Taking Stock:

Payments for Forest Ecosystem Services in the United States

D. Evan Mercer*`§
David Cooley†
Katherine Hamilton‡

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* USDA Forest Service, Southern Research Station
† Nicholas Institute for Environmental Policy Solutions, Duke University
‡ Forest Trends' Ecosystem Marketplace
§ Corresponding author: emercer@fs.fed.us,

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Executive Summary

Forests provide a variety of critical services to human societies, including carbon sequestration, water purification, and habitat for millions of species. Because landowners have traditionally not been paid for the services their land provides to society, financial incentives are usually too low to sustain production of services at optimal levels. To remedy this, a variety of public and private schemes to provide direct payments to landowners have emerged as a strategy to preserve, protect, and restore these ecosystem services.

This report explores and catalogs payments for ecosystem services specifically from forests in the United States. The report focuses on the services of carbon sequestration, water quality regulation, and biodiversity habitat protection. In addition, the report examines payments for "bundled services," or payments made for a suite of services, such as wetland mitigation or the purchase of conservation easements. For each ecosystem service, we identify and quantify three general types of payments made to landowners: payments directly from the government; voluntary payments from businesses, individuals, and non-governmental organizations; and payments made to comply with government regulations, such as the Clean Water Act or the Endangered Species Act.

We collected data directly from buyers and sellers of forest-based ecosystem services in order to determine the gross revenues landowners received for the services they provide. In some cases, lack of available data precluded us from determining the total amount of revenues received by forest landowners. However, in these cases we still discuss the issues surrounding such payments, including important case studies and examples of these types of payments.

Total revenues from all payment sources for all of the services for which we had data equaled almost $1.9 billion in 2007. Because we lacked data on payments for some services, this figure represents a lower bound on the revenues from forest ecosystem service payments. The figure of $1.9 billion includes $365 million from government sources (19%), such as the Conservation Reserve Program, and $1.5 billion from non-governmental sources (81%), including payments for wetland mitigation, conservation easements, and carbon offsets. Payments from non-governmental sources were split roughly evenly between payments driven by compliance with regulation, including wetland mitigation and conservation banking, and voluntary payments, including the purchase of hunting leases and conservation easements. Each totaled more than $760 million and accounted for slightly more than 40% of all payments for forest-based ecosystem services.

Payments for carbon sequestration service were relatively low compared to payments for other services; purchases of voluntary carbon offsets in 2007 totaled $1.7 million. By contrast, payments for biodiversity totaled $509 million and payments for bundled services totaled $1.4 billion in 2007.

Unfortunately, very few landowners participate in these programs. For example, wetland mitigation accounted for 38% of all forest-based ecosystem service payments in 2007, but these payments were received by only about 173 private forest mitigation banks. Only 5.5% of family forest landowners report having ever received cost-share payments and only 1.8% have conservation easements on their property. This suggests that the economic and social forces that have led to forest fragmentation and loss in the US are so strong that PES payments have had a minimal impact on forest land use at the regional or national level. Although this report identifies some PES success stories in the US, changes in government and corporate policy will be critical for PES to result in large enough financial returns to effectively compete with development and other economic drivers of land use in the US to have a significant impact on the provision of forest-based ecosystem services.

1. Introduction

Covering almost one-third of the world's land area, forests provide a variety of ecosystem services crucial to sustaining human societies such as carbon sequestration, water purification, and habitat for millions of species (FAO 2001). Despite these services, forests continue to be cleared or degraded at a rapid rate. Twenty-five countries have completely cut down their primary forests, and another 29 countries have lost more than 90 percent of their forests. Nearly one-third of pre-European settlement forests in the United States have been cleared since the 1600's (Millennium Ecosystem Assessment 2006).

Efforts to preserve forests across the globe have included campaigns to establish national parks and private reserves, promote sustainable forest management for a wide range of goods and services (including timber, recreation/ecotourism, and pharmaceuticals), develop alternatives to slash and burn agriculture, and institute population control policies. However, the continued rate of deforestation and unsustainable use of forest resources suggests that additional efforts are needed. Traditionally, forest landowners have not been paid for providing ecosystem services beyond commodity production, resulting in many communities, industries, and individuals acting as if the services have no value. There has been a growing realization among policymakers and the general public of the importance of ecosystem services, including their significant economic value. This has lead to a search for policy solutions to realign the relationship between the private incentives and social benefits of forest conservation and management. "Payments for ecosystem services" (PES) are one means of connecting the value of the ecosystem services produced by forests to the returns landowners receive for managing their lands to enhance the production of those services (Jack, et al. 2008; Katoomba Group 2007; Wunder 2005).

What are Payments for Ecosystem Services?

Although considerable debate has roiled over how to define PES, the concept is quite simple: pay individuals or communities to manage their lands to conserve or increase the production of desired ecosystem services. More formally, combining the approaches of the Katoomba Group (2007) and Wunder (2005), we define PES as:

> Formal and informal contracts in which landowners are remunerated for managing their land to produce one or more ecosystem service; PES transactions must consist of actual payments between at least one willing buyer and one willing seller to produce or enhance a well defined ecosystem service or bundle of services.[1]

Under this definition, sellers include private individuals or corporate or other non-government landowners paid for managing their lands in a way likely to produce the ecosystem service(s). Buyers can be government agencies (federal, state, and local), non-government organizations, or private individuals and corporations. Transactions are defined as funds changing hands between two different entities.[2]

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[1] Wunder's original definition is narrower, including "A voluntary transaction where a well defined environmental service is being 'bought' by a service buyer from a service provider if and only if the service provider secures service provision." Katoomba Group's definition is slightly broader: Payments for Ecosystem Services (PES) are formal and informal contracts that place financial value on stewardship services - from one-on-one informal agreements to large-scale public systems that shift economic investments towards desirable land stewardship.

[2] Therefore, we do not include funding of government land management agencies or payments from one level of government to another as PES. Rather we interpret these to be transfers within one entity, "the government", and not market transactions that include private landowners.

Some US forest landowners are currently paid for a range of services, including climate amelioration/carbon sequestration, water quality, and biodiversity/wildlife habitat. With a few exceptions (carbon and biodiversity) most PES in the US are for managing land to produce a bundle of ecosystem services, rather than any single service (or the data don't allow determination of the specific service). For example, half of the federal government PES programs are directed at a wide range or bundle of services and the other half at biodiversity (see Appendix A) and the largest PES program, wetlands mitigation banking, pays for the entire range of services produced by wetlands. Likewise, the results of the Land Trust Alliance (2005) census of nearly 1,840 land trust organizations suggest that most conservation easements are intended to produce multiple services.

The practice of paying landowners for the services their lands provide to society has grown over the past decade. Numerous new PES initiatives have been implemented across the globe to preserve or increase the production of hydrological services, biodiversity conservation, and climate amelioration (Jack, et al. 2008; Munoz-Pina, et al. 2008; Pagiola 2008; Xu, et al. 2005; Ecosystem Marketplace 2008; Hamilton, et al. 2010; Madsen, et al. 2010a). While PES is often perceived as a recent policy solution, the US government has at least a quarter of a century of history of paying landowners to convert agricultural land to forests or to manage their forestlands for ecosystem services.

Large-scale government payments to land owners for land conservation in the US began with the creation of the Conservation Reserve Program (CRP) in the 1985 Farm Bill followed by the Wetlands Reserve Program (WRP), Forest Legacy Program (FLP), the Forest Stewardship Program (FLP), and the Stewardship Incentives Program (SIP) in the 1990 Farm Bill. The 1990 Farm Bill marked an important shift in the focus of government incentive programs for forest landowners from timber production to forest stewardship, conservation, and the production of ecosystem services. The 2008 Farm Bill established the following new national priorities for federal assistance for private forest conservation: conserve working forests, protect and restore forests, and enhance public benefits from private forests. The conservation title of the 2008 Farm Bill (Title II) also modified several agricultural conservation programs to include forestry practices on nonindustrial private forest lands including the Conservation Stewardship Program (CSP), Farmland Protection and Grassland Reserve (FPGR), and the Environmental Quality Incentives Program (EQIP). Currently there are at least 14 Federal payment programs that encourage private landowners to adopt stewardship practices to enhance ecosystem services through improved forest management, retention of lands in forest or undeveloped uses, protection of soil and water quality, enhancement and preservation of forested wetlands, and wildlife habitat improvement (Appendix A).

In addition to government funded programs, there are many privately funded PES programs in the US. Non-government conservation organizations, such as the Nature Conservancy, the Trust for Public Land, the Conservation Fund, and Ducks Unlimited have been paying forest landowners for decades (through the purchase of conservation easements) to conserve land to provide ecosystem services such as water quality protection and biodiversity habitat. In some cases these easements are driven particularly by specific environmental services and in other cases driven by broader conservation goals. There has also long been a thriving market of hunters purchasing the rights to access wildlife habitat and species through hunting leases with private landowners, especially in the US South.

Given this long experience with PES in the US, this paper aims to assess the state of forest-based PES policy in the US and the extent to which forest landowners in the US have been compensated for producing ecosystem services. We focus on actual payments to landowners to manage (or reforest) their forestlands to enhance the production or conservation of ecosystem services. It is important to emphasize that we are not attempting to determine the total value of the ecosystem services provided by US forests. Rather the intent is to examine the actual financial returns (revenues) landowners receive to provide ecosystem services, as these are the primary

economic incentives landowners face in deciding whether to include the production of ecosystem services in their land management decisions.[3]

2. Methodology and Data

While many observers agree on which services to include under the definition of PES, there is generally less agreement about which payment mechanisms to include. Some feel that PES should only include private market-based transactions; others also include government conservation payments as PES. We follow Engel, et al. (2008) and Jack, et al. (2008), who categorize PES as either "user-financed" or "third-party-financed." Third-party-financed programs are those in which a third party makes the payment on behalf of the users of the service. The third party in this case is typically a government entity, but it could also include payments made by an international body or an NGO on behalf of their donors. User-financed programs are those in which the actual users of the service make the payment. This could include the purchase of carbon credits to offset one's personal carbon footprint or the purchase of wetland or stream mitigation credits to offset the destruction of aquatic resources caused by development.

