UNC's Center for
Urban & Regional Studies

Working Paper No. 2014-01

Exploring and Understanding the Restoration Economy

Todd K. BenDor
T. William Lester
Avery Livengood
University of North Carolina at Chapel Hill

Adam Davis
Ecosystem Investment Partners-Advisory

Logan Yonavjak
Yale University

Center for Urban and Regional Studies
The University of North Carolina at Chapel Hill
Campus Box 3410, Hickerson House
Chapel Hill, NC 27599-3410
Telephone: 919-962-3074 FAX 919-962-2518
curs.unc.edu

Exploring and Understanding the Restoration Economy

Todd K. BenDor
T. William Lester
Avery Livengood
University of North Carolina at Chapel Hill

Adam Davis
Ecosystem Investment Partners-Advisory

Logan Yonavjak
Yale University

Introduction

For decades, industry groups and the American media have propagated the notion that environmental protection is bad for business (Bezdek et al. 2008, Goodstein 1994). Recent polls demonstrate that this idea is widely accepted as fact (Chinni 2011); proponents of projects that require environmental permits to impact species habitat, water resources and other natural features often appeal to the public using the assumption that more jobs will be created by allowing for environmentally-destructive development practices. Underscoring this trend, the U.S. Chamber of Commerce recently released a report, *Progress Denied*, blaming "corrosive" declines in job growth on the environmental permitting process (Pociask and Fuhr 2011).

What has been almost entirely missing from this public debate is a detailed accounting of the economic output and jobs in the U.S. that are actually created through environmental conservation, restoration, and mitigation actions – the activities that are part of what we will call the "Restoration Economy."[1] This economy is comprised by the restoration sector, a variety of industries, including earth movers, plant nurseries, legal and planning practices, landscape architects, construction companies, and other firms that contribute to the ecological restoration process.

Early studies on the administrative and compliance costs of environmental protection failed to account for the net benefits of environmental protection, including growth in both private- and public-sector environmental protection jobs (Bezdek 1993, Goodstein 1994). More recently, a growing number of studies have identified "green" growth and job creation in renewable energy production (Pollin et al. 2008), energy efficient construction (USGBC 2009), and green goods and services industries (Renner 2000). The Bureau of Labor Statistics' *Green Goods and Services* survey found that the "green" economy accounted for 3.4 million U.S. jobs in 2011, with the vast majority of jobs in the private sector (BLS 2013). The green economy has also been recognized as a potential source of innovation that drives the broader economy (Chapple et al. 2011). Ecosystem restoration has not been explicitly included in this "green" economy accounting, perhaps foremost because it is so difficult to define.

---

[1] Storm Cunningham first documented the rise of the Restoration Economy in *The Restoration Economy: The Greatest New Growth Frontier* (2002). While Cunningham takes a broad perspective of restoration that includes both the built and natural environment, we are focused solely on economic activity relating to ecological restoration.

Restoration does not consistently fall into any single economic sector. Restoration work ranges from scientific research and project planning to earth moving and tree planting. Projects are often collaborative, involving federal, state and local partners from the public and private sectors. The variety of programs, funding sources, and implementing agencies makes for a complex national restoration industry that is difficult to delineate. As such, attempts to assess the restoration industry to-date have been small-scale, focusing on a limited set of programs, specific projects, and individual funding sources.

However, a growing body of evidence suggests the presence of a restoration industry that not only protects public environmental goods, but also contributes to national economic growth and employment. Federal and state agencies have begun to evaluate the impact of their restoration investments on local and state economies, finding that restoration projects support as many as 33 jobs per $1 million invested (Edwards et al. 2013), which compares favorably to estimates generated for other industries (Garrett-Peltier and Pollin 2009). Restoration jobs can stimulate economic activities that create growth and employment in a wide variety of other industries. While this information is promising, we do not yet understand the extent of these activities and benefits at a national level.

The purpose of this report is to synthesize the evidence and construct a framework for estimating the size of the United States restoration sector. This report is organized as follows: the first section defines *restoration*, while the second section attempts to define the *restoration industry* by the factors that drive demand for restoration. The third section reviews previous work to quantify the economic benefits, impacts and contributions of restoration. In the final section, we present our proposed methodology for further research to quantify the size of the restoration industry annually in terms of total economic output and employment.

Defining Restoration

One of the challenges to quantifying the restoration industry is the inconsistent use of the term *restoration* itself. Federal law treats the term restoration differently in different codes, and within different federal agencies. The terms *restoration*, *rehabilitation*, *remediation*, *re-establishment,* and *reclamation* are often used interchangeably (Cunningham 2002, Hobbs and Norton 1996), although they can also be defined as separate and distinct activities (Bradshaw 2002, National Resource Council 1992). Perhaps as a result of the diversity of activities, the North American Industry Classification System (NAICS), the standard that federal agencies use to collect and analyze business data, does not have a code for the restoration industry. Restoration businesses and activities are classified instead by other industry codes, from '*Nursery and Tree Production'* to '*Other Heavy and Civil Engineering Construction*.' Yet, one cannot quantify the economic impacts of restoration without a clear understanding of what activities define the industry.

Traditionally, ecological restoration is defined as an act of returning a system to an original state, and is distinguished from rehabilitation, which is more broadly defined as any act to improve the degraded state of the ecosystem (Bradshaw 2002). Intact or "original" ecosystems will have both high structural and functional attributes, whereas degraded systems lack the attributes of either or both structure and function. While remediation, reclamation, enhancement and mitigation are also activities performed on degraded ecosystems, the final outcome of these activities is an alternative state or partial recovery of an original state. Indeed, some even argue that activities must return *both* the original structural and functional attributes to degraded systems to constitute restoration (National Resource Council 1992).

From an accounting standpoint, these distinctions can be problematic in that many times the original state of an ecosystem is unknown or unattainable (Harding et al. 1998). The extent to which humans can re-establish natural systems is limited, particularly in situations where historic impacts have permanently altered ecosystem structure. Restoration projects frequently present a tradeoff between alternative structures, functions, and mitigation measures rather than the opportunity to fully return an ecosystem to its historic state (Stanley and Doyle 2003). In fact, quite frequently, an ecosystem's historic state may no longer be stable over the long term. Climate change presents an additional challenge for restoration purists; in the future, the integrity of many ecosystems will depend more on proactive mitigation and adaptation to changing climatic and environmental context than a return to historic conditions (Seavy et al. 2009).

Recently, more comprehensive definitions of restoration have been proposed to encompass these alternative, often preferred outcomes. Hobbs and Norton (1996) define restoration as "an attempt to force transitions towards a desired state" with the understanding that the desired state will depend on ecological and human context (pp 98). Activities that might be considered restoration under these broader definitions include remediation of mine sites, land use conversion, invasive species removal, and sustainable forest management.

Bradshaw (2002) suggests that restoration consists of "all those activities which seek to upgrade damaged land or to recreate land that has been destroyed and to bring it back into beneficial use, in a form in which the biological potential is restored" (pp 7). The Society for Ecological Restoration, the non-profit organization that publishes the peer-reviewed journal *Restoration Ecology*, also promotes a broader definition, describing restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed," and noting that full recovery may not always be possible or even desirable (Society for Ecological Restoration 2013).

Thus, from a research perspective, a broader definition is simply more practical. It is nearly impossible to assign investments and programs into distinct categories based on their relation to a highly context-specific natural state, particularly when programs are long-term and outcomes remain unknown. Rather than parse a specific definition of ecological restoration, existing economic impact studies typically define the scope of the restoration industry by the activities and programs that are included in and excluded from the analysis. The choice to exclude a particular activity, such as sustainable forest management, may hinge more on data availability than whether or not the activity constitutes restoration (*for example, see* Baker 2004). Similarly, the choice to include a particular activity, such as site remediation, might occur when the activity cannot easily be separated from a larger restoration project (*see* DOI 2011, Shropshire and Wagner 2009).

Similarly, the choice to include or exclude *conservation* activities as *restoration* is one for which there is no consensus. Restoration activities exist within the broader context of conservation when conserving an ecosystem or species hinges on restoring the remains of degraded habitat or populations (Hobbs and Harris 2001). Likewise, conservation activities become a necessary part of restoration when the trajectory of improved ecosystem health depends on its long-term protection. For the purposes of this study, restoration may include conservation activities such as the purchase of conservation easements, land acquisition, or transfer of water rights, when such investments are a part of the larger restoration effort.

Originating Demand for Restoration

A second major challenge to quantifying the economic and employment impacts of the restoration industry is that it is spread across a multitude of diverse actors. Many restoration projects result from interagency collaborations and public-private partnerships, so that tracking investments requires cross-referencing contracts and budgets from multiple sources (Nielsen-Pincus and Moseley 2010). Initial appropriations for the planning of large-scale restoration programs may occur decades before ground breaking on restoration projects begins.

We can first divide the origins of restoration demand into two pieces, public and private. The different investment and establishment phases of publicly funded restoration work can be further organized into three categories: origination, enablement, and implementation (which itself can be broken into numerous phases; e.g. BenDor, Riggsbee & Doyle (2011) delineate nine phases of restoration implementation). The originating phase involves developing a restoration program. In the public sector, this often occurs through legislation and budget appropriations. The enabling phase is the process by which agencies or organizations research alternatives, prioritize work, and allocate funding to specific projects. Finally, implementation is the phase in which on-the-ground work is carried out to complete the project. The size of the Restoration Economy can be roughly delineated by identifying the major public and private programs that originate demand for restoration.

Factors that create and originate demand include: (1) **regulatory drivers** that mandate or incentivize public and private investment in restoration to offset development activities, (2) **public procurement** of restoration through programs that contract directly with restoration providers, (3) **regional initiatives** that are enabled through a synthesis of legislation and partnerships at different levels of government, (4) **internal agency policies** that require or allow for regular agency activities to be carried out in a more sustainable or restorative manner, and (5) **private investments** by foundations, non-profits, corporations and institutions as a way to increase sustainability or meet corporate social responsibility goals. Each of these factors is discussed in greater detail below.

1. Regulatory Drivers

The primary drivers of restoration investments have long been believed to be federal and state statutes and regulations that require restoration as an offset for covered activities. Perhaps the most well known example is the federal government's *no-net-loss* policy for streams and wetlands. The policy was created under Section 404 of the Clean Water Act (CWA),[2] and requires mitigation to offset adverse and unavoidable impacts to aquatic resources. Compensatory mitigation may include "restoration… establishment (creation), enhancement, and/or in certain circumstances preservation";[3] however, restoration comprises the largest share, or over 40% of wetland mitigation activities (Madsen et al. 2010) and restoration and enhancement jointly comprise over 60% of stream mitigation activities (Environmental Law Institute 2007).

