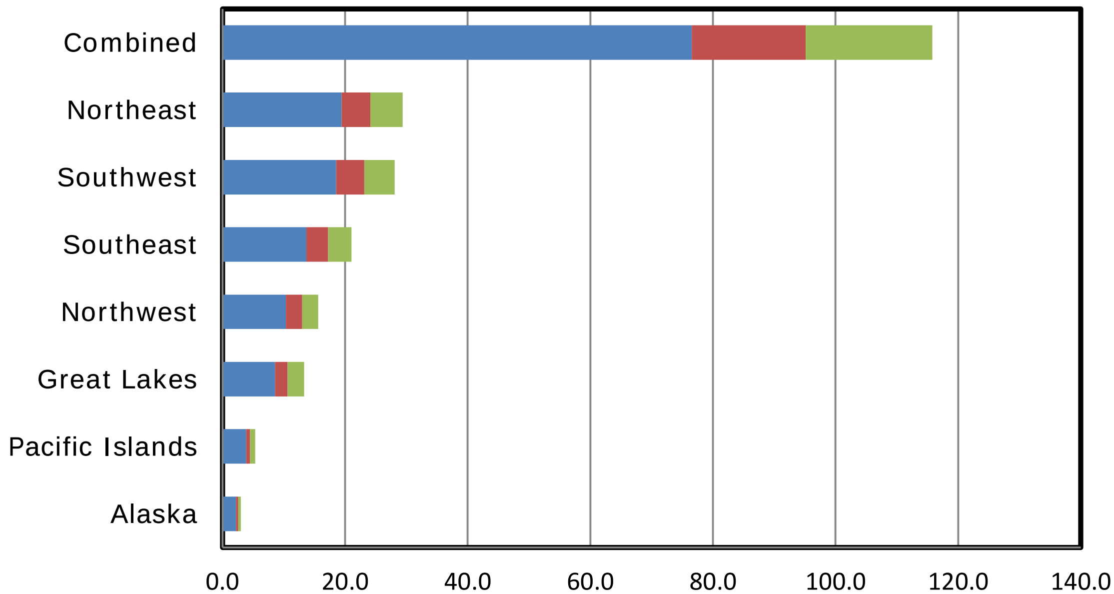


	Alaska	Pacific Islands	Great Lakes	Northwest	Southeast	Southwest	Northeast	Combined
Direct	44	135	132	211	247	325	368	1,462
Indirect	7	16	41	57	67	76	85	349
Induced	10	21	66	65	90	101	115	469

Number of Jobs Supported

Figure 3. Employment effects of restoration.

Figure 4 highlights the economic impact in terms of labor income, which is a measure of employment income including wages, benefits, and proprietor income. For example, the ARRA investment in the Great Lakes generated $8.5 million, $2.1 million, and $2.7 million in direct, indirect, and induced effects of labor income for this region, respectively. This means labor income of $8.5 million was generated from the ARRA investment in habitat restoration. Labor income of $2.1 million was generated from inter-industry transactions such as supplying industries, and the induced labor income of $2.7 million reflects changes in local spending from income changes in the directly and indirectly affected industry sectors.

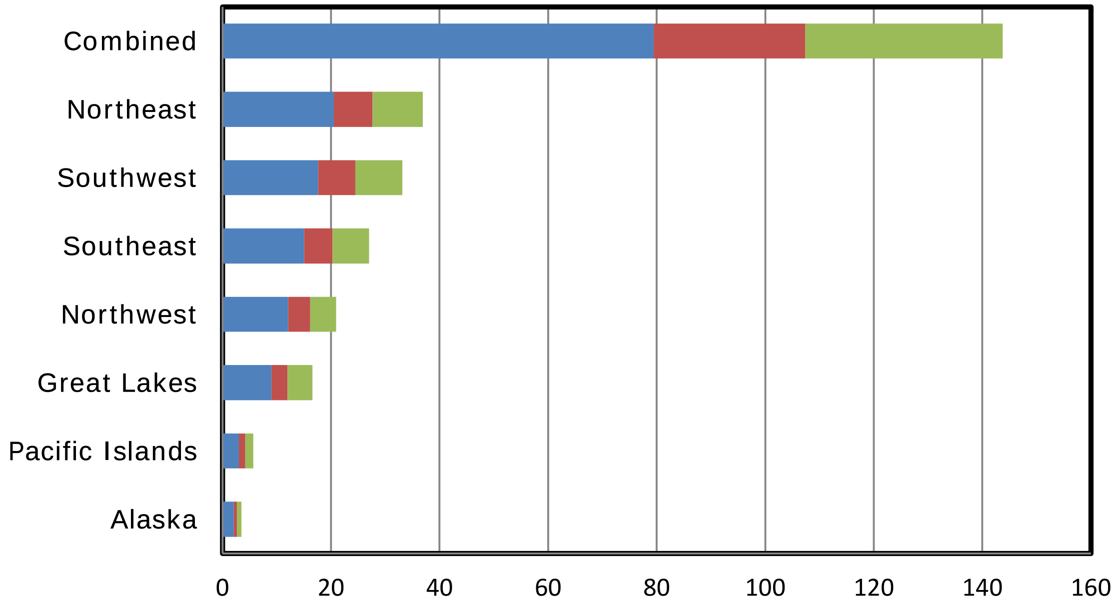


	Alaska	Pacific Islands	Great Lakes	Northwest	Southeast	Southwest	Northeast	Combined
Direct	2.2	3.9	8.5	10.3	13.7	18.5	19.4	76.6
Indirect	0.4	0.6	2.1	2.7	3.5	4.6	4.7	18.6
Induced	0.4	0.8	2.7	2.6	3.8	5.0	5.3	20.7

Labor Income (US$ mil, 2012)

Figure 4. Labor income effects of restoration.

As mentioned above, the value added is the difference between an industry's total output and the cost of intermediate inputs. For example, in the Northwest region, value was added as a result of purchasing wood and native plants, and utilizing labor services for floodplain dike removal and revegetation. Thus, $21 million value added represents the total amount of additional or new economic activity that occurred from the ARRA funds in the Northwest region (Figure 5).

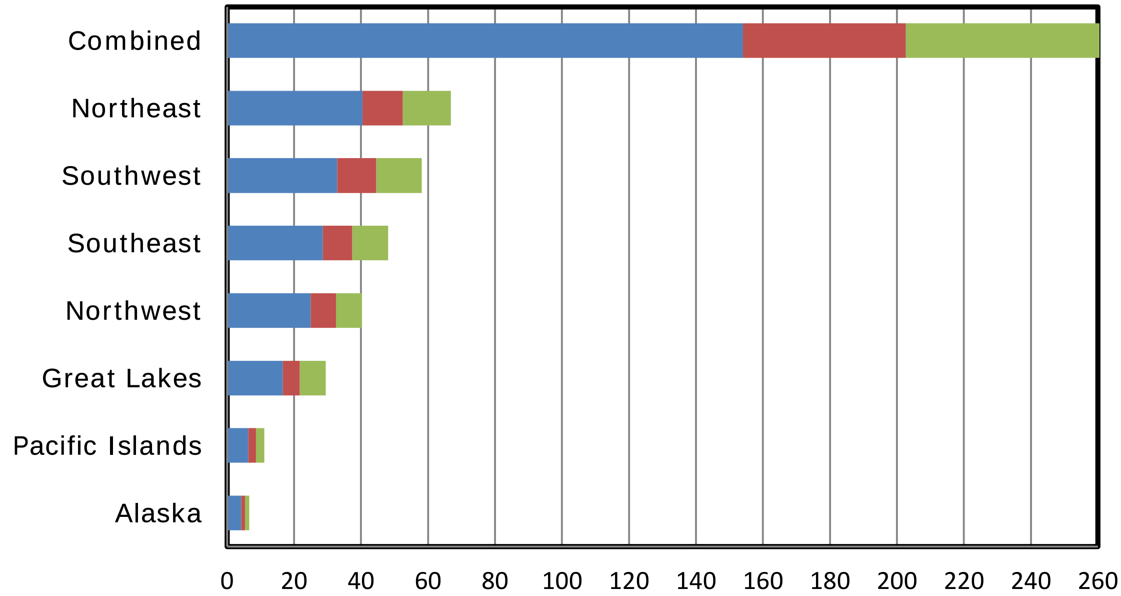


	Alaska	Pacific Islands	Great Lakes	Northwest	Southeast	Southwest	Northeast	Combined
Direct	2.1	3.0	9.0	12.1	15.1	17.7	20.5	79.5
Indirect	0.6	1.1	2.9	4.1	5.2	6.8	7.1	27.9
Induced	0.8	1.5	4.6	4.8	6.7	8.7	9.3	36.3

Value Added (US$ mil, 2012)

Figure 5. Value added effects of restoration.

Output refers to the total value of goods and services. For example, the ARRA restoration projects generated $48 million in output (sales value) in the Southeast region. Of this $48 million, about 60 percent ($28.6 million) was direct effects (direct spending from construction and engineering expenses), and the remaining 40 percent was generated through the direct expenditures trickling through the economy in the form of indirect and induced effects. The indirect effects of $8.8 million are the increased sales (production) of the businesses supplying goods and services. The induced effects of $10.6 million are the increase in the output of the local businesses due to increased jobs and household wages (Figure 6).



	Alaska	Pacific Islands	Great Lakes	Northwest	Southeast	Southwest	Northeast	Combined
Direct	4.2	6.3	16.6	25.0	28.6	32.9	40.4	154.1
Indirect	1.1	2.3	5.1	7.5	8.8	11.6	12.0	48.6
Induced	1.3	2.5	7.7	7.8	10.6	13.6	14.4	57.8

Output (US$ mil, 2012)

Figure 6. Output effects of restoration.

The ARRA coastal habitat restoration projects require the employment of people with diverse sets of skills. For example, marine debris removal requires, among other job types, boat operators and heavy equipment managers, while oyster and coral reef restoration may require divers, barge operators, fishermen, and scientists in addition to the aforementioned. For fish passage, restoration job types were environmental consultants, engineers, and construction workers.

These habitat restoration projects supported, on average, 15 jobs per million dollars spent, and 30 jobs per million invested in labor intensive restoration projects (Table 4). A preliminary estimate of 17 jobs per million spent was based on, projects that were still underway and expenditures were not final (Edwards, et al., 2013).

Table 4. Jobs supported by habitat restoration.

Restoration Effort Type (Number of ARRA Projects)	Range of Restoration Job Types	Number of Jobs per Million US$ (range)
Fish Passage (39) Improving access for migratory fish species such as salmon and reducing hazards	Environmental consultants, engineers, construction workers, landscapers, lawyers, scientists, administrative positions	14 (6-21)
Hydrologic Reconnection (36) Restoring the flow of water to coastal systems and floodplains	Geologists, engineers, landscapers, heavy equipment operators, construction workers, helicopter pilots, biotechnologist, project managers	15 (12-17)
Shellfish Restoration (6) Construction of reef using shell and rock; Stabilizes the shoreline and promotes oyster colonization	Barge, tug operators and loading crews, fishermen, scientists, technicians, biologists, divers, mining and quarry workers, truck drivers, project managers, outreach specialists, administrative positions	16 (8-23)
Coral Recovery (2) Removal of coral reef smothering invasive algal species and control of sedimentation by removal of feral goats and re-vegetation	Pilots, construction workers, feral goat hunters, landscapers, administrative positions	30 (27-32)
Other Strategies (42) Removal of derelict fishing gear, reducing “ghost fishing” impacts	Cleanup crew (laborers), small boat operators, administrative staff, marine salvors, welders, heavy equipment managers, lawyers, accountants.	15 (10-29)
Restoring the habitat function in the areas between land rivers and streams	Construction workers (including site foreman, surveyor, survey assistants, equipment operators, laborers, and dump truck drivers), nursery workers, project manager, environmental consultants, archeological consultant, graphic designer, administrative positions	
All restoration types	Average jobs per million $	15

Updated from Edwards et al. (2013) for completed projects.

3.2. Ecological Performance

On-the-ground restoration opened historic river habitat to migratory fish, removed marine debris from our oceans and coasts, reconnected tidal wetland habitat, and restored shellfish and coral reefs. Marine debris removal involved the collection of derelict fishing nets, crab traps, old ropes, and other fishing gear that ensnare marine life and create navigation hazards. River restoration focused on removing defunct dams, failing or undersized culverts, levees, and other river barriers to reconnect floodplain habitats. Fishway installation and vegetation plantings were installed to help fish pass barriers not appropriate for removal. Coral reef restoration involved the physical removal of algae and other invasive species, planting native vegetation, and other erosion control techniques to limit sediment transport within the watershed. Table 5 presents a list of typical species that benefit from habitat restoration.

The ecological performance measures for these restoration efforts are presented by region and habitat type in Table 6 and Table 7, respectively. These projects restored a total of 25,584 acres of habitat, opened 677 miles of stream for fish passage, and removed 433,397 tons of debris. Uplands, tidal wetlands, and in-stream/pond projects returned the largest restored acreage (Figure 7). Uplands included 11,750 acres that benefitted corals restored by managing sediment.

Table 5. Typical species that benefit from habitat restoration.