In this paper we use the following transaction typology to organize our assessment of payments for forest-based ecosystem services in the US:

1. *Public Payments.* These include payments from federal, state, and local government agencies to landowners to implement afforestation, reforestation, or forest management projects on their forestlands for the purpose of producing or enhancing ecosystem services.

2. *Voluntary Transactions.* Examples of voluntary transactions include the sales of forest carbon offset credits in the voluntary carbon market, purchase of hunting leases by private individuals, entrance fees for wildlife viewing and hunting, and the purchase of conservation easements by non-government organizations.

3. *Compliance-Driven Transactions.* These include markets and payment mechanisms developed in response to government regulation, such as water quality trading, wetland or stream mitigation banking, conservation banking, and carbon offset markets under regional cap-and-trade programs.

We examine the revenues generated from each of these payment mechanisms for individual ecosystem services (carbon sequestration and biodiversity habitat protection), as well as payments for bundled services. The following explains the data sources used to analyze revenues from each ecosystem service we examined. In some cases, the data used for this report came from the published literature. In all other cases, the data were obtained by directly contacting the relevant government agency, non-governmental organization, or private business. Due to the challenges of collecting data most of this information is based on the year 2007.

[3] Motivations for owning forest land vary among non industrial forest landowners, but most have multiple objectives. According to the US Forest Service National Woodland Owner Survey, more than half of private forest land owners primary motivations are beauty, scenery, passing land to heirs, privacy, nature protection. Thirty eight percent own land as investments and only 10 percent were motivated by timber production (Butler 2008).

2.1 Carbon

Data on forest-based carbon offsets in the US describe voluntary payments by non-governmental organizations and private businesses seeking to offset their carbon footprints. Although there is no federal compliance-based cap-and-trade system in the US, three regional programs have been recently established: the Regional Greenhouse Gas Initiative (RGGI), the Western Climate Initiative (WCI), and the Midwestern Regional Greenhouse Gas Reduction Program (MRP). However, as of this writing there have not yet been any trades of carbon offsets (forestry or otherwise) under any of the programs. Similarly, there are no public payment programs focused exclusively on carbon sequestration.

We obtained data on voluntary carbon offset payments directly from carbon offset retailers, aggregators, and purchasers. Appendix B provides a list of the organizations we identified as currently active in the US voluntary carbon market. All data from offset developers were obtained under assurances of confidentiality, so we report only figures that have been aggregated by state.

2.2 Water Quality

There are several types of watershed payments in the United States, including water quality trading, the purchase of conservation easements and government payments to land owners. A recent report, "State of Watershed Payments 2009" (Stanton, et al. 2010), reviews respective programs from across the United States. Most of these payments were made to farmers, as opposed to forest owners. Stanton et al, however, were unable to determine the proportion that went to forest owners.[4] Therefore, while we discuss the opportunities for revenue from such payments, we focus on only a handful of programs for estimates of the total revenues influencing forested land.

2.3 Biodiversity

We identified several data sources with information on payments for biodiversity habitat. These include public payments from a variety of conservation programs, voluntary private payments for hunting and wildlife viewing, and compliance-based payments in the form of conservation banking transactions.

Public payments for biodiversity conservation include government programs, such as the Private Stewardship Program (PSP), the Landowner Incentives Program (LIP), Partners for Fish and Wildlife (PFW), the North American Wetlands Conservation Act Program (NAWCA), and the Wildlife Habitat Incentives Program (WHIP). See Appendix A for more information on all the government programs analyzed for this report. In some cases, the data do not distinguish which payments were for activities involving forests. In these instances, we used the relative percentage of forest to non-forestlands for each state to estimate the portion for forest-based ecosystem services. Government payments reported here were restricted to include only cash payments, such as cost-share payments, grants, rental payments, and payments for conservation easements; in-kind benefits such as technical assistance were not included as no revenues actually changed hands. Due to lack of availability of data, tax incentives were also not included in the analysis.

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[4] Some of the other payments examined in this report, including payments for conservation easements and wetland mitigation credits, similarly lack data on which payments were made to forestland owners. In those cases we adjusted the payments to reflect the relative percentage of forest to non-forested acres in each state to obtain at least a rough approximation of payments to forest landowners. We did not follow this step for the data we obtained on payments for watershed services, because it was clear that few of the payments were made to forestland owners.

Data on voluntary payments for biodiversity came from information on revenues from leases and entrance fees paid to private landowners for hunting and wildlife viewing from the U.S. Fish and Wildlife Service's 2001 and 2006 National Survey of Hunting and Fishing (U.S. FWS 2001, 2006). Because the available data did not specify whether the activity occurred in a forest, we reduced the total revenues by the proportion of forestland to all rural land in each state.

We used data from Ecosystem Marketplace's State of the Biodiversity Markets (Madsen, et al. 2010) to estimate annual revenues from sales of credits by private conservation banks. While we were not able to disaggregate the data annually, Madsen et al. estimated that total revenues from all conservation banks averaged $200 million per year between 2005 and 2007. The data does not specify the types of land on which the conservation banks occurred. In order to estimate of payments on forested land, we adjusted the revenues for the portion of the banks that are in forested ecosystem.

2.4 Bundled Services

Most payments for forest-based ecosystem services in the US are not intended to promote the production of a single, clearly defined service; but rather, to encourage general conservation activities, which provide a range of benefits, including the provision of multiple ecosystem services. These payments may be considered payments for "bundled services," because a single payment is made in exchange for a bundle of different ecosystem services.[5] Examples of these types of payments include many government conservation programs, wetland and stream mitigation banking, and the purchase of conservation easements by land trusts.

Data on public payments for bundled services were derived from the following federal programs: Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Forest Land Enhancement Program (FLEP), Forest Legacy Program (FLP), Environmental Quality Incentives Program (EQIP), Wetland Reserve Program (WRP), and Private Stewardship Program (PSP). Again, because in some cases, the data do not distinguish which payments were for activities involving forests, we used the relative percentage of forest to non-forestlands for each state to estimate the portion for forest-based ecosystem services.

There are at least 35 state forest incentive programs in 27 states, with the most common being programs that help fund traditional forest management practices followed by riparian area protection and wildlife habitat improvement (Kilgore, et al. 2004). Almost all programs paid a portion of the costs of implementing conservation projects, with a few other programs utilizing tax incentives. Appendix C lists the states providing property tax incentives for maintaining land in forests and states identified as having PES programs that provide cost share payments to non-industrial forest landowners (NIPF) to retain forest land uses, protect riparian areas and wetlands, enhance wildlife habitats, and conserve soil and water quality. We contacted the State Forester (or similar officer) in the all states with some type of forest PES program, but we were only able to access data from 11 states. Data from the following states were not currently available: Arizona, California, Colorado, Idaho, Iowa, Michigan, Mississippi, New Jersey, New Mexico, North Dakota, Tennessee, Washington, and Wisconsin.

Data on cumulative acreage of voluntary purchases of conservation easements were obtained from the 2005 National Land Trust Census (Land Trust Alliance 2005). To project the number of new acres placed under easement in 2005, 2006, and 2007, we calculated the average annual change in cumulative acres between 2003

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[5] Payments for bundled services are conceptually distinct from *stacking* of ecosystem service payments. Stacking refers to a landowner receiving multiple payment streams for providing different ecosystem services, such as selling carbon credits and water quality credits from the same property.

and 2005. To estimate the portion of the total eased acreage in forestlands, we first calculated the acreage that occurred in natural areas and wildlife habitat (39%) and in wetlands (26%) as reported by the Land Trust Alliance (2005). Then, to estimate the portion of those easements that occur on forestlands, we applied the relative percentage of forest to non-forestland for each state from the NRCS Natural Resources Inventory (NRCS 2003). To calculate the percentage of forested wetlands under easement, we applied the percentage of forested wetlands to all wetlands for each state derived from the National Land Cover Database (NLCD 2001). The Land Trust Alliance data provides the total number of acres under easement for each time period, but it does not include financial data, such as prices paid for conservation easements. Easement price data were collected from four of the largest land trust organizations in the United States: the Nature Conservancy, the Trust for Public Land, the Conservation Fund, and Ducks Unlimited. The average price paid per acre was applied to the acreage data to estimate the total payments made to landowners for new conservation easements established in each state between 2005 and 2007, in constant 2005 dollars.

Compliance-based payments for bundled services include the purchase of wetland and stream mitigation credits. Regulatory data on numbers of wetland and stream permit decisions and affected acreage are internally collected by the US Army Corps of Engineers (US ACE), but this information is not made public on a regular basis. Ecosystem Marketplace obtained Fiscal Year 2008 data on permit decisions, affected acreage, and mitigation acreage required from a US ACE via a Freedom of Information Act request (Madsen et al. 2010). However, the US ACE only provided acreage data by US ACE district. To convert this to the state level, we calculated the number of acres in each state by applying the percentage of banks in each state to the total acres mitigated nationally. In addition, since US ACE did not provide data on the type of wetland mitigated, we applied the relative percentage of forest wetlands to all wetlands for each state to estimate the portion of revenues paid for mitigating forested wetlands. Using Madsen et al.'s estimated average price paid per acre for wetland mitigation credits, we then derive the total amount paid annually for forested wetland mitigation credits to private mitigation banks.

2.5 Data Limitations

Despite our efforts, we were unable to collect data for the following types of ecosystem service payments and incentives:

- Tax incentives involved in the sale of ecosystem services, such as reductions in property and/or income taxes from granting conservation easements, or reductions in state or local property taxes as an incentive to conserve forestlands.
- Price premiums paid by consumers for sustainably harvested timber and wood products.
- One-off deals between individual landowners, or local government agencies, and private landowners (for example, payments by municipal water authorities to maintain watershed health).
- Private voluntary incentive payments by forest industry or forest professional associations. Kilgore et al. (2004) reports that 29 privately sponsored incentive programs for family forest owners exist in 24 states. However, because we were unable to access data from these programs, they are not included in this analysis.

Because of these limitations on available data, the estimates presented in this report represent a lower bound of the full financial benefits landowners are receiving for producing ecosystem services.