The demand for stream and wetland restoration has triggered the creation and growth of private mitigation banks - businesses that specialize in restoring and protecting aquatic resources. There are nearly 1,000 active and sold out mitigation banks nationwide (BenDor, Riggsbee & Doyle 2011, Madsen et al. 2011).[4] However, banks account for only 26% of all wetland and stream mitigation credits (Madsen et al. 2011). Permittee-responsible mitigation accounts for 67% of credits and In-Lieu Fee Funds account for 7%, suggesting that the actual quantity of wetland and stream mitigation is far greater than that reflected by the number of banks (Madsen et al. 2011). Altogether, compensatory mitigation investments total an estimated $1.3 to $4.0 billion annually (Madsen et al. 2010, Environmental Law Institute 2007).

Similarly, the Endangered Species Act (ESA)[5] has spurred the creation of endangered species credit banks, or conservation banks, through which threatened species' habitat is restored, protected, and managed. Under Section 7 of the ESA, federal agencies may not take actions that adversely impact designated critical habitat or jeopardize listed endangered species.[6] Federal

---

[2] 33 *U.S.C.* § 1344. Permits for Dredged or Fill Material.
[3] 33 *C.F.R.* § 332.2. U.S. Army.
[4] The federal mitigation banking database, RIBITS, does not yet incorporate data from all Army Corps of Engineers districts. National-level surveys conducted to supplement information from RIBITS identified 935 banks (Madsen et al. 2011) and 994 banks (BenDor, Riggsbee & Doyle 2011) in 2011.
[5] 16 *U.S.C.* § 1531 et seq. Endangered Species.
[6] 16 *U.S.C.* § 1536(a)(2))

agencies must consult with the U.S. Fish and Wildlife Service (FWS) to establish reasonable mitigation and enhancement measures, including habitat acquisition and improvement, to minimize the adverse effects on the species or critical habitat concerned.

The ESA also authorizes the FWS to issue permits for the incidental take of endangered and threatened species when a non-federal applicant documents steps to minimize and mitigate impacts.[7] Based on a review of take permits and habitat conservation plans approved between 2003 and 2006, the FWS invests an estimated $200.7 million per year in compensatory mitigation and requires permittees to invest an average of $370.3 million per year to fulfill mitigation obligations (Environmental Law Institute 2007).

Though agencies and private actors can mitigate impacts independently, FWS guidance (2003) formally allowed incidental take within a specified service area to be offset with credits purchased from a private conservation bank, beginning in 2003. Since then, the number of banks has risen steadily (Speciesbanking.com 2013). There are currently 117 active and sold out conservation banks in the U.S. (Speciesbanking.com 2013).

The ESA has also generated demand for riparian buffer restoration and in-stream water rights to restore and protect endangered aquatic species. While terrestrial habitat can generally be restored and protected as a unit of property, aquatic habitats are defined by the quantity, quality, and timing of water flowing through or into an area (Poff et al. 2007). The quantity and timing of flows can be altered through dams and diversion, changes to land cover in the watershed, and groundwater extraction, among other factors (Poff et al. 2007). Protection of endangered aquatic species therefore may require the restoration of flows through the dedication or purchase of water rights. Mitigation of aquatic habitat impacts may also require restoration of land in the watershed, in order to improve water quality and timing of flows. For example, the Columbia Basin Water Transactions Program was developed to mitigate impacts to endangered salmon and steelhead populations in the Pacific Northwest by investing in riparian buffers and the purchase of water rights (BPA 2004). Environmental water markets involved $22 million in transactions in 2011 alone, and have an estimated cumulative value of $227 million since 1986 (Bennett et al. 2013).

Regulatory requirements also create demand for restoration that occurs as a result of a Natural Resources Damage Assessment (NRDA). The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund)[8] and the Oil Pollution Act of 1990[9] authorize federal, state and tribal trustees to determine damages for injuries to natural resources resulting from an oil spill or the release of a hazardous substance. NRDA determines the level of compensation required from responsible parties in order to restore or replace the damaged natural resources. While the NRDA process uses appropriations to fund the management of the program, the restoration projects are funded by penalties from responsible parties. Between 2010 and 2013, restoration settlements averaged more than $150 million per year (DOI 2013).

Restoration is also driven by regulation at the state and local level. For example, Maryland's Forest Conservation Act requires reforestation or afforestation to offset clearing and land disturbance associated with large-scale land development.[10] Over 20,000 acres were reforested and afforested during the first 15 years of the FCA (Maryland Department of Natural Resources 2010). In North Carolina, the Riparian Buffer Protection Program requires mitigation for impacts to protected buffers adjacent to all intermittent streams, perennial streams, lakes, ponds, estuaries and modified natural streams in designated river basins and watersheds.[11] Mitigation may occur through on-site or off-site restoration, payments into a state Riparian Buffer Restoration Fund, or

---

[7] 16 *U.S.C.* § 1539(a)(2)(B))
[8] *42 U.S.C.* § 9601–9675
[9] *33 U.S.C.* § 2701–2720
[10] *Maryland Code* § 08.19 Forest Conservation. (1992)
[11] *North Carolina G.S.* § 143-214.20. Riparian Buffer Protection Program.

donation of real-property containing degraded riparian habitat. Between 2005 and 2010, compensatory mitigation under this regulation resulted in a net increase of 130 acres of forested riparian buffers despite more than 2,000 project impacts in the same period (Hill et al. 2012).

Though not a compensatory mitigation program, California's Global Warming Solutions Act (AB 32) enables businesses to use carbon offsets to cover up to 8% of carbon emissions reduction requirements.[12] This has generated demand for carbon offsets, which can be met through a variety of project types including restorative forestry. Currently, six reforestation projects and 30 improved forest management projects are listed for sale on the reserve (Climate Action Reserve 2013(a)). The Forestland Group Champion Property is the largest registered improved forest management project, encompassing over 100,000 acres in the Adirondack Mountains (Climate Action Reserve 2013(b)). Additionally, the Garcia River Forest is one of the larger conservation-based forest management projects registered, ensuring sustainable forest management practices on over 23,000 acres in California (Climate Action Reserve 2013(c)). Demand for offset projects is expected to grow as the coverage of carbon emissions reduction requirements expands to more industries and agencies in the state (Nichols 2009).

2. *Public Procurement*

A second major driver of restoration activity is the direct public procurement of restoration services. The 2009 American Recovery and Reinvestment Act (ARRA) allocated $167 million to the National Oceanic and Atmospheric Association (NOAA) to administer grants to 50 habitat restoration projects in 22 states and 2 U.S. territories (Edwards 2012). State and local resource management agencies, NGOs and other entities proposed projects to receive the funding, and NOAA awarded funds to high priority, "shovel-ready" projects with the potential to maximize both job creation and ecological benefits. Projects included dam removal, fish passage, marine debris removal, and habitat restoration and protection.

The U.S. Department of Agriculture (USDA) oversees multiple programs that provide direct payments to agricultural operators, forest managers, and tribal organizations willing to engage in restoration and conservation activities. These programs include:

- the Conservation Reserve Program (CRP) and Grassland Reserve Program (GRP) administered by the Farm Service Agency;
- the Environmental Quality Improvement Program (EQIP), the Wetlands Reserve Program (WRP) and the Conservation Stewardship Program (CSP) administered by the Natural Resources Conservation Service;
- the Healthy Forests Reserve Program (HFRP) administered by the Forest Service; and
- the Wildlife Habitat Improvement Program (WHIP) administered jointly by NRCS and FWS.

These programs receive funding through farm bill appropriations, thus while appropriations tend to be large, the scale of investments is subject to change regularly (Baker 2004).

The Department of the Interior provides grants for the procurement of restoration services on other lands. Grant programs include:

- National Coastal Wetlands Conservation Grants;
- Landowner Incentive Program grants and technical assistance;
- Cooperative Endangered Species Conservation Fund grants;
- State Wildlife Grants; and
- Sport Fish Restoration grants, administered by FWS and state partners.

Interior also procures restoration services on the public lands it manages, which cover 20% of the land area of the U.S. (DOI 2012). Public lands restored and managed by the Interior include 21

[12] *California Code of Reg.* Title 17 Subchapter 10. Climate Change, Article 5 § 95854 (2013).

former military bases, consisting of over one million acres, now part of the national wildlife refuge system (Doyle et al. 2008).

Many restoration projects involve partnerships between federal, state, and local agencies, as well as the private sector such that federal investments only constitute a portion of the overall project budget. For example, Section 320 of the Clean Water Act established the National Estuary Program, administered by the U.S. Environmental Protection Agency (EPA), to fund projects to protect and restore the health of estuaries.[13] Between 2003 and 2011, EPA provided $190 million in grants under this program and leveraged an additional $2.9 billion from partner organizations, of which 13% was directly invested in restoration (EPA 2013). The program currently assists with restoration planning and implementation activities in 28 estuaries nationwide.

At the state and local level, public procurement of restoration services is typically funded by bond measures. Since 2010, voters have approved over $3 billion in bonds for conservation across the U.S. (Trust for Public Land 2005). More than 76% of all conservation bond measures proposed since 2010 have passed, indicating widespread public support for restoration and conservation investments.

3. Regional Initiatives

Restoration is also driven by long-term regional initiatives, enabled through coordinated regulatory requirements and direct expenditures at varying levels of government. Regional initiatives are distinguished from other demand factors by a layering of multiple regulations that enable agency partnerships focused on a single geographic area.

For example, the Chesapeake Bay Program was initiated in 1983 to restore water quality and living resources to the Bay.[14] Like many regional initiatives, the Chesapeake Bay Program is funded through Water Resources Development Act (WRDA) appropriations, but coordinates efforts and resources with other restoration and compliance programs, including the CWA and EQIP. The 2008 Farm Bill[15] allocated $23 million of EQIP funding to the Chesapeake to address the water quality problems resulting from agricultural runoff, and created the Chesapeake Bay Watershed Initiative to direct an additional $188 million to purchase restoration and conservation measures upstream of the Bay (USDA 2009). The Program has also had to adapt over time as new regulations have been layered onto the region, including a total-maximum daily load (TMDL) that will require state and local jurisdictions in the watershed to increase land restoration and conservation by 2025 (Chesapeake Bay Commission 2013).