Region	Species (In bold font, to be listed under the Endangered Species Act. Source: RCDB, 2015.)	
Alaska	Coho, king, pink and sockeye salmon	Cutthroat trout
Great Lakes	Largemouth and smallmouth bass Bluegill Muskellunge Northern pike	Black crappie Lake sturgeon Walleye
Northeast	Largemouth and striped bass White perch Brook trout **Atlantic salmon** Rainbow smelt Atlantic and **shortnose sturgeon** River and blueback herring alewife American, hickory and skipjack shad Marshhay and smooth cordgrass	Sea lamprey White flounder Bluefish Eastern oyster Blue crab Bay scallop Mummichog Eelgrass American eel
Northwest	Oregon chub Starry flounder Pacific lamprey Quillback rockfish Chum, pink, **chinook**, **coho salmon** Bull, cutthroat, **steelhead trout**	**Eulachon** Dungeness crab Harbor porpoise Western pond turtle **Steller sea lion** **Gray and humpback whale**
Southeast	Bay anchovy Hardhead and sailfin catfish Atlantic croaker Black and red drum Southern kingfish Sheepshead minnow Striped mullet Pinfish Spotted seatrout Seashore saltgrass Smooth and marsh hay cordgrass Blue and stone crab	Black mangrove Gulf menhaden Black needlerush Eastern oyster Pickleweed Saltwort Bull shark Shoalgrass Grass shrimp Snook Oyster toadfish
Southwest	Northern anchovy Tidewater goby California halibut Pacific lamprey Shiner perch **Coho, Chinook salmon** White and **green sturgeon** Cutthroat and **steelhead trout** **Green sea turtle**	Red legged frog **Sea Otter** Brown pelican **Western snowy plover** **Light-footed clapper rail** **California clapper rail** English sole Savannah sparrow **California least tern**
Pacific Islands	Snapper Sea bass Seamount groundfish Skipjack, yellowfin, bigeye and albacore tuna	Corals Crustaceans **Green sea turtle**

Table 6. Habitat restored, stream miles opened, and debris removed resulting from ARRA restoration funds.

Region	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Northeast	2,376.3	161.4	250,000.0
Northwest	1,121.2	318.2	145.0
Southeast	3,146.4	-	-
Southwest	7,112.8	7.7	-
Pacific Islands	11,776.7	-	-
Alaska	18.1	13.8	390.0
Great Lakes	32.9	176.3	182,862.0
Total	25,584.4	677.4	433,397.0

Source: NOAA Restoration and Conservation Database, 2015.

Table 7. Habitat restored, stream miles opened, and debris removed resulting from ARRA restoration funds by habitat type.

Habitat Type	**Habitat Restored (acres)**	**Stream Opened (miles)**	**Debris Removed (tons)**
Coral reef	60.0		
Freshwater wetland	163.1	15	182,862.0
Stream/pond	2,929.4	659.87	
Water column	232.2		
Tidal wetland	9,475.9		535.0
Oyster reef	513.0		
Submerged aquatic vegetation	5.0		
Riparian zone (non-wetland)	446.7	2.5	
Upland	11,759.2		250,000.0
Total	25,584.4	677.4	433,397.0

Source: NOAA Restoration and Conservation Database, 2015.

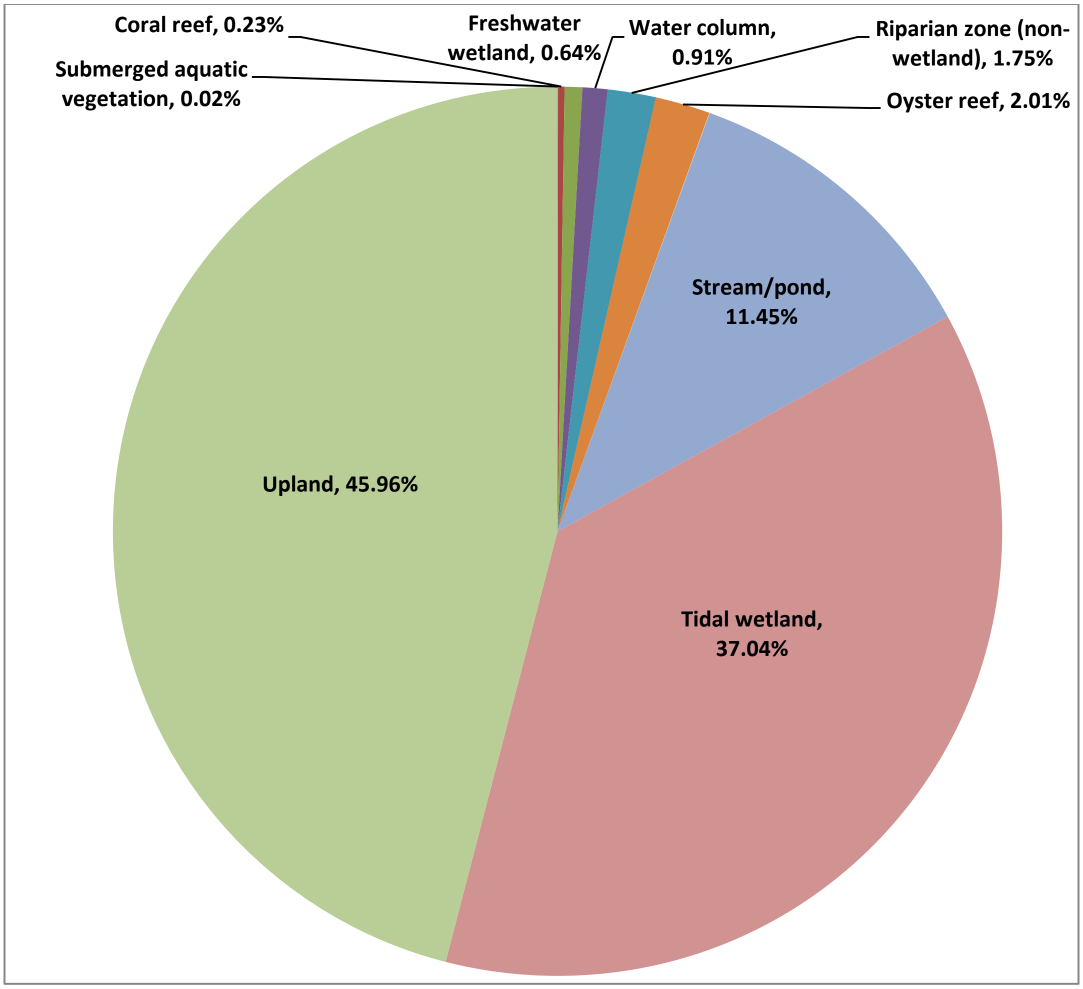


Figure 7. Distribution of habitat restored by type.

3.3. Socioeconomic Benefits

A subset of the ARRA projects measured the downstream effects of restoration such as the socioeconomic benefits of healthier rivers and coastal habitats. These projects were not conducted by NOAA and are a subset of projects conducted by our partners related to the projects that received ARRA funding. These socioeconomic benefits include the economic value of outdoor recreation (e.g., diving, angling) and ecosystem services such as flood control and clean water. These long-term benefits represent a significant expansion on the economic return on investment to the economic impacts. The methods applied in these studies ranged from economic benefit analyses to investigating coastal community perceptions about habitat restoration (Table 8). These estimates refer to the contribution of the habitat restoration activities. The projects highlighted in the report are as follows:

(1) Muskegon Lake Area of Concern Socioeconomic Assessment (Michigan)[7,8]

This project was awarded $10 million to restore wetlands and stabilize shoreline along the south shore of the lake. The Great Lakes Commission restored 33 acres of wetland and stabilized shoreline at 10 separate locations in the Muskegon Lake Area of Concern (AOC). The project was designed to address 40 percent of the loss of fish and wildlife habitat beneficial use impairment target for the Muskegon Lake AOC.

A detailed economic study was conducted using a hedonic, travel cost and contingent valuation to estimate the economic benefits that resulted from the project. The study found that the restoration will generate a $12 million increase in property values, up to $600,000 in new tax revenue annually, and more than $1 million in new recreational spending with nearly 65,000 additional visitors annually over 15 years. The total value generated is nearly six times the initial investment.

(2) Fisher Slough Socioeconomic Study (Washington)[9]

This project restored 60 acres of freshwater tidal marsh and improved passage to 15 miles of high-quality habitat for chum, coho, threatened Chinook salmon, and other important species. Activities included replacing antiquated floodgates with self-regulating gates; conducting tidal wetland restoration; relocating a drainage ditch; and setting back

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[7] Braun, H. (Great Lakes Commission). 2013. *Final Narrative Report American Recovery and Reinvestment Act of 2009, Muskegon Lake Great Lakes Area of Concern, Habitat Restoration Project*. National Oceanic and Atmospheric Administration, National Marine Fisheries Service (17 p).

[8] Isley, P., E. S. Isley and C. Hause. 2011. *Muskegon Lake Area of Concern Habitat Restoration Project: Socioeconomic Assessment.* Final Project Report. Grand Valley State University (26 p).

[9] EconNorthwest. 2012. *Economic Benefits of the Fisher Slough Restoration Project*. Report prepared for The Nature Conservancy and National Oceanic and Atmospheric Administration, National Marine Fisheries Service (33 pp).

levees. The Skagit River supports a regionally significant abundance and diversity of Pacific salmon and is one of the only rivers in the lower 48 states that supports all eight species of anadromous salmonids. However, the area has lost more than 70 percent of its historic tidal wetlands.

This project benefits the local agricultural community by reducing the risk of flood damage and drainage maintenance costs. The study estimated $21 million in economic benefits over 50 years are expected from the restoration activities around Fisher Slough in Washington's Skagit Delta.

(3) Maunalua Bay Reef Restoration Project (Hawaii)[10]

The Maunalua Bay Coral Reef Restoration project is a large-scale restoration in Hawaii that restored coral reefs through manual removal of invasive alien algae. Restoring coral reefs through manual removal of invasive alien algae restored hard substrate and sand bottom habitat enabling coral recruitment and seagrass expansion.

Local perspectives on ecological conditions in Maunalua Bay were examined using a network-based sampling approach, extensive observation in the study area, and in-depth interview surveys. A semi-structured survey instrument was used to guide a total of 131 interviews. More than 94 percent of interviewees indicated that the project had stimulated greater understanding of local history, and more than 89 percent indicated enhanced ecological understanding. More than 82 percent asserted that the project had resulted in a feeling of heightened personal ownership of the bay and its resources, and more than 84 percent believed that the project resulted in an enhanced sense of community-level stewardship. Further, almost 80 percent of interviewees reported the invasive algae removal project was benefiting local businesses, and more than 95 percent agreed that the project had generated interest in future habitat restoration and conservation projects in the region.

(4) *Perceived Value and Effectiveness of Management for Oyster Reefs (Alabama)*[11, 12]

Breakwater reefs created along two stretches of shoreline protect almost 30 acres of habitat for submerged aquatic vegetation and create almost 3 acres of oyster reef. The submerged reefs will protect more than a mile of coastal habitat by reflecting erosive wave energy away from the shoreline.

[10] Petterson, J. S., and E. Glazier. 2011. *Social and Economic Benefits of the Maunalua Bay Reef Restoration Project*. Final Report prepared by Impact Assessment, Inc. for The Nature Conservancy and National Oceanic and Atmospheric Administration, National Marine Fisheries Service (58 p).
[11] DeQuattro, J. 2012. *Coastal Alabama Economic Recovery and Ecological Restoration Project*. Final Report from The Nature Conservancy to NOAA Restoration Center, U.S. Department of Commerce (35 p).
[12] Scyphers, S.B., J.S. Picou, S.P. Powers. 2012. *Perceived Status, Value and Effectiveness of Management Initiatives for Oyster Reefs in Coastal Alabama*. A Final Socioeconomic Report from the University of South Alabama to The Nature Conservancy (23 p).

A socioeconomic survey was developed to determine how Alabama coastal residents perceive oyster reefs, their role in nearshore waters, and their management. Specifically, the survey focused on the current status, ecological importance, management effectiveness, and support for initiatives relating to the oyster fishery. Results show that oysters were recognized for their overall ecological importance, providing a regulating service by filtering bay water (70 percent of respondents), and for protecting shoreline marsh habitats (80 percent of respondents). The strongest support was for stricter fines for sewage spills (73 percent of respondents). Residents strongly support oyster reef restoration and protection, and a majority would pay additional taxes to protect oyster reefs.

(5) Assessing the Long-term Economic Value and Costs of Oyster Reefs (North Carolina)[13]

A total of 46 acres of oyster reefs were created at Crab Hole and Clam Shoal sanctuaries in Pamlico Sound, the second largest estuarine system in the United States. This project provided valuable substrate for high levels of oyster recruitment, habitat use by estuarine reef fish, and fishing opportunities for recreational fishermen.

Cost-benefit analysis was used to assess the long-term value that would be derived from restored oyster reefs. Using a benefit transfer[14] approach, the Crab Hole and Clam Shoal oyster reef sanctuaries collectively provide ecosystem services totaling more than $11,000 per acre annually. The annual value of ecosystem services provided by the 18.60 acres of oyster reef habitat at the Crab Hole Sanctuary was estimated at $206,218, whereas those of the 26.96 acres of reef at the Clam Shoal Sanctuary annually were worth $166,376.

(6) Huntington Beach Wetlands Enhanced Ecosystem Service Values (California)[15]

This project provided tidal circulation and restored 41 acres of urban wetlands in Huntington Beach by breaching a levee, creating channels and planting native vegetation. The Magnolia project was the final phase of this restoration project, which restored habitat for birds, shellfish, and coastal marine fish—such as anchovy, mullet, corvina,

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[13] Grabowski, J. H., M. F. Piehler, and C. H. Peterson. 2011. *Assessing the long-term economic value and costs of the Crab Hole and Clam Shoal oyster reef sanctuaries in North Carolina*. University of North Carolina at Chapel Hill, Institute of Marine Sciences Study Final Report (28 p).

[14] Benefit transfer is defined as the use of research results from pre-existing primary studies to predict estimates such as willingness to pay (WTP) or related information for other, typically unstudied sites or policy contexts. Benefit transfers are most often used when time, funding, data availability or other constraints preclude original research, so that preexisting estimates must be used instead (Johnston, et al., 2015).

[15] IEC (Industrial Economics, Inc.). 2012. *Enhance Ecosystem Services and Associated Values: Restoration of the Huntington Beach*. Report prepared for Office of Response and Restoration, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (53 p).

and halibut—and improved connectivity of coastal marsh habitats along the south coast of California.

The analysis is based on the expected change in carbon stored and the change in property values associated with the restoration activity. Carbon sequestration rates post-restoration and market values of the affected properties were estimated. To estimate the present value of this benefit, a discount rate of 3 percent was used. Carbon storage and sequestration benefits of $130,000 over 50 years can be generated from increased vegetation and salt marsh soils, which remove carbon from the atmosphere where it would otherwise contribute to climate change associated damages. In addition, the restoration investment increases the extent of open water wetland in the region, enhancing space and aesthetics as reflected in increased residential property values of $36.3 million.