3. Overview

Payments for forest-based ecosystem services to US landowners from all sources for which data are available totaled $1.9 billion in 2007 with private sources accounting for $1.5 billion (80%) and government agencies providing $366 million (19%) (Table 1). In 2007, sales of forest wetland mitigation credits amounted to $727 million, conservation bank credits $34 million, sales of carbon offsets $1.7 million, conservation easements $315 million, hunting leases and entrance fees $410 million, and wildlife viewing entrance fees $33 million. Wetland mitigation accounted for the largest percentage of forest-based ecosystem service payments, with 38% of all payments in 2007. However, these payments were received by only about 173 private forest mitigation banks, about 0.00002% of all private forest landowners in the US. Hunting leases and entrance fees represented about 22% of all payments, conservation easements 17%, government payments 19%, wildlife viewing 1.7%, and carbon offsets 0.001% of all forest PES in the US in 2007. These figures do not include payments for water services, due to a lack of data on which payments were made to forestland owners.

Table 1. Total Payments for Forest-Based Ecosystem Services from Government and Non-Government Organizations and Individuals from 2005 to 2007 (in 1000s of Constant 2005$)

	2005	2006	2007
Government	378,075	380,608	365,619
Non-government			
Carbon Offsets	567	1,552	1,692
Conservation Easements	162,074	195,435	314,999
Hunting Lease/Fees	404,517	404,690	410,236
Wildlife Viewing	30,559	31,569	33,537
Conservation Banks	34,000	34,000	34,000
Wetland Mitigation Banks	727,111	727,111	727,111
Total Non-government	1,358,828	1,394,358	1,521,575
Total Payments	**1,736,903**	**1,774,965**	**1,887,194**

Figure 1 and Table 1 show the relative payments made to landowners from all sources from 2005 to 2007. Government payments increased from $378 million in 2005 to $380 million in 2006, but then fell to $365 million in 2007 resulting in an average annual decline of 1.6%. In contrast, payments by non-government sources grew from $1.6 billion in 2005 to $1.8 billion in 2007. Estimated payments for forest carbon offsets increased an average of 99% annually, conservation easements 47%, and hunting and wildlife viewing revenues 5% between 2005 and 2007. Available data for wetlands mitigation and conservation banking did not allow calculation of annual changes.

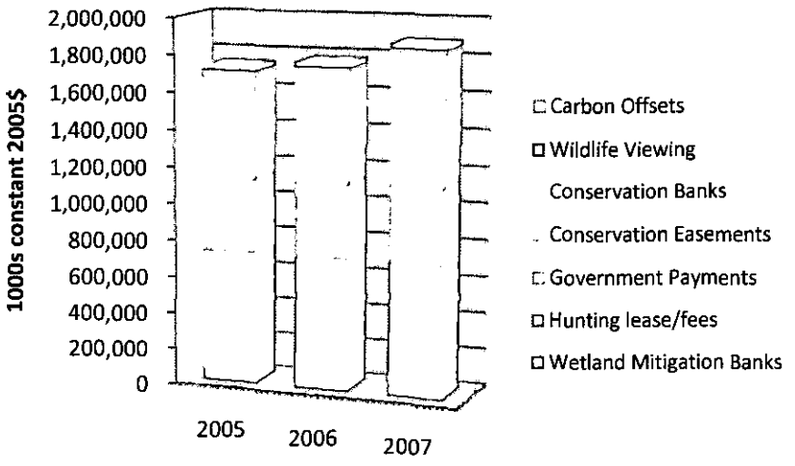

Figure 1. Total Forest Ecosystem Services Payments from All Sources (in 1000s of Constant 2005$)

Figure 2 shows the distribution of payments between states from all sources in 2007. Appendix D provides payment details by state from 2005 to 2007. Payments per state increased from an average of $34 million (median = $19 million) in 2005 to $38 million (median = $18 million) in 2007. In 2007, the states receiving the lowest total payments were Alaska ($428,000), Hawaii ($615,000), and North Dakota ($0.95 million). The highest payments occurred in Georgia ($173 million), Florida ($158 million), and Louisiana ($114 million).

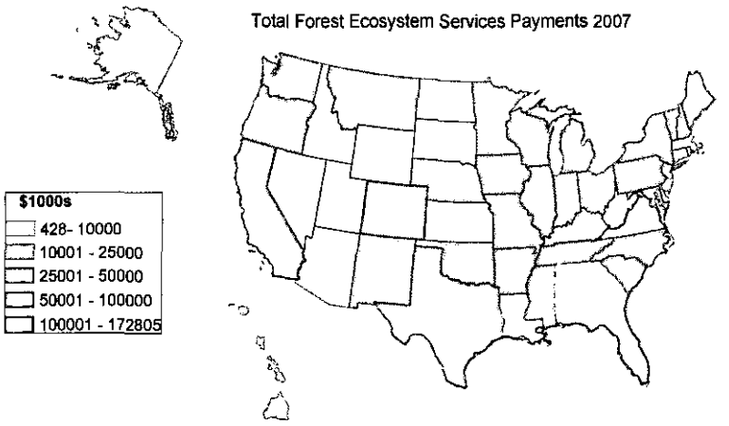

Figure 2. Total Payments in 2007 from Federal and State Agencies and Non-Government Organizations and Individuals (in 1000s of Constant 2005$)

These results differ, however, when accounting for the amount of forestland in each state. Figure 3 and Appendix D show the total ecosystem service payments per acre of all private forestland for each state. Average payment per acre for all sources and all states was $5.22 with a median of $3.34 per acre of forestland. These payments were lowest in Alaska ($0.003/acre) followed by West Virginia ($0.16/acre) and Hawaii ($0.32/acre). The states with the highest revenues per acre of forestland were Illinois ($23/acre), Colorado ($18/acre) and Nebraska ($19/acre).

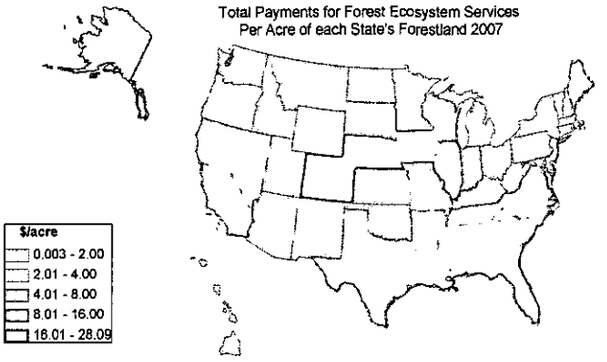

Figure 3. Total Payments per Acre of Private Forest Land in 2007 from All Sources (in Constant 2005$)

The total payments from all sources from 2005 to 2007 are shown in Figure 4 and Appendix E by type of service. The majority of payments in 2007 were for bundled services (76%), followed by biodiversity (23%) and carbon offset projects (0.09%). However the percentages very considerably by state as evidenced by Figure 5.

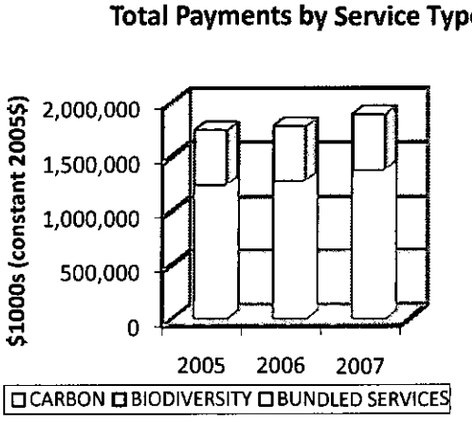

Figure 4. Total Payments from All Sources by Type of Service between 2005 and 2007 (in 1000s of Constant 2005$)

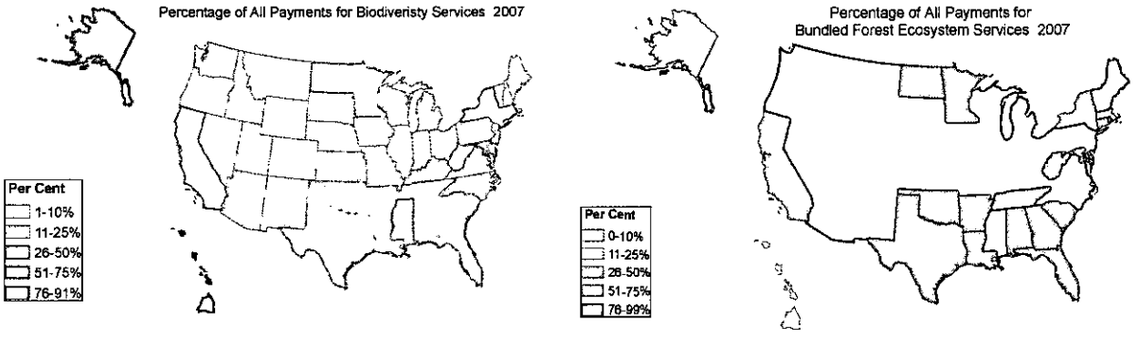

Figure 5. Percentage of All Ecosystem Service Payments for Biodiversity and Bundled Services between 2005 and 2007

4. Payments for Forest Carbon Sequestration

Carbon storage and sequestration are among the most well known ecosystem services provided by forests. Trees sequester carbon as they grow, and they store it in long-term structures, such as trunks and roots. Forest carbon offsets projects offer businesses and individuals the opportunity to invest in projects to offset their own greenhouse gas (GHG) emissions. These include a variety of forestry projects, including afforestation or reforestation, in which trees are planted to sequester carbon; improved forest management, in which timber harvest management activities are changed to increase overall carbon sequestration between harvests; and avoided forest conversion, in which forests are conserved and prevented from being converted to other uses such as development or agriculture.

Carbon sequestration is unique among other ecosystem services in that its benefits accrue globally; the benefits provided by most other (non-carbon) services are often limited to a specific watershed or habitat type. Relative to other ecosystem services, carbon could be described as the "ultimate commodity," because a ton of carbon sequestered in, for example, a forest in Indonesia is considered to be equivalent to emissions reductions from anywhere else in the world. As a result, a wide-ranging market for forest carbon offsets has begun to emerge (Hamilton, et al. 2010b). This section details the payments that US landowners have received from participating in the market for forest carbon offsets.

4.1 Public Payments to Landowners

There are currently no government programs that provide payments to landowners solely for carbon sequestration. Although many government conservation programs encourage practices that result in carbon sequestration, these programs are generally intended to provide other ecosystem services as well.