The Coastal Protection and Restoration Program in Louisiana is another long-term, regional initiative funded in part by WRDA and administered by partnership of multiple federal and state agencies. The program was established by the 1990 Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) to identify, prepare, and fund construction of restoration. The annual CWPPRA budget ranges from $30 million to $80 million per year, and has funded over 150 coastal restoration and protection projects to-date (USGS 2013). The Coastal Protection and Restoration Authority (CPRA), the state agency established to oversee and direct CWPPRA funds, is also charged with developing Coastal Master Plans every 5 years. While the primary goal of the Master Plan is flood protection, many of the improvements make use of green infrastructure solutions, including marsh creation, sediment diversion, and wetland restoration (CPRA 2012). The 2012 Louisiana Coastal Master Plan anticipates adding another $50 billion in investments on the Louisiana Gulf Coast over the next 50 years with funding from WRDA appropriations, the federal Coastal Impact Assistance Program, and penalties from the Deepwater Horizon Oil Spill (CPRA 2012).

---

[13] 33 *U.S.C.* § 1330. National Estuary Program.

[14] 33 *U.S.C.* § 1267. Chesapeake Bay.

[15] *Pub.L.* 110-234. Food, Conservation, and Energy Act of 2008. May 22, 2008.

Other large-scale regional restoration initiatives include the Comprehensive Everglades Restoration Project, the Northeast Coastal Region Ecosystem Restoration Program, the Bay Delta Conservation Plan, and the Great Lakes Restoration Initiative; among others (*see* Appendix).

4. Internal Agency Policies

A fourth source of demand for restoration projects involves internal agency policies that require or allow for regular agency operations to include restoration activities. Some of these agency policies are designed to ensure compliance with existing federal environmental laws; others are designed to provide for greater sustainability within the constraints of existing programs.

Stewardship End Result Contracting was initiated in 1998 to pilot the idea of exchanging forest products for ecological restoration services.[16] The policy allows the U.S. Forest Service and the Bureau of Land Management to contract with timber companies to restore or maintain water quality, promote healthy forest stands, reduce fire hazards, and restore and maintain wildlife and fish habitat in exchange for the right to sustainably harvest timber on public lands. In contrast to traditional forestry contracts, which separate timber sales from service procurement, stewardship contracting allows for the exchange of goods for services, while ensuring that services would help the agencies meet sustainability goals.

Similarly, Department of Defense (DOD) policy has evolved over past decades to encourage greater attention to sensitive natural resources on military installations and sites. In 1994, an internal ecosystem management policy was established requiring military installations to use ecosystem management to restore ecological associations, structures, and functions and biological diversity. This policy was followed in 1996 by the DOD's Environmental Conservation Program which aimed to maintain or restore ecosystems and populations of all native species (Ripley 2008). Since then, DOD has transferred 21 remediated bases to the FWS for habitat management (Doyle et al. 2008) and managed habitat for nearly 425 Federally-listed species and over 500 at-risk species on active installations (DOD 2012). In 2011 alone, the DOD invested $2.1 billion in environmental restoration, $394.7 million in conservation, and $395 million in natural and cultural resources protection (DOD 2012).

5. Private Investments

Philanthropic, non-profit, corporate and institutional investments also generate demand for restoration activities. A 2013 study conducted for the National Fish and Wildlife Foundation (NFWF) found that private investments in conservation and restoration-related activities amounted to over $4.3 billion in 2012 (Southwick Associates 2013). The study tabulated tax return data for non-profit organizations receiving exemptions for listing as *Natural Resources Conservation and Protection* and *Wildlife Preservation and Protection* entities. Though the estimate includes expenditures for both conservation and restoration activities, it provides a preliminary estimate of the total value of private, charitable restoration investments.

Many of these charitable contributions are mission-driven. The River Network, an association of nearly 2,000 different non-profit and grassroots organizations, awarded more than $150,000 in grants for restoration projects in 2011 (River Network 2011). Of the Network income in 2011, 23% came from corporate donors, 37% from foundation grants, 10% from individual donations, and only 9% from public sources (River Network 2011). The Coastal America Foundation, which manages grant funds for the Corporate Wetlands Restoration Partnership, provided $290,000 in restoration grants in 2011 (Coastal America Foundation 2011). These investments are made for a wide variety of reasons, from a desire to meet corporate social responsibility goals or build positive relationships with federal enforcement agencies (NFWF 2013). Some farmers and ranchers view restoration as a sustainable business practice, whereby

[16] 16 *U.S.C.* § 2104 Note. Forest Health Protection.

restoring and managing their natural resources enables the long-term productivity of their operations. The National Cattlemen's Beef Association annually recognizes ranchers who voluntarily engage in outstanding wildlife habitat enhancement and environmental protection practices (Environmental Stewardship 2013).

Private investments may also occur for-profit. Private equity firms are investing institutional funds in wetland restoration, with the expectation of returns from the sale of mitigation credits (PEI 2012). Private forest owners may opt to undergo an improved forest management project in order to sell offsets on the California carbon exchange (Climate Action Reserve 2013(d)). Property owners in Philadelphia may choose to revert impervious parking lots to bio-swales planted with native species in order to reap the benefits of a lower tax assessment (Valderrama et al. 2013). These types of private investments rely on incentives generated through other demand factors; wetland restoration is profitable because of the Clean Water Act, which requires mitigation for losses of aquatic resources. California's offset market is driven by AB32 regulations while Philadelphia's green infrastructure investments are driven by the City's tax policy. The Philadelphia policy, in turn, is driven by the City's need to comply with its Clean Water Act TMDL – a regulatory driver. No single demand factor described above operates independently of the others and it is the linkages between these factors that make the restoration industry so complex.

Quantifying the Economic Benefits, Impacts, and Contributions of Restoration

A broad review of the literature was conducted in order to understand the current status of knowledge on the restoration industry in the United States. The existing literature can be organized into two general categories: (1) economic benefits studies and (2) economic impacts and contributions studies. Economic benefits studies, also known as cost-benefit analyses, examine the net economic benefit, including market and non-market value, of restoration activities. Economic impacts and contributions studies describe how expenditures in a particular industry cycle through the economy and stimulate impacts in other industries. Many economic evaluations of restoration project proposals employ methods from both types of studies. However, it is important to note that benefits and contributions are different measures: the former focuses on the net value while the latter focuses on gross output and employment (DOI 2012).

The literature was also reviewed for information on the current size of the restoration industry. To-date, there are no estimates of size of the restoration industry at a national level. A handful of studies have estimated total investments or spending in a particular segment of restoration work, such as total annual investments made by the mitigation and conservation banking industry (Environmental Law Institute 2007). Industry studies were collected from a variety of other industries to supplement our assessment of best research practices and to provide context for estimates of the economic impacts of the restoration industry.

Economic Benefits of Restoration

The long-term benefits associated with restoration are well-documented, and include increased property values and local tax revenue (Isley, Isley and Hause 2011, Bark et al. 2009, Acharya and Bennett 2001, Kiel and Zabel 2001), increased revenues associated with tourism and outdoor recreation (Isley, Isley and Hause 2011, McCormick et al 2010), increased fish and game revenues (Kroeger 2012, McCormick et al 2010, Kruze and Scholz 2006), and avoided costs associated with improved ecosystem services (see Table 1 *below*). Because environmental assets tend to provide positive externalities and services for which there is no market, traditional price-based approaches cannot be used to assess their value (Barbier 2007). The primary methods used to estimate the value of these benefits include: stated preference approaches, such as contingent valuation, which surveys the willingness to pay for a particular benefits; and revealed preference approaches, such as travel-cost modeling or hedonic pricing, which assess the actual amount paid for a benefit or its proxy (Pascual and Muradian 2010).

Table 1. Long-Term Economic Benefits of Environmental Restoration

Benefit	Source
Aesthetics	
Increased property values	*Isley, Isley and Hause 2011, Bark et al. 2009, Kiel and Zabel 2001*
Increased tourism	*Isley, Isley and Hause 2011, McCormick et al 2010*
Recreation	
Boating, swimming, water sports	*Carson and Mitchell 1993*
Park visitation	*McCormick et al 2010*
Fish and Game	
Fishery enhancement	*Kroeger 2012, Barbier 2007, Kruze and Scholz 2006*
Wildlife enhancement	*Vickerman 2013*
Ecosystem Services	
Erosion Control	*Kroeger 2012*
Stormwater Management	*Valderrama et al. 2013*
Groundwater Recharge	*McCormick et al 2010*
Surface water availability	*Mueller et al. 2013, Milon and Scrogin 2006*
Water quality	*Vickerman 2013, Kroeger 2012, Milon and Scrogin 2006*
Flood Control	*Kroeger 2012, Barbier 2007, Milon and Scrogin 2006*
Carbon sequestration	*Vickerman 2013, Weinerman, Buckley and Reich 2012*

Intact and restored environmental resources have an aesthetic value for which there is higher demand than for degraded resources. Numerous studies have estimated the marginal increase in property value attributable to restoration by the willingness to pay for a property nearer a restored environmental asset. For example, in a meta-analysis of both naturally occuring and man-made wetlands around the world, Ghermandi et al. (2010) used a regression model to analyze 418 observations from 170 valuation studies, finding that human made wetlands create high values for biodiversity enhancement, water quality improvement, and flood control. Along these lines, Kaza and BenDor (2013) found that parcels over 0.5 mi from wetland restoration sites gain substantial amenity value. Additionally, contingent valuation study of residential properties on Muskegon Lake, in the Great Lakes region, estimated an $11.9 million increase in residential property values for all homes within 100 to 800 feet of the restored shoreline (Isely, Isely and Hause 2011). Similarly, a hedonic house price model was used to estimate the willingness to pay for single family homes near two Superfund sites in Massachusetts before and after discovery of contamination (Kiel and Zabel 2001). The study found the aggregate home price value of cleaning up the sites would be $72 million and $122 million respectively.

Enhanced natural aesthetics from restored ecosystems also attract outdoor recreation enthusiasts and tourists. The Muskegon Lake study used a travel cost survey to predict that half of local residents would visit the Lake at least one additional time each year after shoreline restoration was completed, resulting in a local recreation benefit of $2.7 million per year (Isely, Isely and Hause 2011). A predicted 2% increase in recreation and park visits resulting from the Comprehensive Everglades Restoration Program will add an estimated $1.3 billion in benefits over the next 50 years (McCormick et al 2010).

Often the intent of environmental restoration is to improve specific ecosystem services, such as groundwater recharge or flood control that have long-term cost savings compared to conventional infrastructure solutions. These *green infrastructure* assets mature slowly over time, as trees take root, soil and shorelines stabilize, and wildlife populations recover, and are therefore associated with greater uncertainty and risk (Talberth et al. 2013, Barbier 2007). However, environmental restoration is increasingly seen as a viable and sustainable way to avoid the costs of conventional infrastructure construction and maintenance.