(7) Economic Benefits of South San Francisco Bay Salt Pond Restoration (California) [16]

This project provided tidal circulation to previous salt ponds, and restored 4,700 acres of wetlands in southern San Francisco Bay by breaching levees, regrading interior areas, and supporting natural revegetation. This project contributes to the recovery of threatened and endangered species such as steelhead trout; increased habitat for migratory birds and marine mammals; and improved productivity of the Bay’s ecosystem.

Using the benefit transfer method, the estimated annual benefit to local and regional communities ranges from $3 million to $9.5 million.

(8) Economic Benefits of Virginia Seaside Bays Restoration (Virginia) [17]

This project restored native oysters, seagrass, and bay scallops to Virginia's seaside bays from Chincoteague inlet to the Chesapeake Bay. Twenty-two acres of native oyster reefs were restored at 12 different sites, 100 acres of seagrass were planted, and 2.4 million juvenile bay scallops were re-introduced to bays where they have been extinct for 75 years.

The benefits of oyster reefs were examined over a 40-year period. The estimated total economic values, including market values for commercial finfish production and non-market values for recreational fishing, ranged from $49,133 to $112,460 per year.

[16] Abt Associates, Inc. 2014. Estimating the Change in Ecosystem Service Values from Coastal Restoration. Final Report Prepared for Center for American Progress and Oxfam America. (116 p).

[17] Abt Associates, Inc. 2014. Estimating the Change in Ecosystem Service Values from Coastal Restoration. Final Report Prepared for Center for American Progress and Oxfam America. (116 p).

Table 8. Socioeconomic benefit studies.

Ecosystem service value	ARRA Project							
	Muskegon Lake Area of Concern Socioeconomic Assessment (MI)	Fisher Slough Socioeconomic Study (WA)	Socioeconomic Benefits of the Maunalua Bay Reef Restoration Project (HI)	Perceived Value and Effectiveness of Management for Oyster Reefs (AL)	Assessing the Long-term Economic Value and Costs of Oyster Reefs (NC)	Huntington Beach Wetlands Enhanced Ecosystem Service Values (CA)	Economic Benefits of South San Francisco Bay Salt Pond Restoration (CA)	Economic Benefits of Virginia Seaside Bays Restoration (VA)
Total Value	$47.5 million net present value (NPV)	$9.1 - $20.6 million NPV			$13.4 million NPV		$2.9 -$9.5 million annual	$49,133 - $112,460 annual
Commercial harvest		$729,000 - $3,646,000 NPV (increased crop value)	73.6% perceived improvement in local fisheries		$74,476 annual commercial value		$4,198 annual (halibut); $19,976 annual (rockfish)	$34,113 annual
Recreational harvest					$119,309 annual recreational value		$25,789 annual (halibut); $6,308 annual (rockfish); $23,322 annual (striped bass)	$3,439 - $22,696 annual
Ecotourism	$3.5 million per year additional recreational value; $35.6 million NPV							
Aesthetic appreciation	$11.9 million additional housing value		94.2% perceived a cleaner-looking bay			$36.3 million property value		
Erosion prevention		$367,000 - $775,000 NPV (reduced dredging costs)		80% perceived protection for shoreline vegetation				
Flood protection		$198,000 - $4,852,000 NPV (reduced cost of flood damage)						
Water quality				70% perceived improved water quality				
Carbon sequestration						$130,000 annual	$54,303 annual	$132 annual
Nitrogen sequestration					$298,053 denitrification			$11,449 - $55,519 annual
Habitat/species diversity				74% perceived critical habitat for fish and crabs	$15,027 SAV enhancement value		20-40% increase in foraging birds	

4. Conclusion

America's coastal habitats are vital to the local and national economy. Coastal communities provide recreation, tourism, and commercial activities like fishing because of healthy habitats. Nature's benefits—also called "ecosystem services"—are the contributions that support our day-to-day lives. This could include higher property values, lower infrastructure costs, and increased flood protection.

The primary goals of the ARRA projects were to restore habitats and stimulate economic growth. The economic impacts in this study and associated with the ARRA restoration projects are both short-term in nature given their brief on-the-ground duration, as well as long-term. Awarded projects have resulted in 25,584 acres of habitats restored, 677 stream miles opened for fish passage, and 433,397 tons of debris removed from our oceans. In terms of economic growth, the 2,280 jobs supported through ARRA funding signify a valuable contribution to our nation's restoration economy[18] that may have a long-lasting effect in local economies. NOAA generates 30 jobs for each million dollars invested in labor intensive restoration projects. This study determined that habitat restoration projects support, on average, 15 jobs per million dollars spent.

Aside from immediate ecological and economic benefits, coastal restoration projects can provide significant long-term benefits through the rehabilitation and strengthening of the ecosystem services restored areas provide. For example, the rebuilding and restoration of oyster reefs can translate into the protection of critical habitat and infrastructure through wave attenuation, the improvement of habitat health through water filtration, and countless economic, recreational, social, and cultural benefits related to oyster harvesting. Despite the importance of these long-term ecosystem service benefits to coastal managers and stakeholders, not many studies have attempted their quantification. These limitations can affect the local, state, and federal agencies' willingness to support further restoration work and the participation of stakeholders in conservation initiatives.

The present analysis of the ARRA projects suggests restoration investment has and may result in significant ecological improvements and socioeconomic benefits to project participants and to the residents and communities adjacent to coastal areas. Results of this report contribute to the knowledge regarding economic values of different habitat types in different regions and at different scales. The values in this report focus not only on use value but also on non-use value as the latter may have more policy relevance (e.g., anadromous fish passage).

An assessment of the co-benefits of restoring habitat can help policy makers identify and categorize societal values that are generated by NOAA's products, that is improved ocean and coastal environmental quality. Combining social science and ecological approaches can provide NOAA with better understanding about how human

[18] The broad definition of Restoration Economy includes both the built and natural environment (Cunningham, 2002). Restoration economy in this report refers on economic activity relating to ecological or habitat restoration.

behavior impacts the natural environment. Results of these initiatives will assist in NOAA efforts to prioritize, measure outcomes, forecast, and make better resource management decisions with respect to fisheries habitat conservation.

Looking forward, healthy habitats are important for sustainable fisheries and provide numerous other benefits to communities. Decision-makers and local stakeholders may use this information for policy, management, or investment decisions that lead to on-the-ground change. To do this, the following next steps may be considered:

- Developing guidance or suggestions for award recipients about the types of socioeconomic outcomes and data to collect.

- Implementing restoration projects that reflect co-benefits such as potential recreational use and enhanced property values.

- Engaging local citizens and partner organizations when planning restoration projects so that stakeholders are vested in the success of habitat restoration and sustainable fisheries.

- Communicating the co-benefits and improvements that the communities are experiencing from habitat restoration projects.

- Understanding which of these co-benefits are important to the community, if we were to do another project in the area, and providing partners with a status update of the projects.

A healthy economy depends on a healthy environment. We conserve habitat to sustain the nation's fisheries—but habitat is not just valuable for the home it provides for fish and wildlife. It also improves water quality, provides jobs, and supports stronger business growth. This analysis determined that aside from immediate ecological and economic benefits, coastal restoration projects could provide significant long-term benefits through the rehabilitation and strengthening of the ecosystem services restored areas provide. The findings in this study are important to help better understand the role of green jobs in the economies of local communities, as well as the long-term ecosystem services the projects provide, including the reduction of damage to life and property.

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Appendices

Appendix 1. Detailed Regional Impact Analyses

For each of the regions listed below, a summary of the projects completed with ARRA funding is provided. Each summary includes the following key components of the project:

- Number of acres, miles, etc.
- Species benefitted
- Restoration technique implemented
- Key partners

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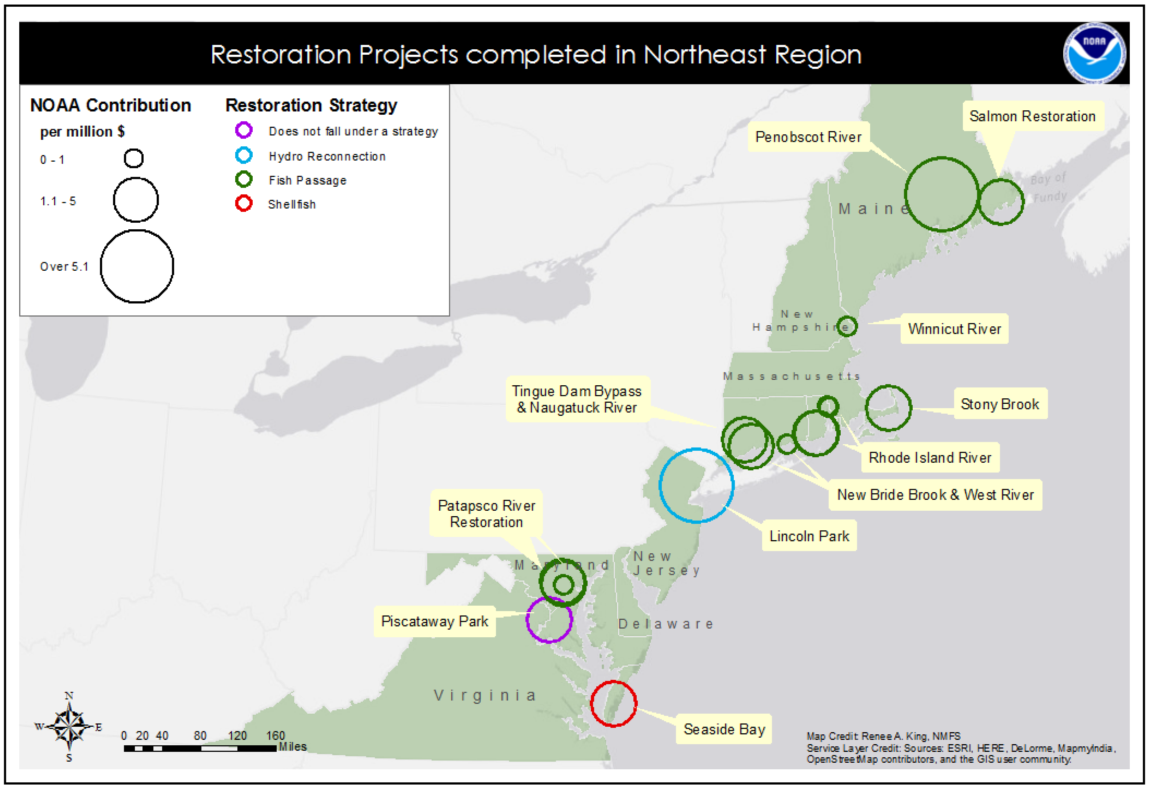
Northeast



Winnicut River Fish Passage Restoration (NH)

This project removed the Winnicut Dam in Greenland, New Hampshire, restoring river connectivity, function, and improving water quality. The dam removal and installation of a fish passage structure under the upstream bridge opened 0.1 mile of upstream habitat for migratory fish such as alewives, blueback herring, and American eel. Intertidal smelt spawning habitat was also restored, enhancing the Winnicut River's significant contribution to this historically important recreational and commercial fishery. This project was implemented by the New Hampshire Department of Environmental Services, University of New Hampshire, New Hampshire Coastal Program, New Hampshire Fish and Game Department, and Coastal Conservation Association of New Hampshire.

Salmon Habitat Restoration (ME)

This project reconditioned 53 fish passage barriers in the Machias River watershed of Maine. Impassable culverts at road crossings were removed and unneeded commercial roads were decommissioned. The project opened 63 miles of habitat for endangered Atlantic salmon and other commercially and recreationally important fish species, restored natural stream function, and reconnected the upper watershed to downstream areas. Project partners included the Maine Department of Marine Resources, U.S. Fish and Wildlife Service, University of Maine, and Project SHARE (Salmon Habitat And River Enhancement).

Piscataway Park Living Shoreline Restoration (MD)

A 2,800 foot vegetated "living shoreline" was constructed along the banks of the Potomac River creating two acres of spawning and nursery habitat for more than a dozen fish species. This project reduced shoreline erosion, which improves water quality and provides protection for 30 acres of freshwater wetland and threatened Native American archeological resources. The project was implemented by the Alice Ferguson Foundation Inc. and the National Park Service. The Chesapeake Bay Trust contributed to this project.

Bride Brook and West Restoration (CT)

This project involved restoration of salt marsh habitat and migratory fish runs at Rocky Neck State Park in East Lyme and West River Memorial Park in New Haven. At Rocky Neck State Park, failing dual Bride Brook culverts were replaced with a single, large box culvert, to restore tidal exchange to 63 acres of salt marsh and improve alewife passage to Bride Lake, restoring Connecticut's largest river herring run. Three failing West River wooden tide gates were removed and replaced with self-regulating structures that allow increased tidal exchange with the upriver marsh and provide river herring access to upriver spawning habitats. These projects opened 12 river miles and restored tidal marshes in the park heavily used for a variety of passive and active recreation. Project implementers were Restore America's Estuaries, Connecticut Fund for the Environment, City of New Haven, and Save the Sound.

Naugatuck River Restoration (CT)

This project involved the construction of a bypass channel around the Tingue Dam, which restored 32 miles of historic migratory fish habitat on the Naugatuck River. This habitat benefits American shad, blueback herring, alewife, and American eel by creating a bypass channel around the Tingue Dam. The project was implemented by the Connecticut Department of Environmental Protection and the Town of Seymour.

Seaside Bays Restoration (VA)

This project restored 22 acres of native oysters at 12 different sites, planted 100 acres of seagrass, and re-introduced 2.4 million juvenile bay scallops to Virginia's seaside bays from Chincoteague inlet to the Chesapeake Bay where they have been extinct for 75 years. The Nature Conservancy worked in partnership with the Virginia Institute of Marine Science, the Virginia Marine Resource Commission, and the Virginia Coastal Zone Management Program throughout the implementation of the project.