4.2 Voluntary Payments

Due to the absence of federal climate policy in the US, the domestic market for forest carbon credits consists almost exclusively of voluntary transactions. Voluntary offset credits can be purchased by businesses or individuals seeking to offset their personal carbon footprints. Carbon offset purchasers can either buy credits directly from suppliers in the over-the-counter (OTC) market, or until recently they could purchase credits from the Chicago Climate Exchange (CCX), which is a voluntary but legally binding cap-and-trade system. However, the market for US-based forest offset projects in the voluntary market remains relatively small; our sources identified only 16 states with carbon offset projects that have actually made payments to forest landowners since 2002.[6]

4.2.1 Over-the Counter (OTC) Transactions

Several different models for project development exist. Several large projects are managed by land trusts, which already control large holdings of land available for carbon projects. For example, a carbon offset transaction in 2002 involved The Climate Trust, a non-profit organization based in Oregon, purchasing offsets amounting to 233,333 metric tons of carbon dioxide equivalent (tCO_2e) from the Deschutes River Conservancy in Oregon and restoring up to 1,800 acres of riparian habitat in the Deschutes River Basin (Climate Trust 2009). Similarly, many other land trusts have participated in voluntary carbon market transactions or have established

[6] These states include Alabama, Arkansas, California, Florida, Georgia, Idaho, Illinois, Indiana, Louisiana, North Dakota, Michigan, Mississippi, Oregon, Pennsylvania, South Carolina, and Wisconsin.

programs to sell carbon offsets. For example, in early 2008, California-based Pacific Gas and Energy (PG&E) partnered with the Conservation Fund, The Nature Conservancy, and Sempervirens Fund to purchase offsets generated by land conservation activities in California (Pacific Gas and Electric 2008). That same year the Trust for Public Land purchased 1,974 acres of land that will be added to the Tensas River National Wildlife Refuge in Louisiana, funded partly from more than $1.3 million in carbon offset funding from Detroit Edison, Conoco-Philips, and the National Fish and Wildlife Federation (Trust for Public Land 2008). Furthermore, The Conservation Fund has established a program called Go Zero, in which offset buyers can purchase offsets directly from the land trust. Offset funds are used to promote reforestation and restoration activities on public lands, including National Wildlife Refuges.[7]

4.2.2 The Chicago Climate Exchange

In addition to offset projects developed by land trusts, several private sector players have also developed projects. The majority of credits sold by the private sector have been transacted through the Chicago Climate Exchange (CCX), a voluntary cap-and-trade system established in 2003, with more than 100 members. In November 2010, CCX announced it was shutting down operations. However, over the past seven years companies that joined the CCX agreed to reduce their GHG emissions and were allowed to purchase offsets from a CCX-approved offset provider to help meet their emissions reductions obligations. As opposed to the OTC market, however, offsets under the CCX were traded over an organized exchange. In addition to other offset project types, including renewable energy and energy conservation projects, CCX allowed three types of forestry carbon projects: afforestation, sustainably managed forests, and long-lived forest products.

Under the CCX, several companies, including Delta Institute and AgraGate Carbon have been particularly successful at aggregating carbon credits from smaller, private landowners. According to Ecosystem Marketplace's *State of the Forest Carbon Markets* 2009 report (Hamilton, et al. 2010b), at least 2.1 $MtCO_2$ were transacted on the CCX from US forest projects from 2006 to 2009. The projects covered at least 306,552 hectares.

4.2.3 Revenues from Voluntary Carbon Offset Transactions

Revenues from carbon offsets from forestry are relatively small compared with revenues from other ecosystem services (Figure 1) and with other types of (non-forest) offset projects. For example forestry projects in North America were the source of only 7.2 million tCO_2e of carbon offsets in 2008, compared with more than 111 million tCO_2e transacted in the total OTC voluntary carbon market in the US in the same year (Hamilton, et al. 2010b).

Table 2 shows data on US-based forest carbon offset payments made to landowners between 2002 and 2007 in 1000s of constant 2005 dollars. From 2002 through 2005, 5 US forest offset projects generated and sold nearly 900,000 tCO2e for about $2.97 million (in 2005 dollars) through OTC transactions. For comparison, in 2007 project developers in the global forest carbon market sold 2.7 million tCO_2e for $15.5 million (2005 dollars) (Hamilton, et al. 2008). Combined US sales in 2006 and 2007 totaled $3.2 million (in 2005 dollars). By mid-2009, the total number of US projects reporting sales in the *State of the Forest Carbon Markets* 2009 report had risen to 24 projects in 17 states (AL, AR, CA, FL, GA, ID, IL, IN, LA, ND, MI, MS, OR, PA, SC, and WI), including several using the Chicago Climate Exchange(Hamilton, et al. 2010b).

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[7] For more information on the Go Zero program, visit http://www.conservationfund.org/gozero.

Table 2. Payments for US-Based Forest Carbon Offset Projects 2002-2007 (in 1000s of Constant 2005$)

	2002	2003	2004	2005	2006	2007	Total
Alabama	—	0.02	0.02	0.02	0.11	0.1	0.27
Arkansas	—	17.97	20.64	21.19	25.9	38.65	124.34
California	—	—	—	—	147.77	—	147.77
Illinois	—	134.74	149.02	167.88	181.01	201.46	834.11
Indiana	—	2.28	2.41	3.35	3.16	3.45	14.64
Louisiana	—	0	1206.86	363.4	1182.12	1434.6	4186.98
Michigan	—	9.66	10.31	11.59	11.67	13.52	56.74
Oregon	717.88	—	—	—	—	—	717.88
Washington	135.75	—	—	—	—	—	135.75
Total	**853.63**	**164.67**	**1389.27**	**567.42**	**1551.72**	**1691.78**	**6218.48**

4.3 Compliance-Driven Payments

The US currently has no federal climate policy requiring GHG emissions reductions or allowing regulated entities to purchase offsets. In June 2009, the American Clean Energy and Security Act (ACES) was passed by the House of Representatives, marking the first time a comprehensive climate bill passed one of the houses of Congress. Three bills were submitted to the Senate in 2009 and 2010: the Clean Energy Jobs and American Power Act (Kerry-Boxer), the American Power Act (Kerry-Lieberman), and the Carbon Limits and Energy for America's Renewal Act (Cantwell-Collins). ACES, Kerry-Boxer, and Kerry-Lieberman would create markets for emitting and offsetting CO_2 and permit the purchase of up to 2 billion tons of carbon offsets annually. Cantwell-Collins does not allow emitters to purchase offsets; however, it does provide for the establishment of a trust fund to provide incentives, loans and grants to fund offset-like projects that reduce, avoid or sequester greenhouse gas emissions through forestry and other land use initiatives. However, at the time of this writing, the Senate has yet to pass any climate change legislation.

International compliance transactions are largely driven by the Kyoto Protocol, which requires certain signatory nations to reduce their GHG emissions. While the Kyoto Protocol allows afforestation offset projects, the United States is not a party to the Protocol, and therefore US forest owners are unable to participate in the Kyoto compliance market.

In the absence of federal climate legislation and US participation in international climate treaties, states have stepped in to fill the void. Several state- and regional-level climate programs are either already operating or in development. The Regional Greenhouse Gas Initiative (RGGI), the nation's first mandatory cap-and-trade system, includes 10 Northeastern and Mid-Atlantic states.[8] RGGI allows regulated entities to purchase offsets for compliance with GHG regulations, including those from afforestation projects; however, as of this writing, no offset projects of any kind had yet been registered with RGGI.[9]

[8] RGGI states include: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. (http://www.rggi.org)

[9] There are currently no projects listed at RGGI's offset project tracking website: http://www.rggi.org/offsets/project_tracking

The Western Climate Initiative (WCI) is a comprehensive regional effort by seven U.S. states and four Canadian provinces to reduce greenhouse gas emissions to 15 percent below 2005 levels by 2020.[10] Offset projects will be allowed, but the program is still in the planning stages. The state with the most emissions in the WCI is California, which is creating a cap-and-trade system under Assembly Bill 32 (AB 32), which requires the state to reduce its emissions to 1990 levels by 2020.[11]

Nine states and 2 Canadian provinces are also developing the Midwestern Regional Greenhouse Gas Reduction Program (MRP).[12] MRP is scheduled to start in 2012 and will incorporate a regional cap-and-trade system covering most sectors of the economy with an emissions target of 16% below 2005 levels. Offset criteria, eligibility and implementation remain in the planning stage.

4.4 The Future of Forest Carbon

The future of payments for sequestering forest carbon in the US will depend largely on the passage of federal and state climate legislation. While the voluntary market has emerged to meet the demand for voluntary emissions reductions, the market would likely expand massively with a federal policy driver in place. Most climate bills introduced in Congress, including ACES, which was passed by the House of Representatives, have included generous provisions for offsets. For example, ACES would allow regulated entities to purchase up to 1 billion tons of domestic offsets each year (H.R. 2454, 2009); this would represent an almost ten-fold increase over the amount transacted in the US voluntary market in 2008 (Hamilton, et al. 2010a).

5. Payments for Watershed Protection

According to the Millennium Ecosystem Assessment (2006), more than three quarters of the world's fresh water comes from forested catchments. These forests play a critical role in protecting water quality by absorbing excess nutrients, reducing soil erosion, and controlling the timing of water flows. For these reasons, forestland owners could potentially receive significant revenues for the watershed services their lands provide. However, in contrast to carbon sequestration services, which are global in nature, watershed services are generally spatially limited and the markets tend to be small and local. Nevertheless, payments for watershed services are playing an increasingly important role in watershed protection in the US. Maintaining forested watersheds and creating forested riparian buffers are among the most important components of local and regional government programs to protect water quality. Furthermore, water quality trading programs, in which watershed services provided by landowners are used to offset pollution by other emitters, are being developed in many parts of the US to comply with Clean Water Act regulations.

5.1 Public Payments to Landowners

Public payments for watershed services are generally for protection of drinking water sources to reduce water treatment costs. Although some treatment of water is necessary, the costs of treatment and risks to public

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[10] WCI states and provinces include: Arizona, California, New Mexico, Montana, Oregon, Utah, Washington, British Columbia, Manitoba, Ontario, and Quebec. (http://www.westernclimateinitiative.org/)

[11] For more information on AB 32, visit: http://www.arb.ca.gov/cc/ab32/ab32.htm

[12] MGGA states and province include: Iowa, Illinois, Kansas, Michigan, Minnesota, Wisconsin, and Manitoba. (http://www.midwesternaccord.org/)

health can be reduced by ensuring that the water is protected from contamination through conserving forest cover in watersheds and providing incentives to landowners to implement Best Management Practices (BMPs). Although many federal conservation programs provide watershed services, they are generally intended to provide other services as well.