These benefits are typically assessed using a cost-based approach, by which the avoided costs of conventional infrastructure or the mitigation costs of a loss of ecosystem services are translated to the value of the environmental asset (Pascual and Muradian 2010). The Fisher Slough tidal marsh restoration project in Skagit County, Washington, restored 60 acres of tidal marsh and 15 miles of streams to simultaneously provide improved salmon spawning habitat and increased flood storage capacity. These dual-benefits are expected to provide between $9.1 and $20.7 million in cost-savings over the next 50 years (Weinerman, Buckley and Reich 2012). Thus, the net value of the restoration project can be thought of as the expected difference between expected cost savings and implementation cost.

Similarly, one of the primary goals of the Comprehensive Everglades Restoration Project (CERP) is to improve water quality and avoid energy costs associated with drinking water treatment. Currently, brackish drinking water in the South Florida Water Management District is treated through a capital- and energy-intensive reverse osmosis process. By restoring freshwater flows, the restoration project intends to flush brackish water further downstream, recharge groundwater aquifers with freshwater, and reduce water treatment costs by at least $13.5 billion over the next 50 years (McCormick et al. 2010).

Pascual and Muradian (2010) provide an incredibly detailed review of over 150 studies on the valuation of environmental assets. This extensive literature shows that there is a growing consensus that environmental restoration can provide long-term benefits to property owners and businesses, increased tourism and recreation activity, increased yields for fisheries, and cost savings for local governments and state and federal agencies.

Economic Impacts and Contributions of Restoration

Restoration investments also have a short-term economic and employment stimulus, which can be measured through economic impact and contributions analyses. The stimulating effects of increases in spending, in any industry as well as in the public sector, are the result of interdependencies among industries, whereby changes in demand in one industry can have ripple effects for suppliers and related businesses. Multiplier effects occur at three levels:

- *Direct* economic effects are changes in economic activity resulting from the initial investment in the focal industry. Effects can be measured as changes in output, earnings, or employment.
- *Indirect* effects are the secondary effects resulting from changes in demand within other industries in the geographic region due to increases or decreases in input purchases from suppliers.
- *Induced* effects represent the changes in economic activity resulting from household spending by workers employed by directly affected businesses as well as suppliers (BEA 2012).

The sum of these three effects represents the total impacts within a regional, state, or national economy.

Multipliers are frequently used by government agencies and industry groups to calculate the direct, indirect, and induced effects of new projects on a state or local economy (BEA 2012). These economic **impact analyses** describe the marginal economic impacts of changes in investment levels. **Contributions analyses** use multipliers to estimate the portion of a region's economy that is attributable to an existing industry or program (IMPLAN Group LLC 2012). Industry groups often use contributions analyses to illustrate the scale of a particular industry at a national level. Recent industry studies taking this approach include the oil and gas industry (PricewaterhouseCoopers 2011), the private forestry industry (F2M 2009), the green building and construction industry (USGBC 2009), the environmental protection industry (Bezdek, Wendling, and DiPerna 2008), and the outdoor active recreation industry (Southwick Associates, Inc. 2007), among others.

Economic and Employment Multipliers

Total demand multipliers calculate the amount of output, earnings, or employment in various industrial categories attributable to a capital investment in one or more related industries (BEA 2012). For example, an output multiplier of 2.5 would mean that for a $1 million investment in a given industry, all related industries experience a combined total of $2.5 million in increased output.

Direct effect multipliers calculate the amount of earnings or employment in related industries that are attributable to an increase in earnings or employment in the focal industry (BEA 2012). If an investment in a textile factory increases employment in the textile industry by 50 jobs, a direct effect employment multiplier could be used to determine the increase in jobs outside of the textile industry. Generally, household multipliers are used to calculate induced effects (BEA 2012), though regression-based methods can also be used (Pollin et al. 2008).

The Regional Input-Output Modeling System (RIMS), which was developed by the Bureau of Economic Analysis in the 1970s, provides multipliers representing over 400 different industries based on the North American Industry Classification System (NAICS). RIMS also provides weights or "location quotients" for different localities and regions, to represent the relative ability of the local economy to support or supply a given industrial category. Impact Analysis for Planning (IMPLAN) is a similar input-output model that provides multipliers for different industries and geographic areas in the U.S. (MIG, Inc. 2012). Multiplier terminology, as described above, varies within each of these modeling systems, but the concept and outputs are the same.

Because restoration is not limited to any single industry, but rather a mixture of industries, assessing the direct, indirect and induced effects requires constructing a custom input-output model by weighting multipliers from multiple industries by their relative contribution to the restoration program or project of interest. Our review has determined that most of the analyses of the ecological restoration sector are articulated as case studies, particularly around specific geographic areas.

Case Studies of the Restoration Industry

Baker (2004) was the first to use economic multipliers to estimate impacts specific to the restoration industry. Baker collected information on all public grants and contracts for restoration project implementation, watershed assessments and sediment inventories in Humboldt County, California between 1995 and 2002. Economic multipliers for farm, forestry and fishing products from the RIMS II input-output model were then applied to the total spent on each type of work to estimate the overall value-added. Direct employment estimates were based on a survey of the businesses and non-profits engaged in local restoration work. Direct-effect employment multipliers from RIMS II were applied to the employment figures to estimate indirect and induced employment effects. Baker estimated that the restoration industry directly supported 160 full time, private-sector jobs in Humboldt County in 2002, and indirectly supported 270-480 private sector jobs, 37 public sector jobs and 11 tribal jobs. In addition, spending on restoration projects resulted in over $29 million in value-added to the County's economy.

Shropshire and Wagner (2009) expanded this methodology to the state level in an assessment of Montana's restoration industry. Rather than attempting to tally every restoration project in the state and calculate total output and employment effects, the authors used a single mine remediation and riparian restoration project, representative of restoration projects in the state, to calculate multipliers that could be used to estimate impacts from other projects. Industries comprising the restoration composite model included construction, engineering services, government oversight, rail and truck transportation, legal and accounting services, hazardous waste handling, forestry support activities, and more.

Using IMPLAN, the authors estimated that 10.97 jobs were directly attributable to a $1 million investment in the restoration project. The total number of direct, indirect, and induced jobs attributable to a $1 million investment was 31.5, meaning the project had an employment multiplier of 2.87. Similarly, the authors found an overall output multiplier of 2.59, such that the state economy added an estimated $2.59 million in value per $1 million invested.

This study was followed in 2010 by an assessment of Oregon's restoration industry (Nielsen-Pincus and Moseley 2010). The authors used a stratified sample of 99 Oregon Watershed Enhancement Board grants to create input-output models for a variety of restoration project types, including in-stream, riparian, wetland, upland, and fish passage restoration as well as for four different types of contracts. Employment multipliers were found to vary widely (from 1.3 to 3.3) depending on the type of contract; labor-intensive contracts were found to have lower employment multipliers because the bulk of employment effects occurred as a direct result of the contract. Output multipliers ranged from 1.4 to 2.4 depending on the type of work performed, with the greatest benefits to trade in fuel, wood products, rock, metal, and other building and landscaping products. The number of jobs supported by restoration activities also varied by project type, from an estimated 14.7 jobs per $1 million invested for in-stream restoration to 23.1 jobs per $1 million invested for riparian restoration. Employment multipliers ranged from 2.7 to 3.8 and output multipliers ranged from 1.9 to 2.4 for all project types (see Tables 2 and 3).

The Massachusetts Division of Ecological Restoration replicated these methods to estimate the economic impacts of four representative restoration projects on the state's economy (Industrial Economics 2012). Cost information was used to populate an IMPLAN model for each project type, including re-creation of a tidal creek/wetland system, wetland restoration (including dam removal), tidal wetland restoration, and dam removal. The number of jobs supported by these projects ranged from an estimated 9.9 per $1 million invested for wetland restoration (with dam removal) to 12.9 jobs per $1 million invested for tidal creek re-creation. Employment multipliers did not have much variation, ranging only from 1.59 to 1.78. Similarly, economic output multipliers ranged only from 1.68 to 1.83. The authors attributed the smaller economic impact of these restoration projects relative to those in Montana and Oregon to the lesser ability of Massachusetts to meet restoration industry demand in-state.

On an agency scale, the Department of the Interior estimated the economic impact of its own restoration investments by creating regional input-output models for a sample of nine restoration projects (DOI 2012). Contractors and program managers provided data on the labor, products and services used to implement each projects, and supplier and household impacts were estimated for the counties within commuting distance (60 miles) from the project site. There was a very wide variation in the local economic effects, ranging from 5.8 to 27.2 jobs per $1 million invested and $23,000 to $5.7 million in total output gained. However, project size ranged from several thousand dollars up to $25 million. Interior found that the impact of projects on local economies was most strongly affected by the type of restoration project, with some types of restoration requiring larger investments than others. However, the size and diversity of the local economy and the Interior's purchasing methods also affected the economic impact, suggesting that economic impacts are not comparable across different geographic scales. The Interior is currently conducting a more detailed survey of its projects to better understand this variation.

Similarly, NOAA used economic multipliers to assess the economic impacts of its coastal habitat restoration grant program, as funded through the American Recovery and Reinvestment Act (Edwards et al. 2013). Grant recipients were required to report restoration expenditures organized by NAICS codes. The authors used expenditure data from 44 sampled projects to create input-output models for six different project types, including marine debris removal, fish passage/dam removal, hydrologic reconnection, invasive species removal, oyster reef restoration, and riparian restoration. The number of direct, indirect and induced jobs supported by these projects ranged from 14.6 per $1 million invested for hydrologic reconnection to 33.3 per $1 million invested for invasive species removal. The employment multiplier for these projects was, on average, 1.48, while the economic output multiplier was 1.60.

Alternative Methods

Employment and output multipliers can only capture the static effects of a one-time investment or change, and are not accurate predictors of economic effects that occur over time (BEA 2012). Thus, Mather Economics (2012) took a slightly different approach to estimate the total employment effects in the Gulf Coast Region resulting from the RESTORE Act. The Act proposed a $25 billion investment in wetlands restoration projects over a 50 year time span. Rather than constructing a static input-output model (as occurred in previous studies), the authors used a federal spending multiplier to construct a regression model of labor demand that controlled for macroeconomic changes over time. Projections of incremental employment were calculated as the difference between the regression model and a baseline scenario. The model showed 129 employment years gained per $1 million invested, which is roughly equivalent to 29 jobs per $1 million with employment duration per job averaging 4.4 years. The largest employment effects occurred in transport, trade and utilities, followed by manufacturing.

Challenges to Scaling Up

The case studies reviewed above highlight a number of key challenges to scaling up the economic impact estimates to the national level in order to describe the size of the Restoration Economy and the number and types of jobs it supports. First, the direct, indirect and induced economic effects are highly variable at different geographic scales, across different geographic areas, and among different types of projects. Second, while the employment multipliers provide an estimate of the quantity of jobs created at a given level of investment, they do not describe job quality. We are unable to draw conclusions about the reliability, wages, and benefits of employment in the restoration industry from the direct, indirect and induced job figures. These issues were also raised by many of the case studies as shortcomings to our existing knowledge.