Lincoln Park Wetland Restoration (NJ)

This project restored 42 acres of coastal habitat on a former 90 acre municipal landfill in a highly urbanized former industrial area of the Hackensack River basin. The project completed the full remediation of the former landfill and replaced it with a combination of wetland, transitional zone, tide pond, and tide creeks. Project partners included the U.S. Army Corps of Engineers, Port Authority of New York and New Jersey, Hudson County (NJ) Parks Department, and the New Jersey Department of Environmental Protection.

Stony Brook Salt Marsh and Fish Passage Restoration (MA)

The Stony Brook award consisted of a fish passage project and a salt marsh restoration project in Brewster, Massachusetts. The fish passage project replaced a degraded, undersized culvert that conveyed Stony Brook beneath a state road with larger box culverts. This restored normal tidal exchange to 20 acres of salt marsh, improved 3,000 feet of a migratory fish run, and repaired a fish ladder to enhance fish passage to 386 acres of ponds that provide habitat for river herring and American eel. The salt marsh restoration project replaced an undersized culvert that conveyed Paines Creek beneath a town-owned road with a larger culvert, which restored normal tidal exchange to 21.3 acres of salt marsh. The project was implemented by the Association to Preserve Cape Cod, Massachusetts Division of Ecological Restoration, and the Town of Brewster.

Patapsco River Restoration (MD)

This project is a critical component of the largest river restoration in Maryland and will establish a model for future dam removal efforts around the state. Removal of the Simkins and Daniels dams is the start of a larger effort to remove four mainstem dams on the Patapsco River aimed at restoring more than 65 miles of spawning habitat for blueback herring, alewife, American shad, and hickory shad, and more than 183 miles for American eel. It has enhanced public access and significantly improved recreational fishing and boating opportunities throughout the Patapsco Valley State Park. The park is one of Maryland's most popular and frequently used parks and is also part of the Chesapeake Bay watershed. The project partners were American Rivers, Maryland Department of Natural Resources, and Friends of Patapsco Valley State Park, Ltd.

Penobscot River Restoration (ME)

This project removed the Great Works Dam, which directly opened 2 river miles for migratory fish species on the Penobscot River. This project is part of a broader initiative, which restored and opened more than 1,000 miles of the Penobscot River and reconnected inland endangered Atlantic salmon habitat to the Gulf of Maine. This regionally and nationally significant project removed three significant barriers to migration; restored the full assemblage of 11 native migratory fish species to the river; provided benefits for wildlife, tribal culture, and the Gulf of Maine; and spurred community and economic development in New England's second largest watershed. Several partners implemented the project: Maine Audubon; Natural Resources Council of Maine, Trout Unlimited, Penobscot River Restoration Trust, The Nature Conservancy, American Rivers, Atlantic Salmon Federation, and the Penobscot Indian Nation.

Rhode Island River Ecosystem Restoration (RI)

This set of projects involved six high-priority fish passage projects—three technical fishways on the Ten Mile River and three passage projects on the Pawcatuck River. With the projects completed, river herring and American shad are able to migrate upstream to access an additional 8 river miles and 1,502 lake and pond acres providing spawning habitat for alewife using the two watersheds. The upper Pawcatuck River is known for its high water quality and diversity of wetlands and other fish habitats. With NOAA funding, one Pawcatuck River dam was removed, a technical fishway was constructed at the iconic Horseshoe Falls dam, and a nature-like fishway was constructed at the uppermost Kenyon Mill dam. The Ten Mile River is characterized as an urban watershed where a remnant river herring run had been sustained for decades by local volunteers who netted the fish at the base of the first barrier (Omega Pond Dam) and released the adult herring unharmed above the dam. With fishways now installed at each of the dams, shad and herring now have access to the upper reaches of the Ten Mile River in southeastern Massachusetts. Our project partners included the Rhode Island Coastal Resources Management Council, U.S. Fish and Wildlife Service, Rhode Island Department of Environmental Management, Ten Mile River Watershed Council, Natural Resources Conservation Service, U.S.

Environmental Protection Agency, Save the Bay (Narragansett Bay), and U.S. Army Corps of Engineers.

Annex Table 1. Ecological performance of ARRA projects in the Northeast.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Winnicut River Restoration (NH)	1.0	0.1	-
Salmon Habitat Restoration (ME)	-	62.6	-
Piscataway Park Living Shoreline Restoration (MD)	32.3	-	-
Bride Brook and West River Restoration (CT)	250.0	12.0	-
Naugatuck River Restoration	-	32	-
Seaside Bays Marine Ecosystem Restoration (VA)	122.0	-	-
Lincoln Park Wetland Restoration (NJ)	42	0.9	250,000
Stony Brook Salt Marsh Restoration (MA)	427.0	0.5	-
Patapsco River Restoration (MD)	-	43.0	-
Penobscot River Restoration (ME)	-	2.0	-
Rhode Island River Restoration (RI)	1,502.0	8.3	-
Total	2,376.3	161.4	250,000

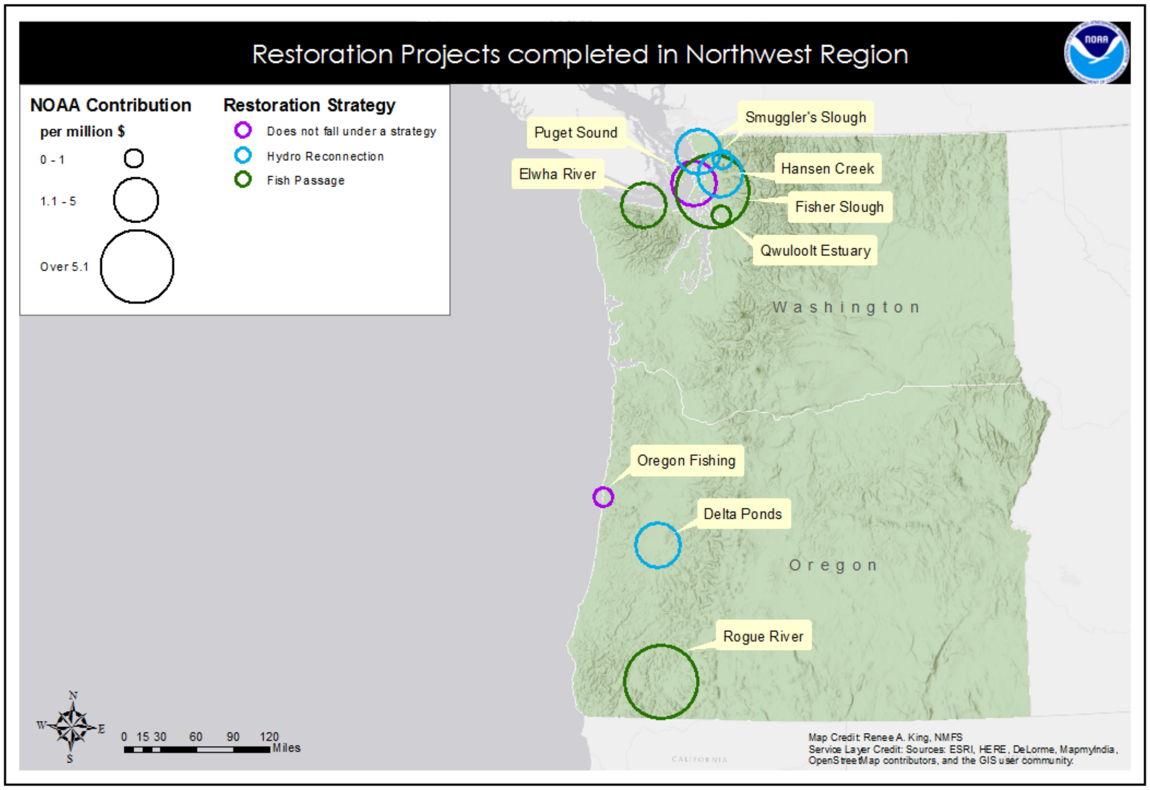
Annex Table 2. Employment and labor income impacts of ARRA projects in the Northeast region.

Project Title	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Winnicut River Restoration (NH)	2	1	1	4	115,736	29,856	37,653	183,245
Atlantic Salmon Habitat Restoration (ME)	27	5	6	37	721,853	194,514	199,852	1,116,219
Piscataway Park Living Shoreline Restoration (MD)	9	2	3	15	624,054	118,317	130,761	873,132
Bride Brook and West River Restoration (CT)	25	6	8	39	1,259,883	389,931	445,219	2,095,034
Naugatuck River Restoration (CT)	18	5	7	31	1,270,768	408,028	436,950	2,115,746
Seaside Bays Marine Ecosystem Restoration (VA)	30	3	3	37	804,676	110,409	94,194	1,009,279
Lincoln Park Wetland Restoration (NJ)	91	24	36	151	6,900,103	1,710,717	1,978,874	10,589,694
Stony Brook Salt Marsh Restoration (MA)	17	4	5	27	783,352	211,270	211,486	1,206,108
Patapsco River Restoration (MD)	30	8	12	50	2,275,341	484,771	566,788	3,326,900
Penobscot River Restoration (ME)	83	18	22	123	2,988,170	707,419	794,513	4,490,102
Rhode Island River Restoration (RI)	36	9	10	55	1,656,434	397,989	405,323	2,459,746
Total	368	85	115	568	19,400,370	4,763,222	5,301,613	29,465,205

Annex Table 3. Value Added and output impacts of ARRA projects in the Northeast region.

Project Title	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Winnicut River Restoration (NH)	528,272	42,606	65,697	636,576	627,448	67,774	102,679	797,901
Atlantic Salmon Habitat Restoration (ME)	577,447	337,197	361,337	1,275,981	1,805,024	619,416	594,089	3,018,529
Piscataway Park Living Shoreline Restoration (MD)	599,356	170,683	248,675	1,018,713	1,150,850	295,619	387,907	1,834,377
Bride Brook and West River Restoration (CT)	1,123,861	585,077	743,095	2,452,033	2,230,360	897,468	1,111,683	4,239,511
Naugatuck River Restoration (CT)	1,430,988	563,915	722,397	2,717,300	2,634,582	879,364	1,086,147	4,600,092
Seaside Bays Marine Ecosystem Restoration (VA)	1,057,215	242,067	213,074	1,512,356	2,166,284	414,870	346,383	2,927,537
Lincoln Park Wetland Restoration (NJ)	7,410,616	2,436,629	3,348,746	13,195,991	13,364,275	4,128,492	5,100,912	22,593,678
Stony Brook Salt Marsh Restoration (MA)	748,629	345,981	394,451	1,489,061	1,645,912	553,233	602,471	2,801,616
Patapsco River Restoration (MD)	2,389,217	713,175	994,139	4,096,531	4,020,438	1,096,066	1,524,659	6,641,163
Penobscot River Restoration (ME)	2,974,233	1,107,779	1,430,845	5,512,857	7,289,543	2,090,723	2,358,797	11,739,063
Rhode Island River restoration (RI)	1,661,883	591,292	737,245	2,990,420	3,490,918	993,364	1,161,685	5,645,966
Total	20,501,716	7,136,401	9,259,699	36,897,817	40,425,634	12,036,390	14,377,411	66,839,434

Northwest



Hansen Creek Floodplain Restoration (WA)

This project restored 140 wetland acres by reconnecting the main stem of Hansen Creek, a tributary of the Skagit River, to its historic floodplain through the modification of levees, excavation, installation of woody debris habitat structures, and native revegetation. These efforts provided important habitat for chum, coho, threatened Chinook salmon and steelhead, and other important species. Downstream agricultural flooding reduction has been achieved with flood water detention and sediment capture within the project site. Holding capacity of the newly restored wetland is effectively lowering downstream flood height, duration, and frequency. The project was implemented by Skagit County Public Works, Upper Skagit Tribe, and the National Association of Counties.

Elwha River Floodplain Restoration (WA)

A series of restoration projects (including engineered log jam placement, dike removals, and re-vegetation activities) improved the habitat conditions of more than 80 acres within the lower Elwha River—the largest tributary draining into the Strait of Juan de Fuca and historically the largest producer of salmon in the region. The project benefits Puget Sound Chinook salmon and Puget Sound steelhead, both listed as threatened under the Endangered Species Act. This project was successfully completed by the Lower Elwha Klallam Tribe and the National Park Service.

Rogue River Restoration (OR)

The project removed the Gold Ray Dam, a 38-foot-high dam that spans the main stem of the Rogue River. The removal restored free-flowing conditions and unimpeded migratory fish access to about 300 upstream miles within the watershed. The project complemented other recent dam removals in the watershed and removed the last fish passage barrier on the river, benefitting Chinook salmon, steelhead, and Southern Oregon/Northern California Coast Coho salmon—listed as threatened under the Endangered Species Act. Various partners implemented the project: Oregon Watershed Enhancement Board, WaterWatch of Oregon, Jackson County, Oregon Department of Fish and Wildlife, National Center for Conservation Science and Policy, Ecotrust, and Rogue Valley Council of Governments.

Qwuloolt Estuary Restoration (WA)

Located in the lower Snohomish River, the Qwuloolt Estuary had been cleared, drained, and cut off from tidal and riverine influences by an extensive network of levees. This project built an upgraded setback levee that protects homes and critical infrastructure for the city of Marysville, Washington. After the setback levee was constructed, 1,500 linear feet of the old levee system was removed, which restored tidal processes to more than 350 acres of highly productive estuarine habitat. This diverse environment provides unique habitat critical for the survival and recovery of five species of salmonids, including Chinook salmon, which is listed as threatened under the Endangered Species Act. The project also restored natural hydrologic connection to two stream systems, providing unrestricted fish access to upstream spawning and rearing habitat. The project was implemented by the City of Marysville, U.S. Fish and Wildlife Service, Tulalip Tribes of Washington, U.S. Army Corps of Engineers, and Snohomish County Public Works.