State and local governments, on the other hand, have many programs dedicated to protecting water quality sources. Many of these efforts are driven by the Safe Drinking Water Act, which requires states to develop and implement Source Water Assessment Programs to analyze existing and potential threats to the quality of public drinking water. As a result of these assessments, many state agencies, local communities, and municipal water authorities have implemented payments for watershed services from forests.

According to Ecosystem Marketplace's State of the Watershed payments report (Stanton, et al. 2010), overall between 2002 to 2008, US state and federal governments have invested just over $8.3 million to landowners, mostly farmers, in programs that benefit water-related ecosystem services among other things. The total transaction value during this period exclusively for payment for watershed services was roughly $3.2 million covering 1.1 million acres. The actual amount paid to forest owners specifically for watershed services is unknown.

Perhaps the most famous example of PES—the New York City Watershed Program—is an example of a government payment for watershed protection. New York City receives most of its drinking water from the Catskills Mountains and had long enjoyed such good water quality that only minimal treatment was necessary. However, declines in water quality in the 1990s prompted the EPA to require the city to make improvements. Rather than spending $6 to 8 billion on a new filtration plant (plus $300 million in annual operating expenses), New York City chose instead to invest in protecting and conserving lands in the watershed. By spending $1 to 2 billion on purchasing and managing lands in the Catskills Mountains, the city was able to achieve its water quality goals at only a fraction of the cost of the filtration plant (Chichilnisky and Heal 1998). The program is ongoing and in 2008, the City invested nearly $209 million dollars in watershed management activities to maintain its high level of water quality.

In addition to New York, a number of US cities have avoided building expensive new filtration plants by investing in watershed protection including Boston, MA, which invested roughly $121 million from 1985 to 2008; Portland, OR; Portland, ME; Seattle, WA, which invested some $38.7 million from 1992-2008; Syracuse, NY; and Auburn, ME (Postel and Thompson 2004; Stanton, et al. 2010). Santa Fe, NM and Denver, CO are the two latest municipalities utilizing a PES approach to pay for the better management of the forested areas that provide critical source drinking water for some 2.8 million customers in the two cities (Stanton, et al. 2010).

State governments have also initiated watershed protection programs. An example is the North Carolina Clean Water Management Trust Fund (CWMTF), which gives grants to local governments and private organizations for acquisition of sensitive watershed lands, in addition to grants for improvements to stormwater and wastewater treatment systems. In 2008 alone, the CWMTF funded $64.5 million in land acquisition grants in the state of North Carolina (CWMTF 2008).

5.2 Voluntary Payments

While there are a several examples of private companies voluntarily paying for watershed services outside of the US, including payments by French bottled water company Vittel to protect water they use in their products (Perrot-Maître 2006), the closest example to a voluntary program in the US is the Bonneville Water Restoration

Certificate Program. The program does not invest directly in land management practices, but instead pays landowners to not use water rights and instead to keep water in the rivers.

5.3 Compliance-Driven Payments

Water quality trading has demonstrated promise as a means to control nonpoint source pollution without the need for additional regulation. Trading occurs when landowners are paid to implement BMPs that reduce the loading of nutrients and pollutants into streams. Each trading program has its own rules, but they all involve some type of cap on the amount of certain nutrients or pollutants, such as nitrogen. Point source emitters receive pollution allowances, and sources that exceed their allowances must either purchase unused allowances from another point source or pay for reductions from nonpoint sources. In this way, nonpoint sources are encouraged to reduce nutrient loading through a market mechanism rather than additional regulation.

EPA's Office of Water published its *Water Quality Trading Policy* (WQT Trading) in 2003, which officially recognized the practice of trading "pollution credits" between and among dischargers within a watershed. The WQT Policy's purpose is to:

> [E]ncourage states, interstate agencies and tribes to develop and implement water quality trading programs for nutrients, sediments and other pollutants where opportunities exist to achieve water quality improvements at reduced costs... [and] encourage voluntary trading programs that facilitate implementation of [Total Maximum Daily Loads], reduce the costs of compliance with Clean Water Act (CWA) regulations, establish incentives for voluntary reductions and promote watershed-based initiatives. (EPA 2003)

Ecosystem Marketplace identified at least 66 water quality trading programs in the United States, of which 11 were actively transacting funds in 2008. Of the 236 point source facilities in the United States that are eligible to trade compliance permits, only 121 facilities have traded at least once over the life of the permit (WRI 2009).

Overall, $52 million was transacted from 2000 to 2008. The amount of funds spent specifically on forest lands or to plant trees is unknown and minimal compared to payments to farmers. For example, the state of Pennsylvania has one of the most established water quality trading programs, and it encourages trades between point and nonpoint sources. However, even in this program, there are very few trades involving forests or trees. The Pennsylvania Department of Environmental Protection has a database of 54 trades taking place since 2006. Of those, only one transaction involved the planting of a riparian buffer, and one transaction involved a stream restoration (Pennsylvania DEP 2010). WRI (2009) predicts that point-to-nonpoint trading activity will rarely be continuous and ongoing, but rather involve single transactions that create credit streams of up to 10 years or more.

5.4 The Future of Payments for Watershed Services

Given the long history of payments from governments and local water authorities for watershed protection, PES for watershed protection should continue to grow and become an increasingly important type of payment for ecosystem services. This is especially true for those payment programs focused on the protection of source drinking water. It is less clear whether water quality trading will significantly encourage more participation by forestland owners. The good news is that the infrastructure to support trading has been developed and tested in numerous watersheds, and program design continues to evolve with each new on-the-ground experiment.

Trading has been inhibited by gaps in regulations that provide the key driver of demand, and in some cases by the size of the market, since trades are generally limited to a single watershed and there are often not enough market actors within a watershed to encourage robust trading. Furthermore, government incentive programs like CRP and WRP can reduce the number of credits available, as many water quality trading programs exclude nutrient reductions that are required by law or for which nonpoint sources have already been paid (King and Kuch 2003; King 2005).

6. Payments for Biodiversity

Payments for biodiversity services occur in all three PES categories: public payments to land owners, voluntary payments, and payments in compliance markets. Both government incentive programs and policy compliance markets have been developed in response to the Endangered Species Act of 1973 (ESA). The ESA subjects all landowners with habitat for threatened or endangered (T&E) species to severe penalties for managing their land in a way that may injure the species by "taking" its habitat. The US Fish and Wildlife Service (USFWS) and Forest Service (USFS) have long histories of providing financial assistance to private landowners to improve habitat prior to listing of a species as threatened or endangered, or to assist landowners in complying with the ESA once T&E species are identified. Furthermore, in 2003 the USFWS developed official federal guidance for the establishment, use, and operation of conservation banks, which allow landowners to create or restore T&E species' habitat to offset impacts to existing habitat (US FWS 2003). In addition to incentive programs and compliance markets encouraged under the ESA, a robust private market exists for biodiversity services through the purchase of hunting leases and the payment of entrance fees for hunting and wildlife viewing on private lands.

PES for biodiversity in 2007 amounted to $509 million or 27% of all PES from US forests for which data are available. Figure 6 shows the distribution of payments between government programs and voluntary and compliance driven private payments for biodiversity services. Voluntary private payments (hunting leases and entrance fees for hunting and wildlife viewing) accounted for 87% of all payments, dwarfing compliance driven private payments (conservation banks) at 7% and government payments (6%).

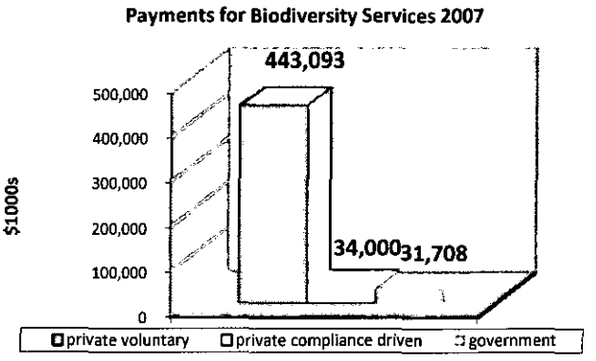
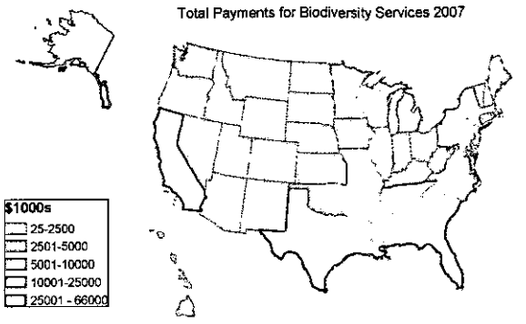


Figure 6. Distribution of Payments for Biodiversity Services from Private Voluntary (Hunting Leases and Entrance Fees), Private Compliance-Driven (Conservation Banks) and Government Sources in 2007 (in 1000s of Constant 2005$)

Figure 7 illustrates the distribution of biodiversity payments from all sources. The average payment per state in 2007 was $10.2 million and the median was $2.4 million. With the exception of California, all of the top 10 states occur in the South, which reflects the dominance of hunting leases and entrance fees in this category. The top three states were Florida ($66 million), Georgia ($50 million) and Alabama ($50 million). The three lowest states were Wyoming ($25,000), Nevada ($43,000) and New Mexico ($94,000). Payments per acre of forestland in each state ranged from $0.0002 (Wyoming) to $0.52 (Florida) with an average of $0.08 and a median of $0.02 per acre in 2007.