Variation in Estimates

The wide variation of employment effects and multipliers across these studies and others (*for example, see* Kroeger 2012, Fayanju 2012, Louisiana Workforce Commission 2011, Davis et al. 2011) is most strongly influenced by the type of restoration project evaluated, but is also affected by geographic location (Table 2).

Different regions in the U.S. have wide-ranging average costs for wetland and stream restoration projects, relating to different patterns and causes of ecosystem degradation, local topography and climate, and local and state regulatory environments (King and Bohlen 1995). States may have different compensation standards that affect labor costs, and rules governing collective bargaining and public procurement that can have large impacts on the shares of labor and equipment that are locally supplied (DOI 2012, King and Bohlen 1995). Shropshire and Wagner (2009) caution that employment multipliers from Montana should not be used for privately-funded restoration projects or projects in other states because the costs of government oversight are not comparable. Land prices and topography also influence cost; median costs for stream restoration are highest in the Southeastern U.S. compared to the rest of the nation (Sudduth et al. 2007), while wetland restoration costs were found to be significantly higher in California (King and Bohlen 1995).

Even within a particular geographic area, employment and economic impacts are likely to vary across different types of projects. In Oregon, the direct, indirect and induced employment effects of restoration varied from 14.7 to 23.1 jobs per $1 million invested depending on the type of ecosystem being restored (Neilson-Pincus and Moseley 2010). Edwards et al. (2013) found a broad range of employment effects from the six types of restoration projects evaluated. Invasive species control produced far more positive employment effects than any of the other restoration activities evaluated. Even among wetland restoration projects there is wide variation in the relative share of labor, materials and equipment inputs required, depending on the type of wetland (King and Bohlen 1995). Thus, the economic and employment multipliers for restoring a freshwater emergent wetland would not be applicable to a tidal marsh wetland, even in the same geographic region.

Finally, impact and contribution estimates are highly sensitive to the geographic scale at which impacts are measured. Some studies used county-level multipliers to estimate highly local impacts, while others used state-level multipliers. The state level multipliers are inherently larger because impacts that leak beyond the borders of any individual county or region are more likely to be captured by the state economy.

Table 2. Variation in Job Impact Estimates by Project Type and Geographic Scale

Type of Restoration	Jobs per $1 M Invested	Geographic Scale (State)	Source
Forest, Land and Watershed	39.7	National	*Garrett-Peltier and Pollin 2009*[17]
Invasive Species Removal	33.3	State	*Edwards et al. 2013*
Grassland	13.0	County	*derived from DOI 2012*
Upland	15.0	State (OR)	*Neilson-Pincus and Moseley 2010*
Wetland	6.8	County	*derived from DOI 2012*
Wetland	12.9	State (MA)	*Industrial Economics 2012*
Wetland	17.6	State (OR)	*Neilson-Pincus and Moseley 2010*
Wetland	29.0	State (LA)	*Fayanju 2012*
Tidal Marsh	7.1	County	*derived from DOI 2012*
Fish Passage	10.4	State (MA)	*Industrial Economics 2012*
Fish Passage	15.2	State (OR)	*Neilson-Pincus and Moseley 2010*
Fish Passage/Dam Removal	18.2	State	*Edwards 2013*
Dam Removal	10.3	State (MA)	*Industrial Economics 2012*
Dam Removal	20.5	State (CA)	*Kruse and Sholz 2006*
River	9.7	County	*derived from DOI 2012*
In-stream	14.7	State (OR)	*Neilson-Pincus and Moseley 2010*
In-stream	31.5	State (MT)	*Shropshire and Wagner 2009*
Hydrologic reconnection	14.6	State	*Edwards 2013*
Riparian	19.0	State	*Edwards 2013*
Riparian	23.1	State (OR)	*Neilson-Pincus and Moseley 2010*
Oyster Reef	16.6	State	*Edwards 2013*
Oyster Reef	20.5	County	*Kroeger 2012*

Job Quantity versus Quality

The higher employment effects for restoration projects compared to projects in other industries can be at least partially attributed to the highly localized nature of restoration work. Unlike industries that derive significant inputs from out-of-state or international imports, restoration tends to use local labor and materials. Shropshire and Wagner (2009) found that 90% of workers employed on the streamside restoration project came from the local Butte region, and 98% of the total earnings went to Butte region workers. Davis et al. (2011) found that a majority of federal restoration projects on Oregon's South Coast were awarded to in-state contractors and that 24% went directly to 26 contractors local to South Coast counties. Local employees and contractors are more likely to have local household spending practices, meaning induced employment effects are also likely to be local. In addition, most restoration projects require local inputs, such as native substrates and plants, which are more likely to come from the local region than external sources.

---

[17] These estimates come from Garrett-Peltier, Heidi and Pollin, Robert (2009) Job Creation per $1 Million Investment. Political Economy and Research Institute, University of Massachusetts. *In* Hurowitz, Glen. (2010) The jobs are in the trees. *Grist*. February 4, 2010. *Available at* http://grist.files.wordpress.com/2010/02/job_creation_for_investment_-_garrett-peltier.pdf. However, for the methodology used to derive the figures, reference Heintz, James, Pollin, Robert, and Garrett-Peltier, Heidi. (2009) How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth. Political Economy Research Institute, University of Massachusetts. January 2009.

However, it is also important to note that jobs per $1 million spent figures do not necessarily represent equivalent levels of compensation or job quality. Employment multipliers in the input-output models include full-time, part-time and temporary jobs, and are not based on measures of full-time employment (BEA 2012). The estimate provided by the input-output model is simply the annual average employment. As a result, employment effects from these models tend to overestimate full-time employment and to underestimate the total number of people employed for industries that employ more part-time and temporary workers. Restoration projects that rely heavily on construction labor are likely to fall into this category.

Several of the restoration case studies have incorporated job quality analyses to clarify how this shortcoming of input-output modeling affects restoration employment estimates. Shropshire and Wagner (2009) collected payroll data from the streamside tailings restoration project to analyze the average pay for each restoration job and found that the direct employment estimates from the IMPLAN model were only slightly higher than actual payroll data, though there was no way to compare indirect and induced employment estimates to actual values.

The authors also found that restoration wages for construction workers and six other work categories were higher than the state average. Unemployment records showed that a majority - 79% - of workers experienced unemployment for at least part of the year, but 73% also showed earnings from before and after working on the restoration project. About half of the workers also worked for other employers during the time they were employed on the restoration project. Overall, the majority of restoration jobs were temporary, but paid above-average wages compared to the state average.

Interviews with restoration contractors in Oregon confirmed that there is an inconsistent, largely seasonal demand for restoration work. Less than 50% of businesses surveyed earn the majority of their revenue from restoration work and over 80% percent experience seasonal fluctuations in employment (Ellison et al. 2010). Nevertheless, business owners also noted that restoration contracts have enabled them to diversify their businesses, retain workers and subcontractors, and invest in new skills and equipment (Davis et al. 2011).

Comparison to Other Industry Studies

Industry studies from a variety of other industries were collected and reviewed to supplement our assessment of best research practices, and to provide context for estimates of the economic contributions of the restoration industry. Industries reviewed included the oil and gas industry (PricewaterhouseCoopers 2011), the private forestry industry (F2M 2009), the green building and construction industry (USGBC 2009), the environmental protection industry (Bezdek, Wendling, and DiPerna 2008), and the outdoor active recreation industry (Southwick Associates, Inc. 2007), among others. All of the studies reviewed used an economic contributions analysis approach. However, several did not provide disaggregated data that would allow for the derivation of output and employment multipliers. In addition, several studies did not include induced effects in the total contributions estimates. Nevertheless, these studies provided a useful comparison for the preliminary estimates of restoration industry contributions.

The employment multipliers of restoration projects hold up in comparison to those of other industries, to the extent that these values can be compared. As the only existing estimates of restoration industry contributions are derived from state-level multipliers, they are not directly comparable to the national-level estimates of other industries. However, state-level multipliers account for leakage to areas outside of the state and are expected to be lower than national-level multipliers for the same types of work.

The American Petroleum Institute estimates that the oil and gas industry has an employment multiplier of approximately 3.0 at the national level (PricewaterhouseCoopers 2011) which falls within the range of employment multipliers found for all forest and watershed restoration projects at the state level, in Oregon (Nielsen-Pincus and Moseley 2010). Crop agriculture has a national employment multiplier of 2.33 while livestock has an employment multiplier of 3.34 (*derived from* Garrett-Peltier and Pollin 2009). The outdoor active recreation industry has an employment multiplier of 1.97 (*derived from* Southwick Associates 2012).

Overall, the employment multipliers within the restoration industry and in other industries are fairly comparable (Table 3). Lower employment multipliers for some types of restoration projects may be due to the large number of direct jobs involved in the restoration activity. Total employment effects may better represent the impact of these projects. Infrastructure investment studies conducted by the Political Economy Research Institute at the University of Massachusetts suggest that the employment effects of restoration projects may actually be greater than those in the oil and gas industry, which only supports about 5.3 jobs per $1 million invested (Pollin et al. 2009). In contrast, restoration industry literature has found total employment effects ranging from 10.4 to 39.7 jobs per $1 million invested. It is important to remember, however, that geographic scale and location also influences the magnitude of the multiplier effect, as described earlier, and that direct comparisons between values must be made with caution.

Table 3. Employment and Output Multipliers by Industry

Industry	Employment Multiplier	Output Multiplier	Geographic Scale	Source
Oil and Gas	~ 3	-	National	*PricewaterhouseCoopers 2011*
Crop Agriculture	2.33	-	National	*Garrett-Peltier and Pollin 2009*[18]
Livestock	3.34	-	National	*Garrett-Peltier and Pollin 2009**
Outdoor Recreation	1.97	-	National	*Southwick Associates 2012*
Conservation	3.4	2.4	National	*Southwick Associates 2013*
Restoration				
	1.48	1.60	State	*Edwards 2013*
	2.7 - 3.8	1.9 - 2.4	State	*Neilson-Pincus and Moseley 2010*
	1.59 - 1.78	1.68 - 1.83	State	*Industrial Economics 2012*
	2.87	2.59	State	*Shropshire and Wagner 2009*

These case studies demonstrate both the evidence for positive economic impacts resulting from restoration investments and the challenge of scaling up existing research to a national estimate of the size of the Restoration Economy. Investment in restoration projects stimulates growth and employment in other industries as it ripples through local and state economies. However, the evidence also indicates that the economic multipliers used to estimate these ripple effects are highly sensitive to the type of ecosystem undergoing restoration and the geographic scale of the economic analysis. Multipliers developed for the county, regional, or state level cannot be extrapolated up to larger geographic areas. Further research is needed to develop national economic multipliers for the restoration industry in order to understand the total impact that restoration investments have on the national economy.