Delta Ponds Restoration (OR)

Delta Ponds is a 150-acre complex of former side-channel habitat along the main stem Willamette River that provided rearing habitat for juvenile salmonids. This project restored and enhanced the side-channel and riparian habitat through earthwork, invasive species removal, and planting activities. Excavation between ponds opened access to more than 2 miles of side-channel habitat along the Willamette River. The increased hydrologic connectivity and the restoration of more than 30 acres of riparian and wetland habitat will benefit juvenile Chinook salmon, listed as threatened under the Endangered Species Act. Project partners included the U.S. Bureau of Land Management, Oregon Watershed Enhancement Board, U.S. Army Corps of Engineers, City of Eugene, and the Oregon Department of Fish and Wildlife.

Fisher Slough Marsh Restoration (WA)

This project restored 60 acres of freshwater tidal marsh and improved passage to 15 miles of high-quality habitat for chum, coho, threatened Chinook salmon, and other important species. Activities included replacing antiquated floodgates with self-regulating gates, conducting tidal wetland restoration, relocating a drainage ditch, and setting back levees. The Skagit River supports a regionally significant abundance and diversity of Pacific salmon and is one of the only rivers in the lower 48 states where all eight species of anadromous salmonids are represented. This project benefited the local agricultural community by reducing the risk of flood damage and drainage maintenance costs. The project was implemented by partners from the Skagit Drainage and Irrigation District 17, Skagit Dike District #3, Skagit System Cooperative, Skagit County Public Works, The Nature Conservancy of Washington, and The Nature Conservancy.

Smuggler’s Slough Nooksack River Restoration (WA)
The project resulted in reconnection of 225.4 acres of freshwater tidal wetlands and salt marsh, and improved flow along the Smuggler's Slough and out into eelgrass habitat in Lummi Bay. An adjacent roadway was raised to decrease flood impacts. These restored areas benefit threatened Chinook salmon and steelhead trout, as well as chum, coho, sockeye, and pink salmon. The project was implemented by the Whatcom Land Trust, Nooksack Tribe, Natural Resources Conservation Service, Whatcom County River and Flood Department, Northwest Indian College, Lummi Youth Academy, U.S. Fish and Wildlife Service, Washington Department of Ecology, and Washington Recreation and Conservation Office.

Puget Sound Derelict Fishing Gear Removal (WA)
This project eliminated derelict fishing nets as a major source of marine species mortality and habitat damage in the Puget Sound by removing 90 percent of legacy derelict fishing nets. The project removed approximately 3,000 nets to benefit the threatened Southern Resident Orca whale, Chinook salmon, and chum salmon. Removal teams included members of the Nisqually, Puyallup, and Squaxin tribes, as well as other commercially trained divers. Various project partners included the Washington State Department of Fish and Wildlife, Natural Resources Consultants, Nisqually Indian Tribe, Northwest Straits Commission, and Northwest Straits Marine Conservation Foundation.

Oregon Fishing Industry Restoration Partnership (OR)
This project employed crab fishermen to help remove derelict Dungeness crab pots and other fishing gear along the Oregon Coast. The project removed a total of 145 metric tons of debris, including nearly 3,000 derelict crab pots, from the marine environment. The project also engaged 32 members of the crabbing industry in 378 hours of volunteer gear recovery. These activities benefit the Dungeness crab population as well as marine mammals, including gray whales, threatened Steller sea lions, and endangered humpback whales. The project was implemented by the Oregon Department of Fish and Wildlife, Oregon Dungeness Crab Commission, Oregon State Police, and various fish processing companies.

Annex Table 4. Ecological performance of ARRA projects in the Northwest region.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Hansen Creek Floodplain Restoration (WA)	140.0	-	-
Elwha River Floodplain Restoration (WA)	82.0	-	-
Rogue River Restoration (OR)	-	285.0	-
Qwuloolt Estuary Restoration (WA)	350.0	16.0	-
Delta Ponds Habitat Restoration (OR)	31.0	2.2	-
Fisher Slough Marsh Restoration (WA)	60.0	15.0	-
Smuggler's Slough Nooksack River Restoration (WA)	225.4	-	-
Puget Sound Derelict Fishing Gear Removal (WA)	232.2	-	-
Oregon Fishing Industry Restoration Partnership (OR)	0.6	-	145.0
Total	1121.2	318.2	145.0

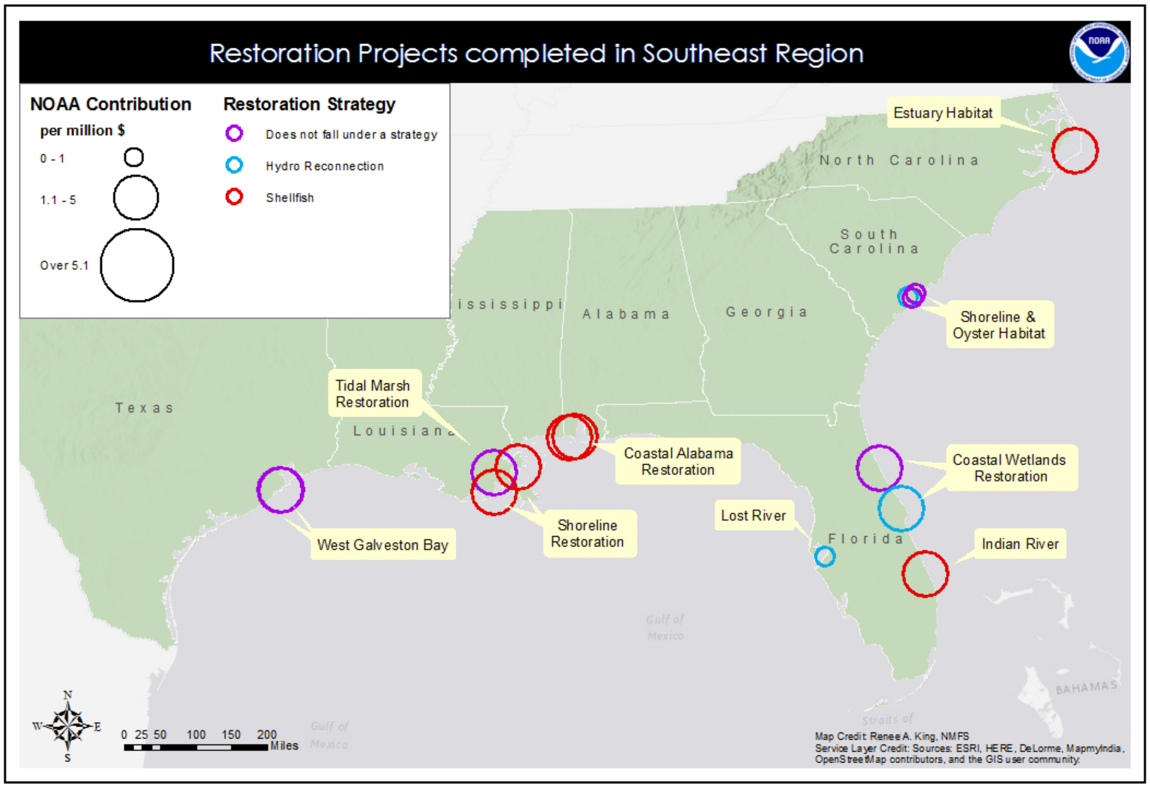
Annex Table 5. Employment and labor income impacts of ARRA projects in the Northwest region.

Project	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Hansen Creek Floodplain Restoration (WA)	12	2	2	16	406,965	79,523	78,792	565,280
Elwha River Floodplain Restoration (WA)	19	4	4	27	781,006	156,821	137,582	1,075,408
Rogue River Restoration (OR)	53	14	16	83	2,320,335	495,372	542,330	3,358,037
Qwuloolt Estuary Restoration (WA)	13	4	5	22	872,069	286,794	267,074	1,425,937
Delta Ponds Habitat Restoration (OR)	15	3	4	23	522,204	128,895	135,582	786,680
Fisher Slough Marsh Restoration (WA)	55	12	14	81	2,671,674	528,725	518,385	3,718,785
Smuggler's Slough Nooksack River Restoration (WA)	13	4	4	21	677,732	173,827	151,933	1,003,491
Puget Sound Derelict Fishing Gear Removal (WA)	21	12	14	47	1,703,306	795,226	684,454	3,182,987
Oregon Fishing Industry Restoration Partnership (OR)	10	1	2	13	368,447	42,858	80,013	491,318
Total	211	57	65	333	10,323,738	2,688,041	2,596,145	15,607,924

Annex Table 6. Value Added and output impacts of ARRA projects in the Northwest region.

Project	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Hansen Creek Floodplain Restoration (WA)	533,971	127,192	154,032	815,195	1,013,915	320,250	250,516	1,584,681
Elwha River Floodplain Restoration (WA)	998,789	247,654	283,247	1,529,690	2,003,653	464,230	455,692	2,923,574
Rogue River Restoration (OR)	2,453,028	779,308	1,012,137	4,244,473	5,507,450	1,469,590	1,665,712	8,642,752
Qwuloolt Estuary Restoration (WA)	1,088,635	397,505	449,128	1,935,267	2,000,000	709,329	702,065	3,411,394
Delta Ponds Habitat Restoration (OR)	749,667	209,056	250,589	1,209,312	1,642,302	365,721	408,763	2,416,786
Fisher Slough Marsh Restoration (WA)	3,027,855	830,532	1,013,402	4,871,789	5,766,100	1,662,735	1,648,191	9,077,026
Smuggler's Slough Nooksack River Restoration (WA)	906,149	265,154	302,957	1,474,260	1,733,803	576,973	505,756	2,816,532
Puget Sound Derelict Fishing Gear Removal (WA)	1,912,349	1,150,681	1,174,647	4,237,677	4,595,369	1,831,448	1,890,673	8,317,490
Oregon Fishing Industry Restoration Partnership (OR)	407,480	67,948	148,490	623,917	733,312	123,589	241,132	1,098,033
Total	12,077,921	4,075,029	4,788,628	20,941,579	24,995,904	7,523,866	7,768,500	40,288,269

Southeast



Mississippi River Tidal Marsh Restoration (LA)

Sediment was hydraulically dredged from the Mississippi River to create intertidal marsh elevations. The 63-acre restored marsh increased the area's habitat value to estuarine-dependent fishes and reduced storm surge impacts to existing infrastructure. The project was implemented by the Louisiana Department of Natural Resources and Office of Coastal Protection and Restoration.

Coastal Wetland Restoration (FL)

Intertidal coastal wetlands in northeastern Florida support a variety of commercially and recreationally important fish species. This habitat restoration project was implemented at two sites with both ecological and recreational importance: North Peninsula State Park and Merritt Island National Wildlife Refuge. By removing dredge spoil and impoundment dikes across 186 acres of historic wetland habitat, natural tidal flow was restored to more than 1,900 acres of emergent salt marsh and mangrove habitats. This comprehensive effort greatly exceeded its proposed restoration goals of 12 miles of dike restoration and 30 acres of wetland restoration, and allowed the St. Johns River Water Management District to advance their restoration plans for the area by at least 5 years. The Merritt Island National Wildlife Refuge and the St. Johns River Water Management District implemented the project.

Louisiana Coast Shoreline Stabilization (LA)

This project protected at least 7 miles of vulnerable shorelines along Grand Isle and St. Bernard Marsh. By building more than 5 acres of bioengineered oyster reef, 287 acres of emergent marsh were protected and more than 100 marine species associated with oyster reefs in the northern Gulf of Mexico benefitted. Local communities also profited, as skilled laborers were hired and welding students were trained to create the reef structures. Project implementers were the The Nature Conservancy of Louisiana, Louisiana State Agricultural Center, and The Nature Conservancy.

Coastal Alabama Restoration (AL)

A submerged breakwater reef was created along two stretches of shoreline, protecting almost 30 acres of habitat for submerged aquatic vegetation and creating almost 3 acres of oyster reef. Several reef types were studied to determine their relative benefits to stabilizing shoreline and creating habitat. Unlike traditional erosion protection structures that contribute to habitat loss, the submerged reefs protect more than a mile of coastal habitat by reflecting erosive wave energy away from the shoreline. The project was implemented by the Dauphin Island Sea Lab, The Nature Conservancy of Alabama, Alabama Department of Conservation and Natural Resources, and The Nature Conservancy.

Oyster Habitat Restoration (NC)

This project created supplemental employment for oystermen and other water-related industries to rebuild 46 acres of oyster reefs across coastal North Carolina. The project moved oyster restoration plans in North Carolina ahead by several years, speeding the recovery of the species and providing the multitude of services derived from oyster reefs. The project documented the synergistic benefits to other fisheries in the areas around created reefs. Project partners included the North Carolina Division of Marine Fisheries, North Carolina State University, North Carolina Coastal Federation, and the University of North Carolina at Wilmington.

West Galveston Bay Estuary Restoration (TX)

The project placed hydraulically dredged material from a 100-acre nearby borrow site to create gradual sloping perimeter and interior intertidal marsh mounds planted with *Spartina alterniflora* in two areas of West Galveston Bay—Carancahua Cove and Jumbile Cove. The mosaic of mounds protected and enhanced 136.1 acres of existing intertidal marsh and salt flat/marsh. It also restored approximately 328 acres of intertidal marsh complex (salt flat marsh/salt flat, intertidal marsh, and protected shallow open water), which serves as highly productive nursery grounds for recreational and commercial fish species in the Gulf of Mexico. The project provides ecological services, such as a buffer to mitigate flood and storm damage, trap sediments to reduce erosion and stabilize shorelines, and filter pollutants to minimize their accumulation in fish and wildlife or the human food chain. The project was implemented by the Texas Parks and Wildlife Department and the Texas General Land Office.

St. Lucie/Loxahatchee Rivers and Oyster Reef Habitat Restoration (FL)
This project restored 26 acres of oyster reef habitat within the St. Lucie Estuary and the Loxahatchee River systems. More than 30 million pounds of limestone and oyster shell cultch were deployed to construct a series of small patch oyster reefs. Oyster reefs provide much needed substrate for oyster spat recruitment. In addition, these restoration efforts will help improve water quality in both rivers, enabling expanded growth of seagrass and supporting both estuarine and marine fish nurseries. These reefs provide habitat structure for other species (e.g., shrimp, clams, crabs, and snails) and a variety of fish, including many economically important species such as gag grouper, gray snapper, sheepshead, and red drum. Enhancing oyster populations in this area also contributed to the goals of the Comprehensive Everglades Restoration Plan. Project partners included the South Florida Water Management District, Martin County Board of County Commissioners, and the Loxahatchee River District.