7a)



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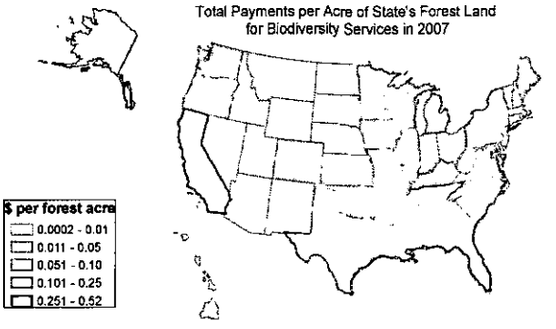


Figure 7. a) Total Payments and b) Total Payments per Acre of Private Forestland for Biodiversity Services from All Sources in 2007

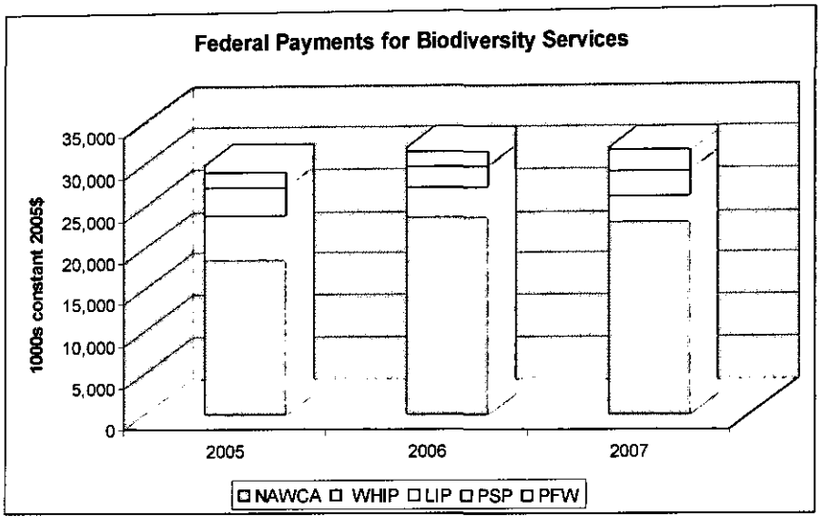
6.1 Public Payments to Landowners

6.1.1 Federal Programs

The Federal government has implemented a variety of programs to pay private landowners to improve habitat and protect biodiversity. The US Fish and Wildlife Service manages four programs: Private Stewardship Program (PSP), Landowner Incentives Program (LIP), Partners for Fish and Wildlife (PFW), and the North American Wetlands Conservation Act Program (NAWCA). In addition, the USDA Natural Resources Conservation Service manages the Wildlife Habitat Incentives Program (WHIP). These are briefly described in Box 1.

Payments by Federal programs for biodiversity between 2005 and 2007 are shown in Figure 8. Total Federal payments were relatively stable at $29.8 million in 2005, increasing to $31.9 million in 2006, and decreasing

slightly to $31.7 million in 2007. NAWCA comprised 73%, WHIP 9%, LIP 9%, PSP 8%, and PFW 1% of all federal payments for forest-based biodiversity services.

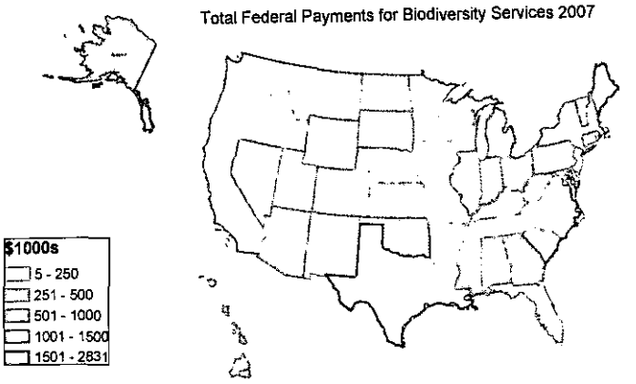


PFW = Partners for Fish and Wildlife; WHIP = Wildlife Habitat Incentive Program; PSP = Private Stewardship Program; LIP = Landowner Incentive Program; NAWCA = North American Wetlands Conservation Act Grants Program.

Figure 8. Federal Payments for Biodiversity Services on Forest Lands (in 1000s of Constant 2005$)

Figure 9 presents the distribution of total Federal payments and payments per acre of state forest land in 2007. Federal payments for forest-based biodiversity services averaged $634,000 per state (median = $440,000) with the highest payments occurring in Louisiana ($2.8 million), Texas ($1.7 million), and South Carolina ($1.6 million) and the lowest in Wyoming ($5,000), Nevada ($22,000) and New Mexico ($31,000). The average payment per acre of private forest land, was $0.005 per acre (median of $0.003 per acre) with Louisiana ($0.022 per acre), Texas ($0.013/acre), and South Carolina ($0.012/acre) having the highest per acre payments and Wyoming ($0.00004/acre), Nevada ($0.00017), and New Mexico ($0.00024) having the lowest federal payments for biodiversity per acre of forestland.

9a)



9b)

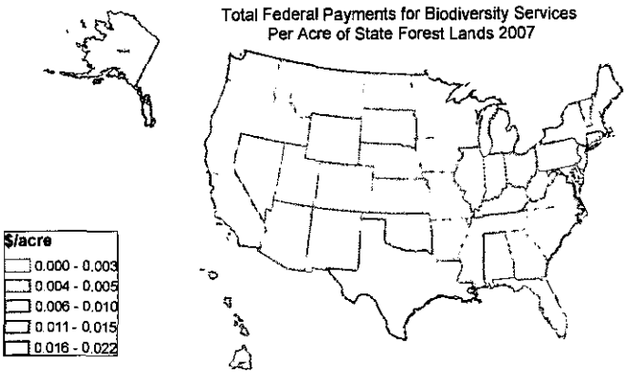


Figure 9. a) Total Federal Payments for Biodiversity Services ($1000s) and b) Total Federal Payments for Biodiversity Services per Acre of Private Forestland in 2007

Box 1: Federal Programs providing PES for Biodiversity to Private Landowners

Private Stewardship Program (PSP). PSP provides direct funding to individuals and groups to implement voluntary conservation activities to benefit federally listed, proposed, or candidate species, or other at-risk species on private lands. Private landowners and groups and organizations that partner with landowners are eligible to participate. A 10 percent non-federal match (cash or in-kind) is required.
http://www.fws.gov/endangered/grants/private_stewardship/

Landowner Incentives Program (LIP). Funded by the USFWS and administered by state wildlife agencies, LIP offers direct funding and technical assistance to supplement state efforts to support projects that enhance, protect, or restore habitats that benefit "species-at-risk" on privately owned lands. LIP is a competitive grant program that establishes partnerships between federal and state governments and private landowners. Landowners or partners provide a 25% non-federal match or in-kind contribution.
http://wsfrprograms.fws.gov/subpages/grantprograms/lip/lip.htm

Partners for Fish and Wildlife (PFW). PFW provides direct funding and technical assistance to support voluntary restoration of wetlands and other fish and wildlife habitats (native grasslands, riparian areas, and in-stream habitats) on private land through public-private partnerships. Landowners must provide a 1:1 non-Federal match (including in-kind) and agree to retain the restoration projects for at least 10 years, but otherwise retain full control of their land. High priority projects benefit migratory birds, migratory fish, or threatened and endangered species near National Wildlife Refuges.
http://www.fws.gov/partners/

North American Wetlands Conservation Act Grants Program (NAWCA). NAWCA assists organizations and individuals in establishing wetlands conservation projects that target the long-term protection of wetlands and associated uplands habitats needed by waterfowl and other migratory birds. Grant proposals generally consist of a 4-year plan of action to conserve wetlands and wetlands-dependent fish and wildlife through acquisition (including easements and land title donations), restoration and/or enhancement. Partners must provide at least a 1:1 non-Federal match.
http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm

Wildlife Habitat Incentives Program (WHIP). Initiated in 1998 and reauthorized in the 2008 Farm Bill and administered by the USDA Natural Resources Conservation Service, WHIP provides technical and financial assistance to landowners to develop and improve upland, wetland, riparian, and aquatic habitat areas. WHIP focuses on private agricultural land including cropland, grassland, rangeland, pasture, and other land determined by NRCS to be suitable for fish and wildlife habitat development; non-industrial private forest land including rural land that has existing tree cover or is suitable for growing trees; and tribal land. WHIP agreements provide up to 75% cost-sharing for 5- to 10-year agreements.
http://www.nrcs.usda.gov/programs/whip/

6.1.2 State Programs

Unfortunately, data is not available to assess the amount of revenues paid to forest landowners by state programs for biodiversity protection. Based on a survey of state incentive programs, Defenders of Wildlife (2002) found that forty-five states provide at least one of the following direct payment incentives for biodiversity protection: cost-shares, grants, green payments, low/no-interest loans, purchase of rights to land rental or lease of habitat. The most common direct financial payments were grants or cost-share programs. Thirty-seven states had cost-share programs, while 20 states had grant programs. Fifteen states have programs to purchase conservation easements or other rights to land. For example, Massachusetts provides $5-10 million annually for acquisitions of easements on lands that contain native species or important natural communities. From 1990 to 2002, the program has acquired approximately 10,000 acres (Defenders of Wildlife 2002). An example of a cost-share program is Wisconsin's Turkey and Pheasant Stamp Program, which provides funding to landowners to manage, restore, and preserve woodlands, savannah, wetlands, and prairies. Total program funding in 2002 was approximately $0.5 million a year.

Another example is Kansas's "Walk-in Hunting Access" program, which provides landowners with lease payments for public hunting and retention and enhancement of wildlife habitat. In 2002, Kansas provided $850,000 a year to lease 680,000 acres of habitat. Georgia administers a program that provides incentive payments ("green payments") to landowners for the preservation, creation or enhancement of bobwhite quail habitat. Under this program, a landowner or lease holder controlling a minimum of 50 contiguous acres of row crop agricultural land or thinned pine stands may be eligible for payments of up to $10,000 for the creation, preservation, or enhancement of bobwhite quail habitat (Defenders of Wildlife 2002).

6.2 Voluntary Payments

The two main ways that private landowners sell rights to access wildlife habitat and associated species are through hunting leases and entrance fees. Hunting leases typically provide exclusive rights to an individual, a group of people, or to a hunting club for a season or year, while entrance fees allow non-exclusive access and are typically charged for shorter periods (Mozumder, et al. 2007).