[18]* These estimates come from Garrett-Peltier, Heidi and Pollin, Robert (2009) Job Creation per $1 Million Investment. Political Economy and Research Institute, University of Massachusetts. *In* Hurowitz, Glen. (2010) The jobs are in the trees. *Grist*. February 4, 2010. *Available at* http://grist.files.wordpress.com/2010/02/job_creation_for_investment_-_garrett-peltier.pdf. However, for the methodology used to derive the figures, reference Heintz, James, Pollin, Robert, and Garrett-Peltier, Heidi. (2009) How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth. Political Economy Research Institute, University of Massachusetts. January 2009.

Research Design

As indicated above, much of the existing research on the restoration industry has focused on estimating multiplier effects from specific projects, or by attempting to calculate the economic value of certain environmental assets. While these analyses are important, our goal is to study the restoration industry in its entirety on a national scale. Specifically we want to answer the following questions:

- What is the total output of economic activity generated on an annual basis by restoration industry?
- How many direct jobs are created annually through ecological restoration work?
- How many additional jobs are generated through multiplier effects due to direct restoration activities?
- What is the relative size of the restoration industry's distinct demand drivers (e.g. direct federal procurement versus regulatory induced restoration)? That is, how many jobs are leveraged in the private sector due to regulations like the Clean Water Act?

Our primary method to answer these questions will entail surveys of contractors and restoration companies that actually engage in restoration work. However, since the Restoration Economy is a nascent industry which is not neatly described by government industry accounting classification systems (e.g. NAICS codes), surveying firms engaged in restoration presents several challenges. First, since many of the contractors who actually carry out restoration work are in the construction and landscaping industries, we need to develop a method of breaking out how much of a given firm's annual sales stem from restoration compared to other construction work. Similarly, the environmental engineers and other high-skilled professionals who perform work on restoration projects may also spend a portion of their time on other projects.

Second, when we contact a survey respondent we need to make sure we are not double counting work that was generated by different demand drivers. For example, we wouldn't want to count work conducted under a Federal wetland restoration grant if the same work had already been included as part of a cost-sharing arrangement with a non-profit conservation group.

To develop our sampling strategy, we will segment the overall universe of restoration actors by the broad demand driver segments discussed above. These segments are 1) *regulatory drivers; 2) public procurement; 3) regional initiatives; 4) internal agency policies; and 5) private investments.* However, as discussed above, most restoration projects involve some combination of these factors. Due to the significant overlap between regulatory drivers and private sector investments, we will consider private philanthropic investments separately from private sector investments made to comply with regulatory requirements. In addition, internal agency policies will be captured by the public procurement segment of restoration. Restoration projects will be categorized as regional initiatives when there is a clear layering of programs, policies, and partnerships focused on a single geographic area. In other words, wetland restoration projects that occur in the Chesapeake will be categorized under the regional initiative segment rather than the regulatory driver segment because they are part of the larger Chesapeake Bay Program.

We have already developed a database on individual restoration projects, categorized by segment that includes 50 restoration programs and over 400 ongoing projects. Based on this initial research, we will develop lists of contractors, environmental professionals, and restoration companies (i.e. survey subjects) that have conducted work on projects within each of these 5 demand segments. We plan to spend the next several months developing this categorized sampling frame. Once developed, we will consider this segmented contact list the quasi "universe" of restoration actors.

A critical issue facing any survey research design is how to determine whether one has accurately accounted for the full universe, or population of subjects. As described above, the restoration industry is so new, that it is in some sense an unknown population. While it is impossible to know with 100 percent certainty the size of the true population (in any research situation), by segmenting the universe by demand driver and conducting an exhaustive search of programs across these segments, our research design is intended to produce as accurate an estimate as is currently possible. The determination of the overall size of the universe within each segment is critical because this is how we will determine the frequency weights to apply to actual set of sample respondents. (i.e. if we get a 10% response rate from a random set of respondents, we inflate each response by a factor of 10). Since there is inherent uncertainty as to the size of the population in each segment, we will conduct a sensitivity analysis by adjusting the assumed population size (i.e. if we think we developed a contact list that is only 80% of the true size, we inflate the population by 20%). Based on these adjustment factors, we will develop a range of estimates of the size of the restoration industry.

Survey Instrument

We will develop a unique survey instrument that will ask subjects a range of questions on their economic activities over the previous calendar year and specifically ask them about the level and type of restoration activities performed. The research team will work over the next three months to develop and refine the survey and will coordinate with other researchers, such as those at the University of Oregon who are engaged in a survey of public contractors only. However, at this time we know that we will ask questions that at a minimum allow us to observe or impute the following characteristics from each respondent:

- Annual sales across all work activities
- Share of annual sales derived from restoration work
- Client breakdown (i.e. do you work on projects funded by the private sector or public sector, or a combination).
- Years working on restoration
- Restoration work by type of restoration (e.g. wetlands, streams, endangered species protection, forest restoration, grassland restoration).
- Key input costs for restoration work (e.g. material purchases, capital expenditures, insurance)
- Number of employees, by broad category.
- Average payroll expenses per employee (a figure which will be compared to IMPLAN statistics).
- Firm characteristics/baseline information
    - NAICS code
    - Geographic area of work
    - Ownership structure

We will use the results of the survey to produce an estimate of the total sales (i.e. economic output) associated with the overall universe of the restoration industry for the nation as a whole. In a similar manner we will use the survey to provide the total direct employment estimate. We will use the information on labor costs and material purchases to estimate the multiplier effects associated with the restoration industry using a national IMPLAN model. Specifically, we will categorize respondents into closest-fit industries with existing NAICS codes and multipliers. Similarly the labor income figures are essential in determining the induced effects of spending by restoration employees.

Survey implementation

We will conduct the survey via a web-based survey system licensed by the University of North Carolina at Chapel Hill (Qualtrics). Our research team has access to survey design professionals to assist in the wording and construction of survey flow logic. The research team will then analyze the compiled results internally.

Conclusion

Based on a thorough review of the literature, it is clear that the U.S. has a highly active restoration industry, contributing growth and jobs to the national economy in the short-term as well as long-term value and cost-savings. Despite the commonly held idea that environmental regulations like the Clean Water Act and Endangered Species Act impede development, there is ample evidence that the public and private investments driven by these regulations have a stimulating effect on economic output and employment. Restoration investments appear to have particularly localized benefits, which can be attributed to the tendency for projects to employ local labor and materials (Weinerman, Buckley and Reich 2012, Davis et al. 2011, Shropshire and Wagner 2009). Though contractors and workers may experience seasonal and inter-annual fluctuations in income and employment, like their counterparts in the construction industry, preliminary evidence indicates that restoration jobs are well compensated in comparison to average wages (Shropshire and Wagner 2009).

Federal appropriations for restoration-related programs can be conservatively estimated at $2.5 billion per year (*see* Appendix: Restoration Program Database). Public and private investments linked to compensatory mitigation total an estimated $3.8 billion per year (Environmental Law Institute 2007), and non-profit investments in natural resources and wildlife preservation and protection are estimated to exceed $4.3 billion annually (Southwick Associates 2013). As demonstrated by the economic contributions literature, these large-scale restoration investments stimulate output and employment in a wide range of other industries, through supplier and household spending effects. However, due to variability in multiplier effects at different geographic scales, across different geographic areas, and among different types of projects, there are real challenges to scaling up contributions estimates to the national level. Further research is needed in order to understand the total size of the Restoration Economy, and the impact that restoration investments have on the national economy.

References

Baker, Mark (2004) Socioeconomic Characteristics of the Natural Resources Restoration System in Humboldt County, California. *Forest Community Research*. March 2004

Bark, R.H., D.E. Osgood, B.G. Colby, G. Katz, and J. Stromberg (2009) Habitat Preservation and Restoration: Do Homebuyers Have Preferences for Quality Habitat? *Ecological Economics* 68, no. 5 March 15, 2009: 1465–1475

Baxter, Marianne and King, Robert G. (1993) Fiscal Policy in General Equilibrium. *American Economic Review*, 83: 315–334.

BEA (2012) RIMS II: An essential tool for regional planners and developers.

BenDor, T. K., Riggsbee, J. A., & Doyle, M. (2011). Risk and Markets for Ecosystem Services. *Environmental science & technology*, *45*(24), 10322-10330.

Bennett, Genevieve, Carroll, Nathaniel and Hamilton, Katherine (2013) Charting New Waters: State of Watershed Payments 2012. Washington, DC: Forest Trends. *Available at* http://www.ecosystemmarketplace.com/reports/sowp2012

Bernhardt, E.S., Palmer, M.A., Allan, J.D., Alexander, G., Barnas, K., Brooks, S., Carr, J., Clayton, S., Dahm, C., Follstad-Shah, J., Galat, D., Gloss, S., Goodwin, P., Hart, D., Hassett, B., Jenkinson, R., Katz, S., Kondolf, G.M., Lake, P.S., Lave, R., Meyer, J.L., O'Donnell, T.K., Pagano, L., Powell, B. & Sudduth, E. (2005) Synthesizing U.S. River Restoration Efforts. *Science*, 308, 636–637.

Bezdek, Roger H., Wendling, Robert M., and DiPerna, Paula (2008) Environmental protection, the economy, and jobs: National and regional analyses. *Journal of Environmental Management*, 86: 63-79

Bezdek, Roger H. (1993) Environment & Economy: What's the Bottom Line? *Environment*, 35, no. 7: 6-32.

Bivens, Josh (2003) Updated Employment Multipliers for the U.S. Economy. *Economic Policy Institute*, no. 268. August 2003.

BLS (2013) Green Goods and Services Summary. *Economic News Release,* U.S. Bureau of Labor Statistics. March 19, 2013

BPA (2004) Columbia Basin Water Transactions Program: The Program. Bonneville Power Administration and National Fish and Wildlife Foundation. *Available at* http://www.cbwtp.org/jsp/cbwtp/program/history.jsp

Bradshaw, Anthony D. (2002) Introduction and Philosophy. In: *Handbook of Ecological Restoration, Volume 1*, Martin R. Perrow and Anthony J. Davy (Eds.), Cambridge University Press, Cambridge, UK.