Shoreline and Oyster Habitat Restoration (SC)
Charleston, South Carolina, is an example of a coastal urban area where impacts from historic development activities have led to the degradation of shoreline and estuarine habitats. Fortunately, many of these areas, important for commercial and recreational fish species and aesthetic and recreational value, can be restored to provide their former benefits. These restoration projects stabilized eroding shorelines, revitalized a degraded salt marsh, and increased fisheries habitat by up to 200 acres—all in recreational areas with high value to the public. The project was implemented by the South Florida Water Management District, Martin County Board of County Commissioners, and the Loxahatchee River District.

Lost River Preserve Restoration (FL)
The Lost River Preserve project restored 70 acres of coastal habitat through the removal of exotic Brazilian pepper and Australian pine by regrading the disturbed portions of the site into an estuarine marsh and planting marsh vegetation. Daily tidal exchange increased with the installation of a large box culvert under the adjacent county road. Channels constructed to convey tidal waters into the estuarine areas allows for the natural recruitment of mangroves and restoration of overall estuarine function. The restoration and enhancement of this site provides essential fish habitat for species such as snook, redfish, and spotted sea trout along the coastline of Tampa Bay. The project was implemented by the Gulf of Mexico Foundation, Hillsborough County Environmental Land Acquisition and Protection Program,
Ecosphere Restoration Institute, Southwest Florida Water Management District-S.W.I.M. Program, and Preserving the Environment through Ecological Research (PEER).

Annex Table 7. Ecological performance of ARRA projects in the Southeast region.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Mississippi River Restoration (LA)	63.0	-	-
Coastal Wetland Restoration (FL)	2,094.9	-	-
Louisiana Coast Shoreline Stabilization (LA)	287.7	-	-
Coastal Alabama Ecological Restoration (AL)	31.4	-	-
Oyster Habitat Restoration (NC)	45.5	-	-
Galveston Bay Estuarine Habitat Restoration (TX)	328.0	-	-
St. Lucie and Loxahatchee Rivers Oyster Reef Habitat Restoration (FL)	25.6	-	-
South Carolina Shoreline and Oyster Habitat Restoration (SC)	200.4	-	-
Lost River Preserve Fisheries Habitat Restoration (FL)	70.0	-	-
Total	3,146.4	-	-

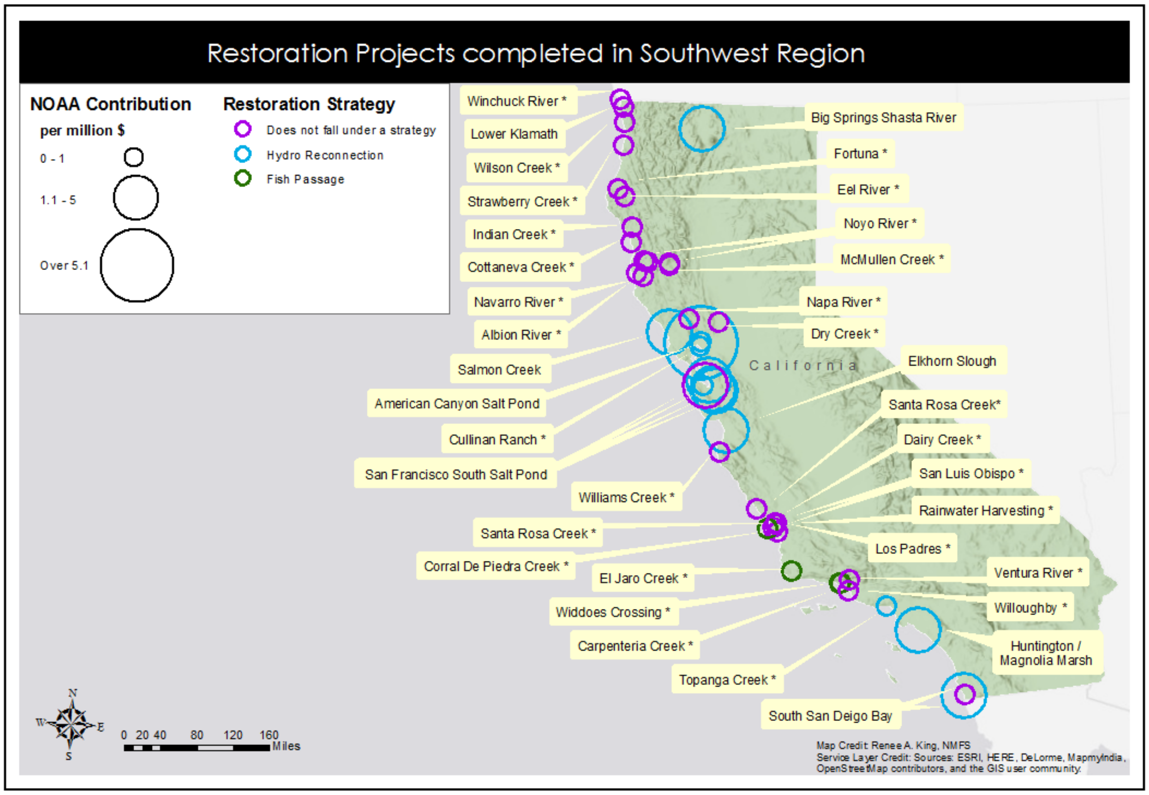
Annex Table 8. Employment and labor income impacts of ARRA projects in the Southeast region.

Project	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Mississippi River Restoration (LA)	23	7	10	40	1,497,975	445,591	450,157	2,393,723
Coastal Wetland Restoration (FL)	25	8	11	44	1,115,326	444,441	439,598	1,999,365
Louisiana Coast Shoreline Stabilization (LA)	44	11	20	75	3,072,155	490,633	881,420	4,444,208
Coastal Alabama Ecological Restoration (AL)	54	7	7	68	932,671	244,325	236,398	1,413,394
Oyster Habitat Restoration (NC)	24	11	8	43	1,266,911	445,924	254,362	1,967,197
Galveston Bay Estuarine Habitat Restoration (TX)	33	10	14	57	2,803,663	786,416	730,337	4,320,416
St. Lucie and Loxahatchee Rivers Oyster Reef Habitat Restoration (FL)	32	9	13	54	2,237,704	475,822	560,672	3,274,197
South Carolina Shoreline and Oyster Habitat Restoration (SC)	7	2	3	12	395,226	96,920	118,737	610,883
Lost River Preserve Fisheries Habitat Restoration (FL)	7	2	3	12	362,190	116,286	149,980	628,456
Total	247	67	90	404	13,683,821	3,546,358	3,821,661	21,051,840

Annex Table 9. Value added and output impacts of ARRA projects in the Southeast region.

Project	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Mississippi River Restoration (LA)	1,522,296	604,527	753,910	2,880,732	3,023,303	1,060,125	1,212,923	5,296,352
Coastal Wetland Restoration (FL)	1,172,053	647,287	784,365	2,603,705	2,748,812	1,108,925	1,255,527	5,113,264
Louisiana Coast Shoreline Stabilization (LA)	2,892,868	715,252	1,480,248	5,088,369	4,156,222	1,139,504	2,396,084	7,691,811
Coastal Alabama Ecological Restoration (AL)	1,278,935	469,069	436,943	2,184,946	2,956,446	854,526	712,675	4,523,647
Oyster Habitat Restoration (NC)	1,935,664	738,741	546,823	3,221,228	5,030,001	1,192,216	858,305	7,080,522
Galveston Bay Estuarine Habitat Restoration (TX)	2,950,098	1,082,208	1,217,599	5,249,905	5,133,103	1,898,407	1,914,031	8,945,541
St. Lucie and Loxahatchee Rivers Oyster Reef Habitat Restoration (FL)	2,501,256	675,257	984,485	4,160,998	4,024,959	1,072,062	1,519,822	6,616,843
South Carolina Shoreline and Oyster Habitat Restoration (SC)	423,078	133,751	209,364	766,193	760,799	228,203	339,909	1,328,911
Lost River Preserve Fisheries Habitat Restoration (FL)	392,524	169,264	264,070	825,857	750,000	290,419	426,197	1,466,616
Total	15,068,771	5,235,355	6,677,806	26,981,933	28,583,645	8,844,389	10,635,473	48,063,507

Southwest



Elkhorn Slough Restoration (CA)

This project restored 450 acres within the Elkhorn Slough wetland complex. It is expected to boost ecosystem resilience to climate change by increasing the retention of sediment, critical to keeping pace with sea level rise. To dissipate tidal energy and re-establish the historic tidal range of the area, an adjustable water control structure was constructed at Parsons Slough, a major branch of the Elkhorn Slough estuary. The project was implemented by the California Department of Fish and Game, Elkhorn Slough National Estuarine Research Reserve, and the Elkhorn Slough Foundation.

Big Springs Shasta River Restoration (CA)

This project will improve more than 11 miles of important salmon spawning and rearing habitat along the Shasta River and tributaries by supporting natural revegetation of 125 acres of the riparian zone and actively planting 32 riparian acres. This project also created structural improvements to allow for fish-friendly irrigation. These efforts will protect cold water springs, enhance cold water flows, and restore aquatic habitat critical for Chinook, steelhead, and threatened coho salmon in the Shasta River, which is the last major tributary before the mainstem

Klamath River dams and crucial for salmonid restoration. The project was implemented by The Nature Conservancy California Chapter and the University of California Davis.

San Diego Bay Restoration (CA)

This project restored 281 acres in southern San Diego Bay by breaching levees, creating channels, and revegetation. The restoration addressed an important need in an urban area that has seen significant loss of estuarine habitat from development, including a 70 percent loss of salt marsh. Two areas of the bay were transformed to provide habitat essential to fish and other marine life, birds, and native plants. These two sites are the western salt ponds of the South San Diego Bay National Wildlife Refuge and the Chula Vista Wildlife Reserve, located in the Bay to the east of the salt ponds. The sites provide additional habitat for at least five federally or state listed threatened and endangered species; a diverse array of commercial and recreational fish; and tens of thousands of migratory birds. Project partners included the Southwest Interpretive Association, U.S. Environmental Protection Agency, San Diego Unified Port District, California State Coastal Conservancy, and U.S. Fish and Wildlife Service.

San Francisco South Bay Salt Pond Restoration (CA)

This project provided tidal circulation to former salt ponds and restored 3,208 acres of wetlands in southern San Francisco Bay at the Eden Landing, Alviso, and Middle Bair Island sites. Restoration activities included breaching levees, regrading interior areas, and supporting natural revegetation. In addition, remaining acres (approximately 150) of invasive spartina were treated throughout the Bay area. San Francisco Bay lost an estimated 85 percent of its historic wetlands to development, and this project represents part of the largest tidal wetland restoration effort on the West Coast of North America (more than 15,000 acres in total). The project also contributes to the recovery of threatened and endangered species such as steelhead trout; increasing habitat for migratory birds and marine mammals; and improving the productivity of the Bay's ecosystem. Project partners included the California State Coastal Conservancy, Santa Clara Valley Water District, and the U.S. Fish and Wildlife Service.

Huntington/Magnolia Marsh Restoration (CA)

The project provided tidal circulation and restored 41 acres of urban wetlands in Huntington Beach by breaching a levee and creating channels and revegetation. The Huntington Beach Wetlands were once part of a large tidally influenced wetlands area encompassing 3,000 acres of what is now Costa Mesa. At present, only 300 acres of historic wetlands remain, most of which has been cut off from the ocean for decades. The Magnolia project is the final phase of this restoration project, not only restoring significant habitat for birds, shellfish, and coastal marine fish such as anchovy, mullet, corvina, and halibut, but also enhancing recreational use through adjacent public access improvements. This project was implemented by the Huntington Beach Wetlands Conservancy, California Conservation Corps, and the California State University Long Beach.

Lower Klamath Riparian Restoration and Tribal Nursery (CA)

This project restored 9 acres of in-stream habitat and 200 acres of riparian habitat; created two off-channel ponds in the lower Klamath River to benefit threatened coho salmon as well as Chinook salmon and steelhead trout, riparian buffers, and in-stream complexity on Lower Klamath tributaries; and expanded native plant nurseries. It created jobs in an area with high unemployment directly benefiting the tribal community. The project partners were the Green Diamond Resources, Inc., Yurok Tribe, U.S. Fish and Wildlife Service, and U.S. Bureau of Indian Affairs.

American Canyon Salt Pond Restoration (CA)

The American Canyon "south unit" salt pond restoration project restored 1,164 acres of tidal wetlands by removing levees and contouring/excavating stream channels to re-create a natural tidal exchange, restore marsh, and provide flood protection. This project involved an important restoration expansion of the Napa-Sonoma Wildlife Area and San Pablo National Wildlife Refuge. The project will benefit threatened species including green sturgeon, delta and longfin smelt, steelhead, and Chinook salmon. The project was implemented by the California Department of Fish and Game and Ducks Unlimited.

Coastal Fisheries Restoration Project (CA)

This project involved the California Conservation Corps crew members in the restoration of more than 20 sites, restoring a total of 41 acres and opening 3 stream miles throughout coastal California. Restoration activities that benefited threatened and endangered salmon and steelhead included salmonid spawning surveys (live fish, carcasses, and redd counts) within selected stream reaches of the Eel River, Redwood Creek, and Humboldt Bay watersheds; enhanced salmonid habitat in Wilson Creek; revegetation of the banks of the creek to prevent erosion and reduce sediment runoff into Dry Creek; and salmonid habitat monitoring.