Based on the US Fish and Wildlife Service (2006) *National Survey of Fishing, Hunting, and Wildlife Associated Recreation*, 12.5 million people took 185 million hunting trips within the United States and spent 220 million days hunting in 2006. Most, 7.2 million or 58%, hunted solely on private lands, while slightly over 3 million (24%) hunted on both public and private lands. Seventy five percent of all hunting days were on private lands. Hunters spent a total of $22.9 billion on hunting related expenses in 2006, of which about 5% or $1.1 billion was spent on leasing land ($740 million) or paying entrance fees ($391 million) to hunt on private lands. Teasley et al. (1999) reported that only 3% of rural private landowners in the US charged a fee to access their land for hunting or other recreational activities, but the rates vary by region with 8% charging fees in the South. Jones, et al. (1998) found that 12% of Mississippi landowners allowed fee-hunting on their land with gross revenues averaging about $9000 per landowner and annual expenditures for wildlife management averaging $2,057 per landowner.

In contrast to hunting, wildlife viewing (closely observing and photographing wildlife) occurs most often on public land. The US Fish and Wildlife Service (2006) survey found that approximately 80% of wildlife watchers used public lands and 38% used private lands.[13] Approximately 12.2 million (53%) only visited public areas

[13]The numbers add up to more than 100% because 27% of all respondents viewed wildlife on both public and private land.

compared to 2.5 million (11%) who only visited private lands to view wildlife. Although 5.6 times as many U.S. residents (71 million people or 31% of the population aged 16 or over) participated in wildlife-watching activities as compared to hunting, they spent only twice as much ($45.7 billion in 2006) as hunters ($22.9 billion). However, only $66 million, 1.5% of all wildlife viewing expenditures, was paid to private landowners for wildlife viewing, (U.S. FWS 2006).

The above figures represent payments to all landowners. Assuming hunting and wildlife payments are equally distributed between forest and non-forest lands (a conservative assumption), we estimate that voluntary payments for hunting leases and entrance fees for hunting and wildlife viewing on forestlands were about $444 million in 2007. Hunting leases accounted for $255 million (58%), hunting entrance fees for $155 million (35%), and wildlife viewing for $33 million (7%) during 2007.

6.3 Compliance-Driven Payments

Compliance-based payments for biodiversity services are almost exclusively driven by the Endangered Species Act (ESA). Section 9 of the ESA prohibits "taking" a threatened or endangered species by harming or harassing the species or adversely modifying its habitat. However, Section 10(a)(1)(B) of the act allows non-Federal landowners to apply to the US Fish and Wildlife Service (USFWS) for a permit to take a listed species under certain circumstances. This exception has led to the emergence of a market-based approach to protecting critical habitat for listed species called conservation banking, which is similar to wetland mitigation banking.

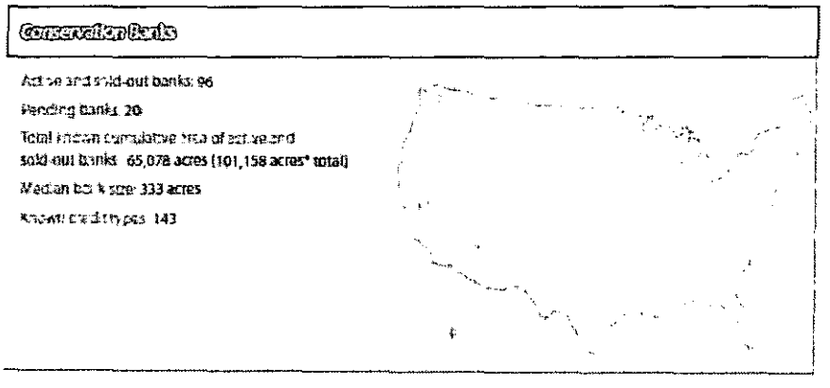
Conservation banks are permanently protected privately or publicly owned lands, managed to provide habitat for endangered or threatened species. The banks sell habitat or species credits to developers who need to compensate for "takings" of listed species when developing other habitats. In 1995, shortly after *Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks* (60 FR 58605-58614) was published, the State of California established policies to promote conservation banks to preserve existing critical habitats, and the USFWS began approving conservation banks for a variety of federally listed species. Experiments by California and other states with conservation banking were successful enough that in 2003, USFWS issued a federal policy on conservation banking: *The Guidance for the Establishment, Use, and Operation of Conservation Banks* (US FWS 2009, US FWS 2003).

To comply with the ESA and conservation banking regulations, landowners or developers whose actions are potentially harmful to a listed species must obtain an incidental take permit (ITP) from the USFWS. Requirements for the permit include developing a habitat conservation plan (HCP) that delineates specific actions to mitigate the impacts by restoring habitat for the listed species, enhancing streams or corridors to create habitat linkages, or other actions negotiated with the USFWS. Designing an HCP for on-site mitigation is time-consuming and expensive, often costing $50,000 to $100,000 per year. Furthermore, HCPs do not create market value because listed species are viewed as a liability, and finding listed species on property can result in intense regulation and possible property devaluation (Mills 2004).[14]

Ecosystem Marketplace has collected and reported information on conservation banking, credit prices, and estimated annual sales of conservation credits (www.speciesbanking.com). As of December 2009, there were

[14] In fact, in some cases the ESA has created an unintended *dis*incentive to conserve habitat, as private landowners may intentionally kill listed species or alter potential habitat before the species or its habitat are identified on the landowners' property (Lueck and Michael 2003).

96 active and sold-out banks in 10 states conserving a total of 101,158 acres[15] and 143 species or habitat types. As shown in Figure 10, most of the banks are in California (82 banks or 85 percent of all banks); Texas and Florida have three banks; Arizona has two banks; and Washington, Oregon, Utah, Colorado, South Carolina, and West Virginia each have one bank (Figure 10). In the State of the Biodiversity Markets Report, Madsen, et al. (2010) estimate that total revenues for all banks in the US averaged $200 million annually between 2005 and 2007. ELI (2007) listed habitat types only for banks in California, and only 17% of the banks14 of its 82 banks) were in forest habitats. Assuming all other states have a similar distribution of forest to non-forest banks, we estimate that banks in forest habitats received a total of $34 million in revenues annually between 2005 and 2007.



*Represents acreage data for all but four conservation banks.
Source: Madsen, et al. (2010).

Figure 10. Distribution of Conservation Banks in the U.S.

Combining voluntary and compliance driven private payments gives a picture of total private payments for biodiversity. Figure 11 shows the distribution of these payments in 2007. Hunting leases accounted for 54%, hunting entrance fees 32%, wildlife viewing 7%, and conservation banks 7% of private payments during 2007. Figure 12 illustrates how the (a) total payments and (b) payments per acre of private forestland are distributed across the states. The average payment per state was $8.8 million and the median was $1.9 million while the average payment per acre of the state's private forestland was $0.84/acre with a median of $0.39/acre.

[15] There is also additional acreage in inactive banks (1,636 acres); pending banks (23,906 acres), and banks with unknown status (10,538 acres). Four banks did not have acreage data.

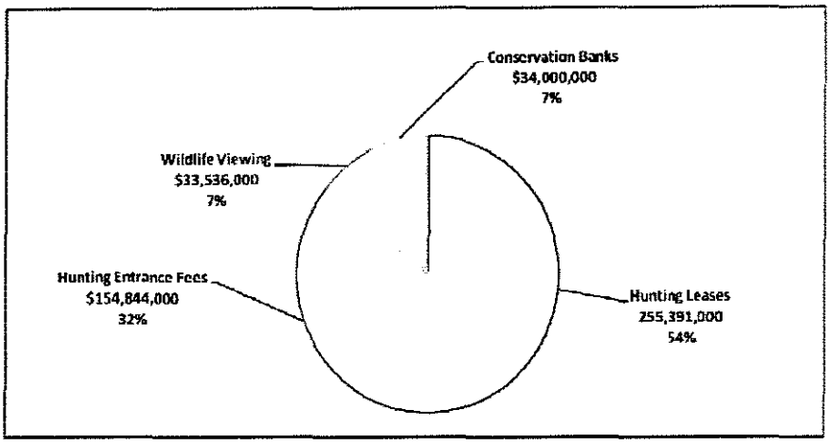
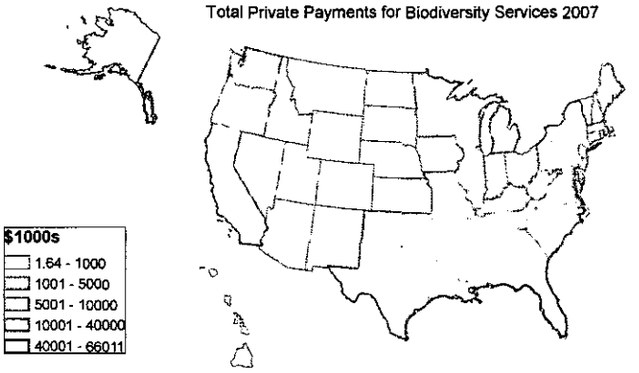


Figure 11. Voluntary Payments for Biodiversity, including Hunting Leases, Hunting Entrance Fees, Wildlife Viewing Entrance Fees, and Conservation Banks in 2007 (in Constant 2005$)

12a)



12b)

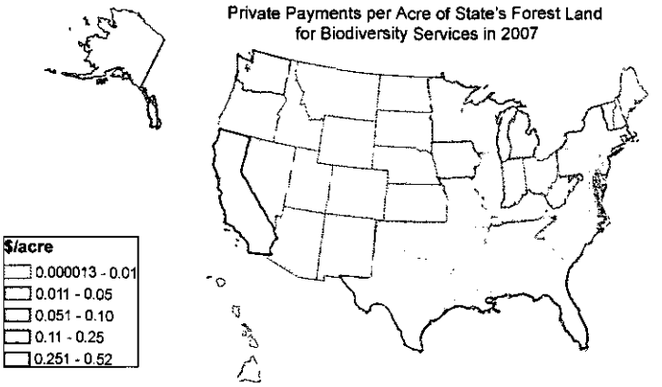


Figure 12. a) Total Private Payments (Hunting, Wildlife Viewing and Conservation Banks) for Biodiversity Services ($1000s) and b) Total Private Payments for Biodiversity Services per Acre of Private Forest in 2007

7. Payments for Bundled Services

Most forest-based payments for conservation for which data are available are made to produce a bundle of ecosystem services. There are several traditional government conservation programs that pay for bundled services, including the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP). There have also been significant voluntary payments made to landowners from non-governmental land trusts and other organizations for conservation easements. Finally, there is a robust compliance-driven wetland and stream mitigation banking market.