Carson, Richard T., and Mitchell, Robert Cameron (1993) "The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable, and Swimmable Quality Water." *Water Resources Research* 29 (7): 2445–2454

Chapple, Karen, Cynthia Kroll, T. William Lester, and Sergio Montero (2011) "Innovation in the Green Economy: An Extension of the Regional Innovation System Model?" *Economic Development Quarterly* 25, no. 1 (February 1, 2011): 5–25.

Chinni, Dante. (2011) "Environment vs. Economy in 2012." 26 August 2011. *PBS Newshour*. http://www.pbs.org/newshour/rundown/2011/08/the-environment-vs-the-economy-in-2012.html

Climate Action Reserve (2013) (a) "Projects Registered." *Accessed on* June 4, 2013. https://thereserve2.apx.com/myModule/rpt/myrpt.asp?r=111

Climate Action Reserve (2013) (b) "Project Information." *Accessed on* October 10, 2013. https://thereserve2.apx.com/mymodule/reg/prjView.asp?id1=645

Climate Action Reserve (2013) (c) "Project Information." *Accessed on* October 10, 2013. https://thereserve2.apx.com/mymodule/reg/prjView.asp?id1=102

Climate Action Reserve (2013) (d) "Forest Project Protocol." *Accessed on* August 22, 2013 http://www.climateactionreserve.org/how/protocols/forest

Coastal America Foundation (2011) IRS Form 990. Available at http://www.coastalamericafoundation.org/homepage.html

Conservation Registry. (2013). The Conservation Registry. 2006-2013. http://www.conservationregistry.org. West Linn, OR.

CPRA (2012) Louisiana's Comprehensive Master Plan for a Sustainable Coast. March 21, 2012. *Available at* http://www.coastalmasterplan.louisiana.gov/2012-master-plan/final-master-plan

Cunningham, Storm (2002) *The Restoration Economy: The Greatest New Growth Frontier : Immediate and Emerging Opportunities for Businesses, Communities and Investors*. Berrett-Koehler Publishers.

Davis, Emily Jane, Sundstrom, Shiloh, and Moseley, Cassandra (2011) The Economic Impacts of Oregon's South Coast Restoration Industry. Ecosystem Workforce Program, University of Oregon. Working Paper no 34. Fall 2011.

DOD (2012) Fiscal Year 2011 Defense Environmental Programs: Annual Report to Congress. Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. November 2012.

DOD (2005) Defense Base Closure and Realignment Commission Report, 2, Appendix P: Environmental Restoration Costs for DoD's 33 Major Proposed Closures.

DOI (2013). Natural Resource Damage Assessment and Restoration Program Budget Justifications and Performance Information: Fiscal Year 2014. Department of the Interior. *Available at* http://www.doi.gov/budget/appropriations/2014/index.cfm

DOI (2012) DOI-related Ecosystem Restoration, Additional Case Studies and Information on Case Study Methods. In: *The Department of the Interior's Economic Contributions, FY 2011*. U.S. Department of the Interior, Office of Policy Analysis, Washington, DC.

Doyle, M.W., Stanley, E.H., Havlick, D.G., Kaiser, M.J., Steinbach, G., Graf, W.L., Galloway, G.E. & Riggsbee, J.A. (2008) Aging Infrastructure and Ecosystem Restoration. *Science*, 319, 286–287.

Edwards, P.E.T., A.E. Sutton-Grier, and G.E. Coyle (2012) Investing in Nature: Restoring Coastal Habitat Blue Infrastructure and Green Job Creation. *Marine Policy* 38 (March 2013): 65–71.

Ellison, Autumn, MacDonald, Fraser, Nielsen-Pincus, Max, and Moseley, Cassandra (2010) The Business of Restoration: A Profile of Restoration Contractors in Oregon. Ecosystem Workforce Program, University of Oregon. Working Paper no 23. Spring 2010.

Environmental Law Institute (2007) Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities. Environmental Law Institute. October 2007. *Available at* http://www.elistore.org/reports_detail.asp?ID=11248

Environmental Stewardship (2013) "Environmental Stewardship Program and Award." *Available at* http://www.environmentalstewardship.org/default.aspx

EPA. (2011). Grants Reporting and Tracking System. Version 2.0 - November 29, 2011. http://iaspub.epa.gov/pls/grts/f?p=110:199:0::NO::: Washington, D.C.

EPA (2013) "NEP Financing Strategies." *Accessed on* May 31, 2013. *Available at* http://water.epa.gov/type/oceb/nep/fund.cfm

EPA (2012) "Mitigation Banking Factsheet." *Accessed on* May 30, 2013. *Available at* http://water.epa.gov/lawsregs/guidance/wetlands/mitbanking.cfm

F2M (2009) The Economic Impact of Privately-Owned Forests. *Prepared for* National Alliance of Forest Owners. September 8, 2009. *Available at* www.grist.files.wordpress.com/2010/02/f2m_economic_impact_study_2009.pdf

Fayanju, Seyi (2010) Profiles in Restoration. Restoration and Resilience: Central Wetlands Unit. Environmental Defense Fund *Blogs*. *Available at* http://blogs.edf.org/restorationandresilience/category/central-wetlands-unit

FWS (2003) Guidance for the Establishment, Use, and Operation of Conservation Banks. May 2, 2003. *Available at* http://www.fws.gov/Endangered/pdfs/MemosLetters/conservation-banking.pdf

Garrett-Peltier, Heidi and Pollin, Robert (2009) Job Creation per $1 Million Investment. Political Economy and Research Institute, University of Massachusetts. *In* Hurowitz, Glen (2010) The jobs are in the trees. *Grist*. February 4, 2010. *Available at* http://grist.files.wordpress.com/2010/02/job_creation_for_investment_-_garrett-peltier.pdf

Ghermandi, A., van den Bergh, J.C.J.M., Brander, L.M., de Groot, H.L.F., Nunes, P.A.L.D., 2010. Values of natural and human-made wetlands: A meta-analysis. *Water Resouces Research* 46, W12516.

Goodstein, E.B. (1994) Jobs and the Environment: The Myth of a National Trade-Off. *Economic Policy Institute*, Washington, D.C.

Harding, J.S., Benfield, E.F., Bolstad, P.V., Helfman, G.S. & Jones, E.B.D. (1998) Stream biodiversity: The ghost of land use past. *Proceedings of the National Academy of Sciences*, 95, 14843–14847.

Heintz, James, Pollin, Robert, and Garrett-Peltier, Heidi. (2009) How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth. Political Economy Research Institute. January 2009.

Hemming, Richard, Kell, Michael and Mahfouz, Selma (2002) The Effectiveness of Fiscal Policy in Stimulating Economic Activity: A Review of the Literature. Washington, D.C.: International Monetary Fund

Hill, T., Mueller, A., Munoz, B., Dorney, J. (2012) Aquatic resources in NC: an examination of the spatial relationship between approved impacts and compensatory mitigation. NC Division of Water Quality, Raleigh.

Hobbs, R.J. & Norton, D.A. (1996) Towards a Conceptual Framework for Restoration Ecology. *Restoration Ecology*, 4, 93–110.

IMPLAN Group LLC (2012) "Estimating the Contribution of a Current Industry." *Available at* http://implan.com/V4/index.php?option=com_multicategories&view=article&id=201:impact-vs-contribution-analysis&Itemid=

Industrial Economics Inc. (2012) The Economic Impacts of Ecological Restoration in Massachusetts. *Prepared for* the Massachusetts Department of Fish and Game. March 2012

Isley, Paul, Isley, Elaine Sterrett, and Hause, Carrie (2011) Muskegon Lake Area of Concern Habitat Restoration Project: Socio-Economic Assessment. Grand Valley State University. December 2011.

Nikhil Kaza and Todd K. BenDor. 2013. Land Value Impacts of Wetland Restoration. *Journal of Environmental Management* 127:289-299.

Kiel, Katherine and Zabel, Jeffrey (2001) Estimating the Economic Benefits of Cleaning up Superfund Sites: The Case of Woburn, Massachusetts. *Journal of Real Estate Finance and Economics* 22:2/3, 163-184

King, D. and Bohlen, C. (1995) The Cost of Wetland Creation and Restoration. *Prepared for* the U.S. Department of Energy. Oak Ridge, TN. August 1995.

Kroeger, Timm (2012) Dollars and Sense: Economic Benefits and Impacts from two Oyster Reef Restoration Projects in the Northern Gulf of Mexico. The Nature Conservancy. May 2012.

Kruze, Sarah A. and Scholz, Astrid J. (2006) Preliminary Economic Assessment of Dam Removal: The Klamath River. EcoTrust. January 31, 2006.

Louisiana Workforce Commission (2011) Coastal Restoration Spending in Louisiana: Economic Impact Analysis. September 2011.

Madsen, Becca, Nathaniel Carroll, Daniel Kandy, and Genevieve Bennett (2011) Update: State of Biodiversity Markets. Washington, DC: Forest Trends. *Available at* http://www.ecosystemmarketplace.com/reports/2011_update_sbdm

Madsen, Becca, Carroll, Nathaniel, Moore Brands, Kelly (2010) State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide. *Available at* http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf

Maryland Department of Natural Resources (2010) "15-Year FCA Review - Revised." Publication no. 02-342009-378. *Available at* http://www.dnr.state.md.us/forests/programapps/newFCA.asp

Mather Economics (2012) Job Creation from Gulf Coast Wetlands Restoration. *Prepared for* the Walton Foundation. June 5, 2012

McCormick, Bobby, Clement, Robert, Fischer, Daniel, Lindsay, Matt, and Watson, Reed (2010) Measuring the Economic Benefits of America's Everglades Restoration. Prepared for the Everglades Foundation. Mather Economics.

MIG, Inc. IMPLAN System, 502 2nd Street, Suite 301, Hudson, WI 54016 www.implan.com

Mueller, Julie M., Wes Swaffar, Erik A. Nielsen, Abraham E. Springer, and Sharon Masek Lopez (2013) "Estimating the Value of Watershed Services Following Forest Restoration." *Water Resources Research* 49, no. 4: 1773–1781.

National Resources Council (1992) *Restoration of Aquatic Resources: Science, Technology and Public Policy*. Washington DC: National Academy Press.

Nichols, Mary D. (2009) "California's Climate Change Program: Lessons for the Nation." *UCLA Journal of Environmental Law & Policy*, Winter 2009. LegalTrac.

Nielsen-Pincus , Max and Moseley, Cassandra. (2010) Economic and Employment Impacts of Forest and Watershed Restoration in Oregon. Ecosystem Workforce Program, University of Oregon. Working Paper no 24. Spring 2010.

Niemi, Ernie, Fifield, Anne and Whitelaw, Ed (2001) Coping with Competition for Water: Irrigation, Economic Growth, and the Ecosystem in the Upper Klamath Basin. ECONorthwest. September 2001.