These projects were implemented by partners, as follows: AmeriCorps Watershed Stewards; Audubon Society; Big Sur Land Trust; Cachuma Operation and Maintenance Board; Cachuma Resource Conservation District; California Coastal Conservancy; California Conservation Corps.; California Department of Fish and Wildlife; California Department of Forestry; California Department of Parks and Recreation; California National Guard - Grizzly Youth Academy; California Polytechnic State University; California State Coastal Conservancy; California State Parks; Campbell Timberland Management; Cate School Corporation; Carpinteria Creek Watershed Coalition; Central Coast Salmon Enhancement; City of Santa Barbara; City of San Luis Obispo; Ducks Unlimited; Eel River Watershed Improvement Group; Greenspace-Cambria Land Trust; Green Diamond Resources, Inc.; Land Conservancy of San Luis Obispo County; Land Trust for Santa Barbara County; Los Padres National Forest; Mendocino Redwood Company; Morro Bay National Estuary Program; Mountains Restoration Trust; Mr. Jamie Widdoes (Landowner); Napa County Flood Control District; Natural Resources Conservation Service; Outside Now Academy; Pacific Coast Fish, Wildlife, and Wetlands Restoration Association; Partners for Fish and Wildlife Program; Redwood Forest Foundation; San Luis Obispo County; Santa Lucia Fly Fishers; Santa Monica Bay Restoration Commission; Santa Monica Mountains Resource Conservation District; Sierra Watershed Progressive; Soper-Wheeler Company; South Coast Habitat Restoration / Earth Island Institute; Trout Unlimited; U.S. Environmental Protection Agency; U.S. Fish and Wildlife Service; Wildlife Conservation Board; Yolo County Resource Conservation District.

Salmon Creek Restoration (CA)

This project improved streamside corridor and in-stream habitat to benefit the endangered coho salmon and threatened steelhead. Project activities included installing rain catchment tanks to improve instream flow, planting native vegetation, and implementing other stream-related restoration activities to benefit fisheries resources. The project partners were the Bodega Water Company, Gold Ridge Resource Conservation District, Prunuske Chatham Inc., Salmon Creek Watershed Council, and Dragonfly Stream Enhancement.

Annex Table 10. Ecological performance of ARRA projects in California, Southwest region.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Elkhorn Slough Ecosystem Resilience	450.0	-	-
Shasta River/Big Springs Creek Coho Recovery	157.0	-	-
San Francisco Bay Salt Pond Restoration	4,704.2	-	-
San Diego Bay Restoration	257.0	-	-
Huntington Beach Wetlands/Magnolia Marsh Restoration	40.5	-	-
Lower Klamath Tributaries Riparian Restoration	214.5	-	-
American Canyon Tidal Wetlands Restoration	1,164.4	1.5	-
Coastal Fisheries Restoration	41.0	3.0	-
Salmon Creek Habitat Restoration	84.2	3.2	-
Total	7,112.8	7.7	-

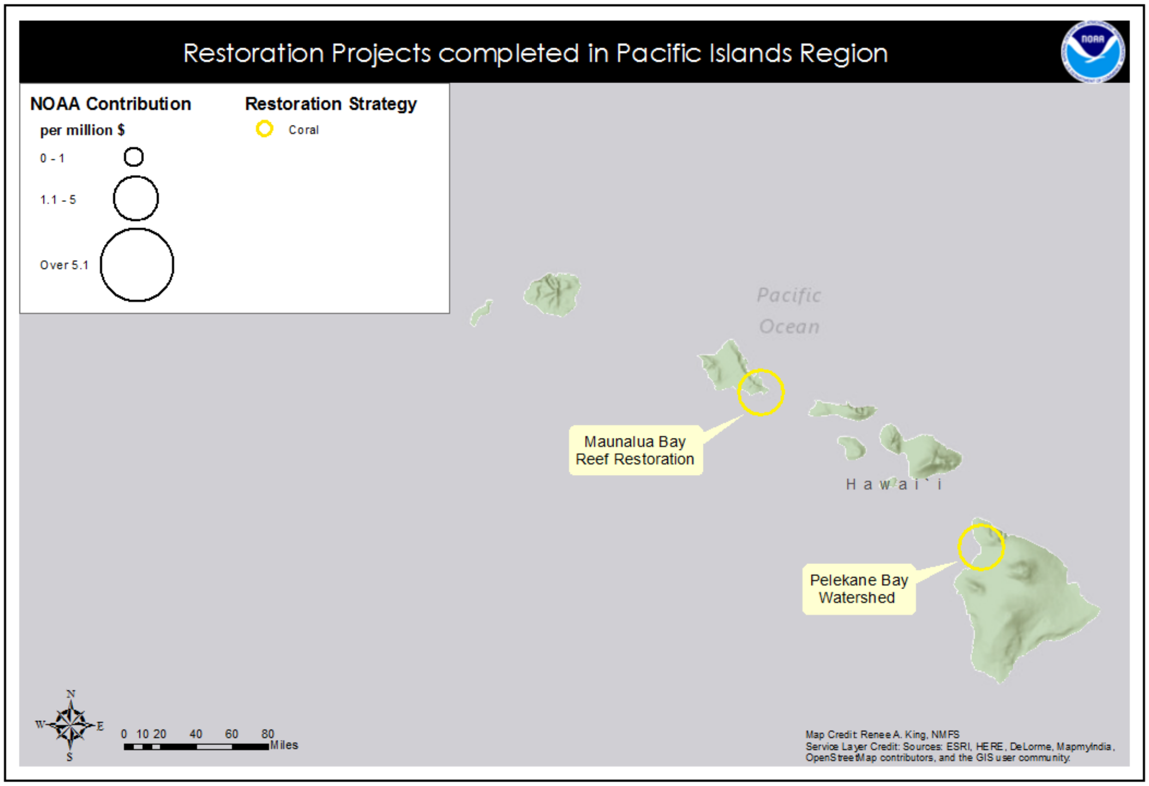
Annex Table 11. Employment and labor income impacts of ARRA projects in California, Southwest region.

Project	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Elkhorn Slough Ecosystem Resilience	42	8	10	61	2,967,581	608,815	594,263	4,170,660
Shasta River/Big Springs Creel Coho Recovery	29	5	4	37	765,450	148,188	130,956	1,044,593
San Diego Bay Restoration	29	8	12	49	1,746,800	475,912	550,106	2,772,818
San Francisco Bay Salt Pond Restoration	62	15	22	100	4,377,650	1,047,626	1,160,035	6,585,311
Huntington Beach Wetlands/Magnolia Marsh Restoration	32	11	16	59	1,847,860	688,131	796,159	3,332,150
Lower Klamath Tributaries Riparian Restoration	4	1	1	6	372,708	7,428	57,568	437,704
American Canyon Tidal Wetlands Restoration	74	20	25	119	4,661,733	1,116,275	1,178,925	6,956,933
Coastal Fisheries Restoration	36	5	7	48	937,997	258,093	320,267	1,516,357
Salmon Creek Habitat Restoration	16	4	4	24	871,916	206,157	202,922	1,280,995
Total	325	77	101	502	18,549,695	4,556,625	4,991,200	28,097,520

Annex Table 12. Value added and output impacts of ARRA projects in California, Southwest region.

Project	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Elkhorn Slough Ecosystem Resilience	2,701,829	880,407	976,031	4,558,267	4,503,614	1,320,493	1,437,355	7,261,462
Shasta River/ Big Springs Creel Coho Recovery	505,747	280,904	277,601	1,064,252	1,645,741	541,892	453,532	2,641,165
San Diego Bay Restoration	1,722,399	686,940	962,465	3,371,804	3,270,636	1,128,916	1,488,154	5,887,706
San Francisco Bay Salt Pond Restoration	4,371,323	1,467,729	1,964,348	7,803,400	7,620,943	2,374,576	3,022,352	13,017,871
Huntington Beach Wetlands/ Magnolia Marsh Restoration	1,810,340	1,025,192	1,372,706	4,208,238	3,532,800	1,865,758	2,217,278	7,615,836
Lower Klamath Tributaries Riparian Restoration	538,857	12,557	120,703	672,117	592,010	24,400	197,590	814,001
American Canyon Tidal Wetlands Restoration	4,280,336	1,677,670	2,118,869	8,076,876	8,477,108	3,189,565	3,367,246	15,033,919
Coastal Fisheries Restoration	889,839	463,246	558,405	1,911,490	1,659,212	705,093	889,494	3,253,799
Salmon Creek Habitat Restoration	844,557	298,688	354,252	1,497,497	1,580,661	484,561	546,257	2,611,479
Total	17,665,228	6,793,333	8,705,381	33,163,942	32,882,725	11,635,253	13,619,259	58,137,238

Pacific Islands



Pelekane Bay Watershed Restoration (HI)

This restoration project, conducted in the upland areas of the Kohala watershed, reduced land-based sediment inputs into coral reefs through erosion control, native revegetation, and limiting sediment transport. This restoration project is a comprehensive partnership of all the major stakeholders in the Pelekane Bay Watershed area. The Kohala Center contributed to this project.

Maunalua Bay Reef Restoration (HI)

This project restored 26.7 acres of coral reefs through manual removal of invasive alien algae. The restored sand bottom and hard substrate habitat enabled seagrass expansion and coral recruitment. Improvements included an increase in the abundance of certain native fish and limu species, better water quality, and sandier bottom conditions. Local communities experienced first-hand how their efforts have succeeded while engaging in stewardship of the Bay. The Nature Conservancy of Hawaii, local government agencies, and local residents contributed to this project.

Annex Table 13. Ecological performance of ARRA projects in Hawaii, Pacific Islands region.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Pelekane Bay Watershed Restoration	11,750.0	-	-
Maunalua Bay Reef Restoration	26.7	-	-
Total	11,776.7	-	-

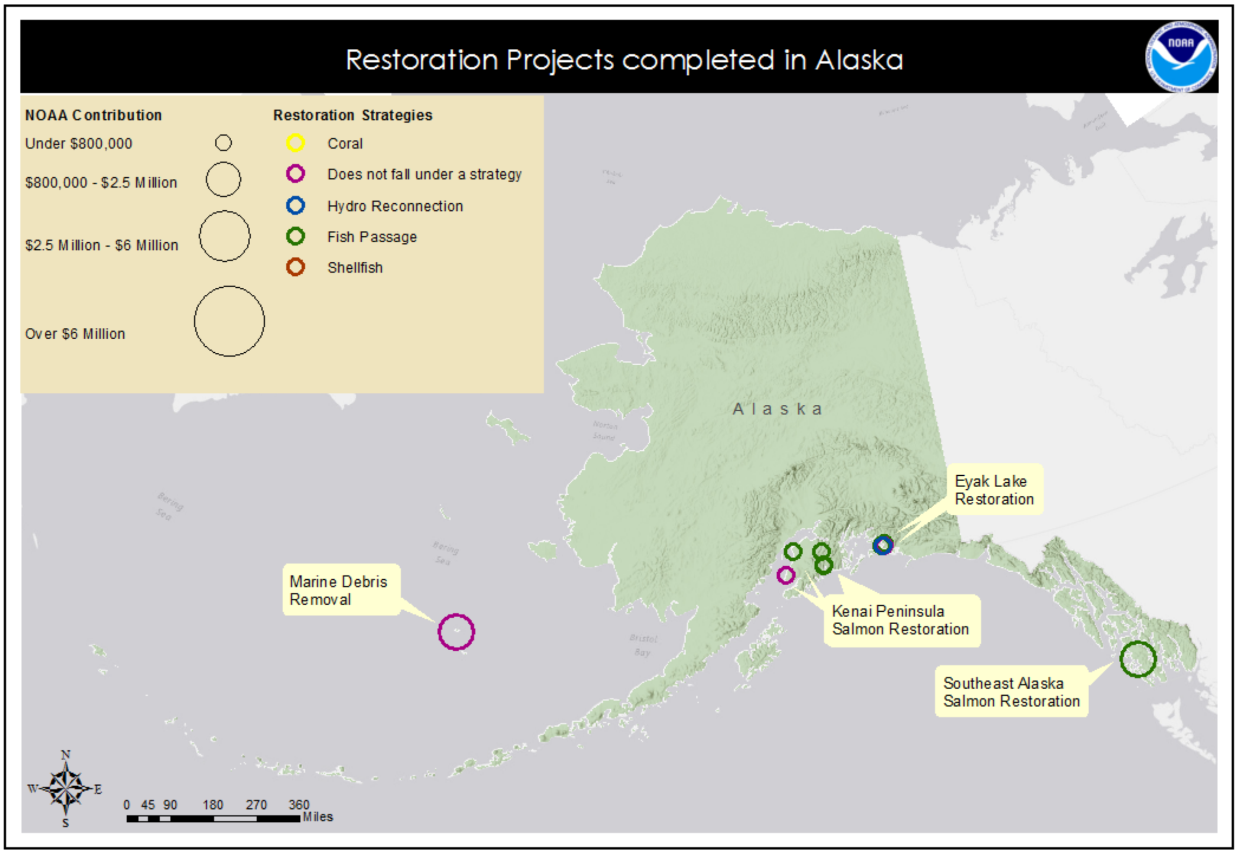
Annex Table 14. Employment and labor income impacts of ARRA projects in Hawaii, Pacific Islands region.

Project	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Pelekane Bay Watershed Restoration	60	8	8	76	1,842,631	270,727	290,588	2,403,947
Maunalua Bay Reef Restoration	75	8	13	96	2,030,717	354,106	547,079	2,931,902
Total	135	16	21	172	3,873,348	624,834	837,667	5,335,849

Annex Table 15. Value added and output impacts of ARRA projects in Hawaii, Pacific Islands region.

Project	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Pelekane Bay Watershed Restoration	1,501,095	542,451	549,063	2,592,609	2,905,065	904,271	888,593	4,697,929
Maunalua Bay Reef Restoration	1,546,783	600,984	952,488	3,100,254	3,408,848	1,406,043	1,579,811	6,394,703
Total	3,047,877	1,143,434	1,501,551	5,692,863	6,313,913	2,310,314	2,468,404	11,092,631

Alaska



Eyak Lake Restoration

This project addressed several key stressors in the Eyak Lake, a 2,400-acre shallow lake in Cordova, Alaska. Fish passage was improved by removing barriers to lake circulation, restoring the stream channel to a more natural configuration, and revegetation of the shoreline. Trout and pink salmon have already been observed using the upstream habitat. Implemented by the Copper River Watershed Project with the U.S. Fish and Wildlife Service, U.S. Forest Service, Prince William Sound Science Center, Alaska Department of Fish and Game, National Fish and Wildlife Foundation, City of Cordova, Cordova District Fishermen United, Native Village of Eyak, Alaska Department of Transportation, Ecotrust, Prince William Soundkeepers, and the local communities.