NFWF (2013) Corporate Partners. *Available at* http://www.nfwf.org/partnerships/corporate/Pages/corporatepartners.aspx

Outdoor Industry Foundation (2006) The Active Outdoor Recreation Economy. Fall 2006

Pascual, Unai and Muradian, Roldan (2010) The economics of valuing ecosystem services and biodiversity. *In* The Ecological and Economic Foundations. Simpson, David R. *Ed.* TEEB: March 2010. *Available at* http://www.teebweb.org/publications/teeb-study-reports/foundations

PEI (2012) "Ecosystem Investment Partners raises conservation fund." PEI Media Ltd. June 25, 2012. *Available at* www.ecosystempartners.com/uploads/EIPinPEI_June2012_1.pdf

Pociask, Steve and Fuhr, Joseph P. (2011) Progress Denied: A Study on the Potential Economic Impact of Permitting Challenges Facing Proposed Energy Projects. U.S. Chamber of Commerce. March 10, 2011. *Available at* http://www.projectnoproject.com/progress-denied-a-study-on-the-potential-economic-impact-of-permitting-challenges-facing-proposed-energy-projects

Poff, N. L., Allan, J. D., Bain, M. B., Karr, J. R., Prestegaard, K. L., Richter, B. D., … Stromberg, J. C. (1997). The Natural Flow Regime. *BioScience*, *47*(11), 769–784.

Pollin, Robert, Wicks-Lim, Jeannette, and Garrett-Peltier, Heidi. (2009) Green Prosperity: How Clean-Energy Policies Can Fight Poverty and Raise Living Standards in the United States. Political Economy Research Institute, University of Massachusetts. June 2009.

Pollin, Robert, Garrett-Peltier, Heidi, Heintz, James, and Scharber, Helen. (2008) Green Recovery: A Program to Create Good Jobs and State Building a Low-Carbon Economy. Political Economy Research Institute, University of Massachusetts. *Prepared for* the Center for American Progress. September 2008.

Price Waterhouse Coopers LLP (2011) The Economic Impacts of the Oil and Natural Gas Industry on the U.S. Economy in 2009: Employment, Labor Income and Value Added. *Prepared for* the American Petroleum Institute.

Ramey, Valerie (2011) Can Government Purchases Stimulate the Economy? University of California, San Diego and National Bureau of Economic Research. June 14, 2011

Renner, Michael (2000) Working for the Environment: A Growing Source of Jobs. Worldwatch Institute no. 152, September 2000: Washington, D.C.

Ripley, J. Douglas (2008) Legal and Policy Background. *In* Conserving Biodiversity on Military Lands: A Guide for Natural Resource Managers. NatureServe. *Available at* http://www.dodbiodiversity.org/ch3/index.html

River Network (2011) Annual Report. *Available at* http://www.rivernetwork.org/about-us

Seavy, N.E., Gardali, T., Golet, G.H., Griggs, F.T., Howell, C.A., Kelsey, R., Small, S.L., Viers, J.H. & Weigand, J.F. (2009) Why Climate Change Makes Riparian Restoration More Important than Ever: Recommendations for Practice and Research. *Ecological Restoration*, 27, 330–338.

Society for Ecological Restoration (2004) SER International Primer on Ecological Restoration. Society for Ecological Restoration, International Science & Policy Working Group, V2, October 2004. http://www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration

Shropshire, Robin and Wagner, Barbara. (2009) An Estimation of the Economic Impacts of Restoration in Montana. Research and Analysis Bureau, Montana Department of Labor and Industry. September 17, 2009

Southwick Associates, Inc. (2013) The Conservation Economy in America: Direct Investments and Economic Contributions. *Prepared for* National Fish and Wildlife Foundation. February 18, 2013.

Southwick Associates, Inc. (2012) The Economic Contributions of Outdoor Recreation: Technical Report on Methods and Findings. *Prepared for* Outdoor Industry Association. August 30, 2012.

Southwick Associates, Inc. (2007) State-Level Economic Contributions of Active Outdoor Recreation – Technical Report on Methods and Findings. *Prepared for* Outdoor Industry Foundation. April 13, 2007.

Speciesbanking.com (2013) United States – Banks. The Katoomba Group. *Accessed on* August 21, 2013. *Available at* http://speciesbanking.com

Stanley, E.H. & Doyle, M.W. (2003) Trading off: the ecological effects of dam removal. *Frontiers in Ecology and the Environment*, 1, 15–22.

Sudduth, Elizabeth B., Meyer, Judy L., and Bernhardt, Emily S. (2007) Stream Restoration Practices in the Southeastern United States. *Restoration Ecology*, 15, no. 3, 573–583

Talberth, J. Gray, E. Yonavjak, L. Gartner, T. (2013) Green versus Gray: Nature's Solutions to Infrastructure Demands. *Solutions.* Vol 4, No. 1. http://www.thesolutionsjournal.com/node/1241

Trust for Public Land (2005) LandVote Database. *Accessed on* July 30, 2013. *Available at* https://tpl.quickbase.com/db/bbqna2qct?a=dbpage&pageID=10

USDA (2009) Farm Bill Program Fact Sheets. Natural Resource Conservation Service. *Available at* http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/facts

USGBC (2009). U.S. Green Building Council Green Jobs Study. *Prepared by* Booz Allen Hamilton.

USGS (2013) "About CWPPRA." USGS National Wetlands Research Center. *Accessed on* June 4, 2013. *Available at* http://lacoast.gov/new/About/Default.aspx

Valderrama, Alisa., Levine, Lawrence., Bloomgarden, Eron., Bayon, Ricardo., Wachowicz, Kelly., and Kaiser, Charlotte (2013) Creating Clean Water Cash Flows: Developing Private Markets for Green Stormwater Infrastructure in Philadelphia. Natural Resources Defense Council. January 2013.

Vickerman, Sara (2013) Nature's Benefits: The Importance of Addressing Biodiversity in Ecosystem Service Programs. Defenders of Wildlife.

Walter, Milon, J. and Scrogin, David (2006) "Latent Preferences and Valuation of Wetland Ecosystem Restoration." *Ecological Economics* 56, no. 2. February 15, 2006: 162–175.

Weinerman, Michael, Mark Buckley and Sarah Reich (2012) Socioeconomic Benefits of the Fischer Slough Restoration Project. ECONorthwest. *Prepared for* the Nature Conservancy and the National Oceanic and Atmospheric Administration. November 2012.

Appendix: Restoration Program Database

Existing restoration databases tend to focus on either a particular type of restoration or a particular funding stream, and are not comprehensive enough for the purposes of estimating total investments in all restoration programs and projects nationwide. For example, the National River Restoration Science Synthesis (NRRSS) database is an extremely detailed compendium of more than 37,000 river restoration projects, but does not include other types of restoration projects (Bernhardt et al. 2005). The U.S. Environmental Protection Agency's Grants Reporting and Tracking System (GRTS) provides detailed information on restoration, conservation and management projects funded through Clean Water Act appropriations, but does not include projects funded by other sources or administered by other federal agencies (EPA 2011).

The Conservation Registry is a database containing over 110,000 spatially-referenced conservation, restoration and wildlife projects nationwide, and claims to be the most comprehensive repository of conservation project information (Conservation Registry 2013). The Registry tracks the primary motivation for undertaking each project, including climate change adaptation, conservation mission, carbon sequestration, financial incentive, mitigation, personal interest, profit, public benefit, and regulation. However, the Registry requires volunteer data entry, and is therefore biased toward projects implemented by organizations and agencies that value and dedicate time for such information sharing and project monitoring.

As existing databases are insufficient to sample for a perspective on the scale of the national restoration industry across multiple funding sources and types of projects, we created a new database to track restoration investments from their point of origin (regulation, appropriation, etc.) to the on-the-ground implementation. This appendix documents our methodology for populating the database as well as the methods used to analyze its contents.

Methods

A systematic online search was conducted for restoration programs within each federal agency that works on natural resource, water, fish and game, and infrastructure issues. Where programs were identified, an additional search was conducted to identify enabling legislation and appropriations, as well as specific projects carried out and funded by the program, when available. Following the methods of Bernhardt et al. (2005), no judgment was made regarding the outcomes or quality of the restoration program; programs were identified solely on the basis of name and goals. If the name and/or goals of the program included restoration goals, habitat enhancement/improvement goals, or conservation stewardship/management goals, it was included in the database.

Federal appropriations bills were used to identify federal investment associated with each program; however many programs are not specified within appropriations bills and are funded through general operations appropriations for various federal agencies. In such cases, approximate investment amounts were obtained from agency budgets and press releases. In addition to the enabling legislation, program names, demand drivers, and funding levels, information on the duration of the program or project was collected whenever possible. The database was also populated with the same fields for project information, when available. Only projects initiated after the year 2000 were included in order to reduce the database population effort.

The frequency of each demand driver was tallied at the program level. Summary statistics were calculated for the program appropriations for 2011, 2012, and 2013 when the most data was available. As many programs did not have a special appropriation associated with them, we also calculated the average funding level by dividing the total program budget by the program duration and used the average as a proxy for annual spending. Programs that were ongoing in 2012 were selected and summary statistics were calculated on the average annual budget figures. Though not directly comparable to one another, the average appropriation levels and average annual budget statistics can begin to suggest the economic scale of federal restoration initiatives.

Results

Our database contained 26 federal statutes that drive some form of ecological restoration. These statutes guided 119 restoration programs, which led to at least 312 restoration projects since 2000. Of the 119 programs, the majority (56%) involved public procurement of restoration services. There were also 31 regional initiatives, 18 regulatory-induced programs, and three internal agency policies. Budget information was only available for 44 programs, only 37% of the total, which likely reflects the lack of emphasis placed on providing cost information on restoration projects (Bernhardt et al. 2005). The average annual budget among the 41 programs with budget information that were ongoing in 2012 was $131 million with a standard deviation of $612 million. The large variance is due to the wide spread of the data, which ranged from $160,000 to $4.1 billion per year in restoration budgeted spending. Over 80% of the programs with budget information were public procurement programs, which were also the most frequent type of restoration program in our sample.

The appropriations data is also sparse, and thus highly variable. In 2011, of the six programs with special appropriations, the mean appropriation level was $167 million (*sd* = $139 million). The total value of all restoration-related appropriations in 2011 was $1 billion (**Figure A.1**). In 2012, there were 15 programs with special appropriations; the mean level was $166 million (*sd* = $309 million). The total value of all restoration-related appropriations was $2.5 billion. In 2013, only 8 restoration programs received appropriations, which had a total value of $2 billion. The mean appropriation level was $252 million (*sd* = $397 million).

Figure A.1. Total Restoration-Related Appropriations, 2011-2013