Kenai Peninsula Salmon Habitat Restoration

The Kenai Watershed Forum restored a natural stream channel within Daves Creek, Stariski Creek and removed several barriers to fish passage along the Anchor River, Lagoon Creek, and Salmon Creek. This will benefit Chinook, coho, pink, and sockeye salmon. Other partners included the City of Kenai, City of Seward, U.S. Forest Service, Kenai River Sportfishing Association, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Kenai River Center, City of Soldotna, and the Kenai Peninsula Borough.

Southeast Alaska Salmon Habitat Restoration

This project restored estuarine hydrology within the Klawock River by constructing a culvert through a causeway that has blocked tidal exchange for nearly 50 years and that contributed to the decline of salmon in the Klawock River. The project restored access for out-migrating juvenile salmonids to 460 acres of eelgrass habitat and provided adult salmonids with increased access to the Klawock River watershed. The project was completed in partnership with the Klawock Watershed Council, Alaska Department of Transportation and Public Facilities, and The Nature Conservancy.

Marine Debris Removal and Restoration

The Marine Conservation Alliance Foundation (MCAF) worked within 19 locations to restore the Alaska shoreline from Prince of Wales Island at the southern tip to Little Diomede Island at the northern end of Alaska. Large-scale community cleanups included the removal of derelict fishing gear and vessels totaling 390 tons of marine debris. The restoration benefited numerous seals, sea lions, whales, birds, and other species, many of which are protected under the Endangered Species Act.

Annex Table 16. Ecological performance of ARRA projects in Alaska.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Eyak Lake Restoration	0.2	1.2	-
Kenai Peninsula Salmon Habitat Restoration	12.0	12.6	-
Southeast Alaska Salmon Habitat Restoration	5.0	-	-
Marine Debris Removal and Restoration	1.0	-	390.0
Total	18.1	13.8	390.0

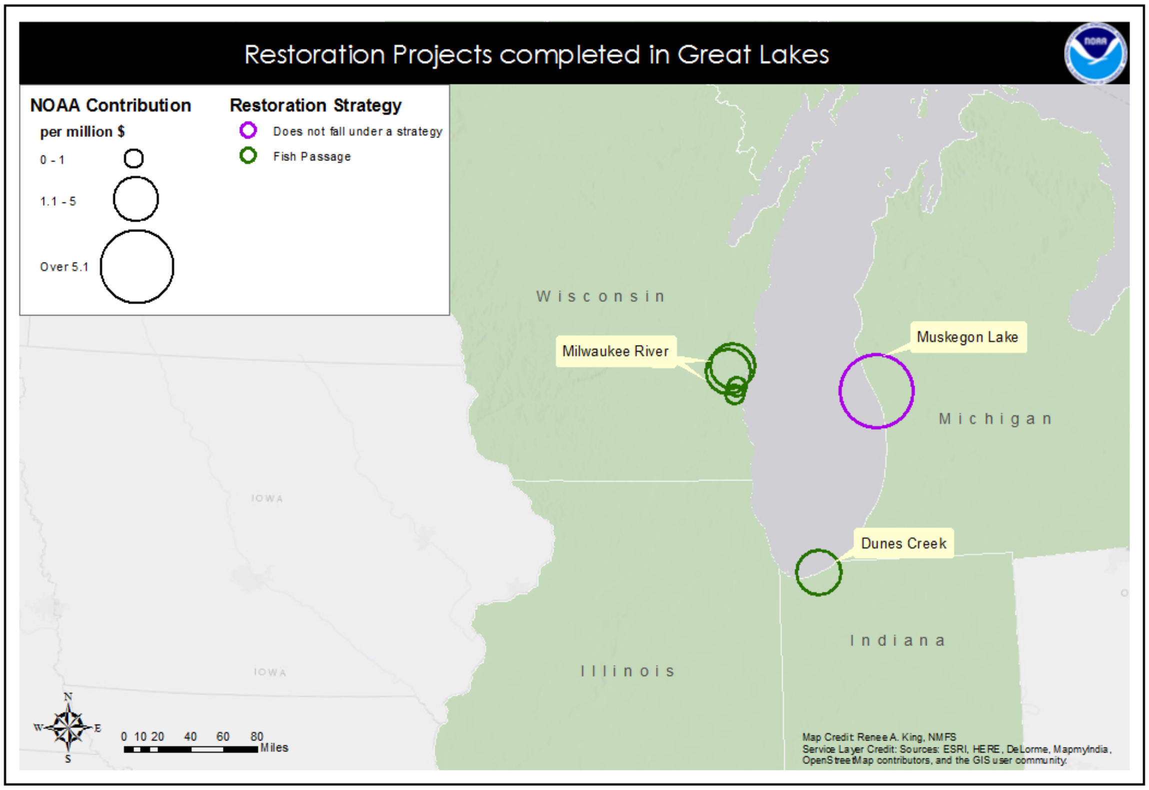
Annex Table 17. Employment and labor income impacts of ARRA projects in Alaska.

Project Title	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Eyak Lake Restoration	8	1	1	10	323,706	47,477	52,072	423,254
Kenai Peninsula Salmon Habitat Restoration	13	3	6	21	948,370	191,877	264,071	1,404,318
Klawock River Salmon Passage and Habitat Restoration	15	2	2	19	523,080	86,711	65,782	675,573
Marine Debris Removal and Restoration	8	1	1	10	389,585	41,767	47,607	478,959
Total	44	7	10	61	2,184,741	367,832	429,532	2,982,105

Annex Table 18. Value Added and output impacts of ARRA projects in Alaska.

Project Title	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Eyak Lake Restoration	265,441	78,863	102,342	446,646	638,473	162,781	167,611	968,865
Kenai Peninsula Salmon Habitat Restoration	890,630	298,409	464,572	1,653,611	1,568,272	519,510	736,466	2,824,249
Klawock River Salmon Passage and Habitat Restoration	343,575	153,602	132,898	630,075	1,018,486	272,076	209,100	1,499,662
Marine Debris Removal and Restoration	578,084	75,990	97,457	751,531	1,012,640	163,306	161,446	1,337,392
Total	2,077,729	606,865	797,267	3,481,862	4,237,871	1,117,673	1,274,623	6,630,167

Great Lakes



Dunes Creek Watershed Restoration (IN)

The State of Indiana's Department of Natural Resources daylighted 750 feet of culvert within Indiana Dunes State Park to reconnect 7,407 acres of the Dunes Creek watershed to Lake Michigan. The project improved the flood capacity and resiliency along the creek and offers additional flood protection for historic public facilities that serve beachgoers. Federal Emergency Management Agency, State of Indiana Department of Natural Resources, and Department of Transportation were project implementers.

Milwaukee River and Watershed Restoration (WI)

The Ozaukee County Planning and Parks Department re-established fish access to riverine habitat through the removal of natural and man-made barriers within the Milwaukee River watershed (Village of Grafton's Lime Kiln and Newburg dams within the Milwaukee River), and the construction of a nature-like fishway along the Village of Thiensville's Mequon-Thiensville Dam. The project was implemented by the Ozaukee County Planning and Parks Department in coordination with the City of Mequon, Village of Thiensville, Village of Grafton, Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, Milwaukee Community Service Corps, Milwaukee Riverkeeper, Riveredge Nature Center, Ulao Creek Partnership, and others.

Muskegon Lake Restoration (MI)

The Great Lakes Commission and local partner West Michigan Shoreline Regional Development Commission restored 32 acres of wetland and stabilized shoreline at 10 separate locations for the Muskegon Lake Area of Concern. Project partners were the Great Lakes Commission, West Michigan Shoreline Regional Development Commission, Grand Valley State University-Annis Water Resources Institute, Muskegon River Watershed Assembly, Muskegon Lake Watershed Partnership, and landowners.

Annex Table 19. Ecological performance of ARRA projects in the Great Lakes region.

Project Title	Habitat Restored (acres)	Stream Opened (miles)	Debris Removed (tons)
Dunes Creek Watershed Restoration (IN)	-	6.0	-
Milwaukee River and Watershed Restoration (WI)	-	170.3	-
Muskegon Lake Restoration (MI)	32.9	-	182,862.0
Total	32.9	176.3	182,862.0

Annex Table 20. Employment and labor income impacts for projects in the Great Lakes region.

Project Title	Employment				Labor Income (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Dunes Creek Watershed Restoration (IN)	9	2	5	16	762,893	99,151	168,843	1,030,887
Milwaukee River and Watershed Restoration (WI)	44	12	23	80	3,003,019	683,750	1,031,982	4,718,751
Muskegon Lake Restoration (MI)	79	26	38	143	4,780,988	1,286,132	1,481,085	7,548,206
Total	132	41	66	239	8,546,900	2,069,033	2,681,910	13,297,844

Annex Table 21. Employment and labor income impacts of ARRA projects in the Great Lakes region.

Project Title	Total Value Added (US$ 2012)				Output (US$ 2012)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Dunes Creek Watershed Restoration (IN)	794,681	148,050	305,451	1,248,182	1,401,602	332,882	512,772	2,247,256
Milwaukee River and Watershed Restoration (WI)	3,103,185	959,618	1,714,534	5,777,337	5,246,850	1,604,013	2,776,408	9,627,271
Muskegon Lake Restoration (MI)	5,148,837	1,810,879	2,599,063	9,558,778	10,000,000	3,161,703	4,374,675	17,536,378
Total	9,046,702	2,918,547	4,619,048	16,584,297	16,648,452	5,098,599	7,663,854	29,410,905

Appendix 2. Restoration techniques

The descriptions are meant to help clarify the techniques referenced in the project descriptions in Appendix 1.

Appendix Table 1. Restoration techniques.

Fish and Wildlife Management	
Invasives removal: fauna	Physical removal or eradication of organisms from the habitat, which are non-native or native but overabundant
Species enhancement	Addition of native animals to a restoration site. This can be used for oyster planting (such as “spat on shell” placement), coral transplant, other species reintroduction, or stock enhancement.
Hard Structural Techniques	
Fishway	Building or maintenance of a structure to enhance fish passage. This may be a concrete or metal fish ladder, or be a "nature-like" fishway made of rock and other natural bottom substrate. This project type may include modifying the dam during installation.
Berm/dike modification (including replacement)	Modification of a man-made earthen water retention structure. This can include partial removal, adding to an existing structure, or building a new structure to restrict water at a setback location.
Berm/dike removal	Any project that results in permanent removal of a man-made earthen water retention structure.
Culvert modification (including replacement)	Modification of a culvert to increase the diameter or width and height dimensions, decrease the longitudinal slope, or otherwise enhance the passability of fish through the culvert.
Culvert removal	Any project that results in permanent removal of a culvert, including daylighting culverts.
Dam removal	Any project that results in permanent removal of a dam.
Tide gate modification (including replacement)	Modification of tide gates to alter the current flow regime, or replacing the existing tide gate with a new gate.
Weir construction	Creation of a low structure for the purpose of creating greater ease of fish passage, enhancing grade control or habitat enhancement such as pool creation.

Other Habitat Modifications	
Bird habitat enhancement	Creation, restoration, and/or enhancement of nesting and roosting habitat for birds.
Contaminant removal/ remediation	Removal of contaminants from soil, sediment, waste, or water.
Debris removal	Removal of on-shore or off-shore debris such as trash, fishing gear, vessels, or other man-made objects.
Fencing/netting	Erection of permanent or temporary fences, nets, or strings to prevent or reduce herbivory, predation, or other forms of habitat degradation.
Large woody debris/ structure placement	Addition of large wood or rock structures to increase habitat diversity, including pool creation, for fish and wildlife within streams and other waterways, including their banks.
Stream channel reconnection/ creation	Any project that increases the length of a stream channel, but not one that increases the habitat quality within the channel. Project types include re-connecting oxbows or side channels or otherwise adding off-channel habitat as well as main-stem channel.
Stream flow modification	Modification of stream flow through physical (not legal) measures to reduce water usage permanently, or provide water storage for later availability. This includes projects that install water catchment systems and/or tanks for water storage, etc.
Protection	
Education and outreach	Implementation of on-site or in-classroom educational activities, or outreach activities such as developing press or leading site tours.
Signage	Placement of signage on-site to inform the public regarding restoration and ecologically appropriate activities. This technique may include projects that develop or install educational/interpretive signage or signage to delineate restricted access zones, no-motor zones, etc.
Research/ recommendations	Activities NOT specifically resulting in on-the ground restoration, related to restoration research, involving the recommendation of future conservation/restoration actions.
Restoration Infrastructure	
Native plant nursery	Building or maintaining a structure to grow native plants. The structure may be wood, glass, metal, plastic, or other construction materials. This technique also includes raising plants at the facility.

Sediment/Substrate Modification	
Oyster reef construction	Placement of durable structure(s) to enhance the potential for oyster spat settlement. This can include shell, rock, or man-made materials such as “Baycrete.” Projects that utilize shells collected from oyster gardening should also include the “oyster gardening” technique, and those that include supplementation through spat on shell should also include “species enhancement.”
Erosion control	Use of soft erosion control methods, such as installing coconut fiber, rock, large wood, breakwaters, etc. This technique should be used for shorelines or banks, including living shoreline or bioengineering projects.
Fill removal	Removal of sediment to reach the desired project elevation.
Placement of fill/dredge material	Placement of sediment to reach the desired project elevation.
Beach nourishment	Addition of sand to sandy shorelines, regardless of whether the shoreline is in-shore or open ocean (beach) shoreline
Vegetation Management	
Invasives removal: vegetation	Removal of non-native or nuisance plant species from the restoration site. This can be used for any prevention methods, such as biological controls.
Planting	Addition of native plants to a restoration site.

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