Figure 13 shows the total payments for bundled services between 2005 and 2007 from federal and state governments and estimates of voluntary payments. Total payments increased from $1.2 billion in 2005 to $1.4 billion in 2007.[16] Private payments to wetland mitigation banks made up about 53% of all payments ($727 million), government about 24% ($334 million), and private payments for conservation easements about 23% ($315 million).

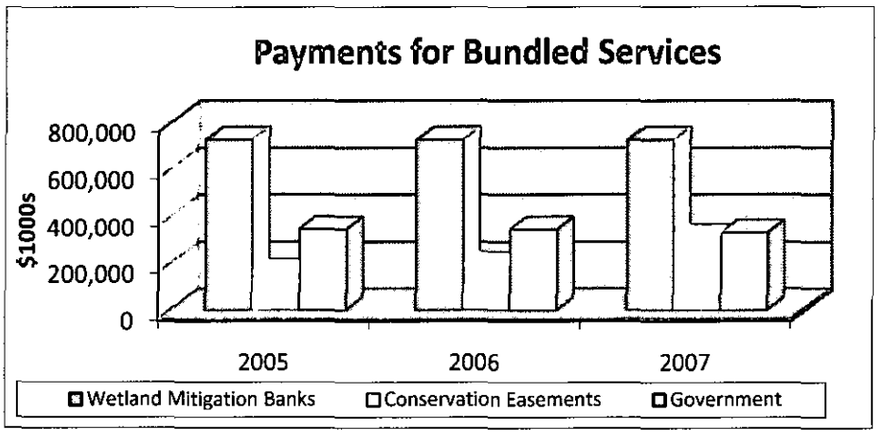
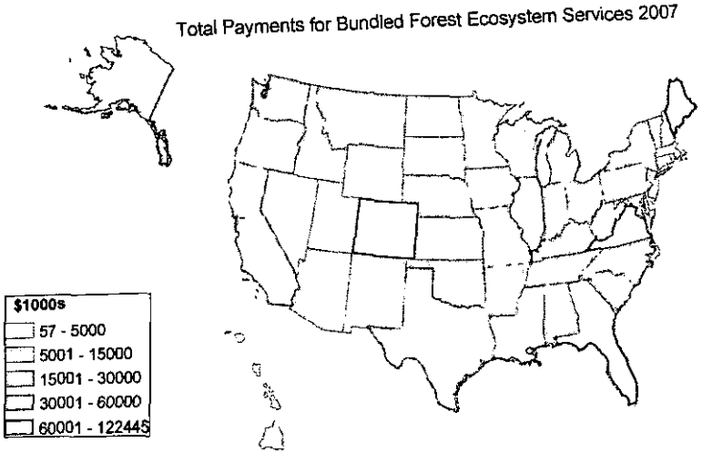


Figure 13. Payments to Forest Landowners for Bundled Ecosystem Services by Federal and State Governments and Self-Organized Private Deals for Newly Purchased Conservation Easements by Land Trusts 2005-2007 (in 1000s of Constant 2005 US$)

Figure 14 compares the distribution among the states of total bundled service payments and the amount of bundled service payments per acre of the state's forestland in 2007. Total bundled service payments ranged from $57,000 in Hawaii to $122 million in Georgia with an average payment per state of $27.5 million and a median of $16.5 million. Payments in five states were less than one million dollars (HI, AK, ND, RI, and CT) while the top three states were Georgia ($122 million), Maine ($94 million) and Virginia ($92 million). Payments per acre of forestland in 2007 ranged from $0.001 (Alaska) to $27.28 (Nebraska) with an average of $4.27 and median of $2.39.

[16] Growth in payments between 2005 and 2007 do not include changes in wetland mitigation banking as we data were only available to calculate average wetland mitigation revenues for the period 2005-2008.

14a)



14b)

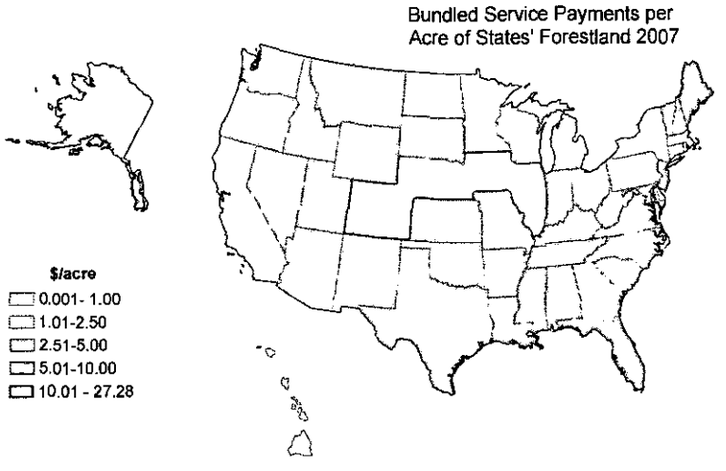


Figure 14. a) Payments to Forest Landowners for Bundled Ecosystem Services, and b) Payments per Acre of the State's Forest Land for Bundled Services from All Sources (in 1000s of Constant 2005$) in 2007

Box 2. Federal Programs Providing PES for Bundled Services

Conservation Reserve Program (CRP). CRP, established by the 1985 Farm Bill, is funded through the Commodity Credit Corporation and administered by the Farm Service Agency (FSA). The CRP targets marginal crop and pasture lands to reduce soil erosion, reduce sedimentation in streams and lakes, improve water quality, establish wildlife habitat, restore floodplains, and enhance forest and wetland resources. Farmers receive annual rental payments for 10-15 year contracts. Land rental payments are based on soil productivity. Cost sharing, up to 50%, is provided to establish approved conservation practices, with an additional 25 percent available for practices to restore wetlands. Applicants are ranked and selected based on an Environmental Benefits Index (EBI) rating system which includes probable long-term environmental benefits and cost. http://www.nrcs.usda.gov/programs/crp/

Conservation Reserve Enhancement Program (CREP). CREP is administered by the FSA, Natural Resources Conservation Service (NRCS), and local Soil and Water Conservation Districts. The program provides benefits similar to the CRP, but is tailored to meet specific environmental needs of individual states. CREP programs have been funded in roughly half the states. State and federal partnerships provide landowners with incentive payments, cost-share assistance, and rental payments for installing specific long-term conservation practices on eligible land. Landowners enter into contracts for 10-15 years to remove certain lands from agricultural production and must meet the eligibility criteria for the CRP.
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep

Forest Land Enhancement Program (FLEP). FLEP was administered by the USDA Forest Service and state agencies to provide educational, technical, and cost-share assistance to help private forest landowners implement sustainable forestry management. The objectives are to invest in or implement practices to establish, restore, protect, manage, maintain, and enhance the health and productivity of the non-industrial private forest (NIPF) lands in the United States for timber, habitat, soil, water, and air quality, wetlands, and riparian buffers. Although $100 million was originally allocated to FLEP for 2003-2007, $50 million was transferred in 2003 to the US Forest Service to help pay for costs of fighting wildfire. Only $40 million was repaid to FLEP in the 2004 Interior Appropriations budget and the remaining FLEP budget was cancelled. No payments were made after 2006. http://www.fs.fed.us/spf/coop/programs/loa/flep.shtml

Forest Legacy Program (FLP). The FLP, administered by the USDA Forest Service and state agencies, was established in the 1990 Farm Bill and renewed in the 1996 and 2002 Farm Bills to support state efforts to protect environmentally sensitive private forest lands from conversion to non-forest uses. The Forest Legacy program protects "working forests" - those that protect water quality, provide habitat, forest products, opportunities for recreation and other public benefits. The program supports acquisition of conservation easements that restrict development, require sustainable forestry practices, and protect other values. The federal government funds up to 75% of program costs, with at least 25% coming from private, state, or local sources.
http://www.fs.fed.us/spf/coop/programs/loa/flp.shtml

The Environmental Quality Incentives Program (EQIP). Authorized in the 2002 Farm Bill, EQIP is administered by the Natural Resource Conservation Service (NRCS). EQIP concentrates on improving water and air quality, conserving both ground and surface water, reducing soil erosion from cropland and forestland, and improving rangeland, riparian and aquatic areas. One to 10 year contracts provide incentive payments and cost-shares (up to 75%) to implement conservation practices with approved management plans. Incentive payments may be provided for up to three years to encourage producers to install practices. However, individuals or entities may not receive payments that exceed $450,000 for all EQIP contracts entered during the term of the current Farm Bill. http://www.nrcs.usda.gov/programs/eqip/

Wetlands Reserve Program (WRP). WRP was created in the 1990 Farm Bill to restore and protect degraded wetlands through the acquisition of permanent and 30-year easements. The NRCS provides technical and financial support for the program. The goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre. Beginning as a pilot program in nine states in 1992, WRP became a nationwide program in 1995. WRP offers landowners three options: (1) permanent conservation easement, with NRCS paying for the easement plus 100% of restoration costs; (2) 30-year conservation easement with NRCS paying 75% of the value of the easement plus 75% of restoration costs; or (3) ten-year cost-share restoration agreement, (NRCS pays 75% of the costs of restoration). The enrolled land can be used for hunting, fishing, and other uses that are compatible with providing wetland functions. Wetlands converted to drylands since 1985 are not eligible. http://www.nrcs.usda.gov/programs/wrp/

Healthy Forests Reserve Program (HFRP). The HFRP, administered by the USDA Forest Service, provides financial assistance to private forest landowners to protect, restore, and enhance forest ecosystems to promote the recovery of endangered species, improve biodiversity, and enhance carbon sequestration. Cost-share assistance is provided and, in the case of easements, landowners may receive payments for the reduction in property value due to the easement. The landowner has three choices of easement contracts with associated cost-share rates: 10-year easements (50% of conservation easement value plus 50% of restoration costs), 30-year easements (75% of conservation easement value plus 75% of restoration costs), or 99-year easements (75-100% of conservation easement value plus 100% of restoration costs). NRCS was unable to provide detailed data on payments under HFRP. However, in 2006 NRCS had $2.3 million available to fund the program in three states and in 2007 had enrolled approximately 196,000 acres in the program in Arkansas, Maine, and Mississippi. The average estimated cost per acre for easement acquisition was approximately $1,048 (CFDA 2009).
http://www.nrcs.usda.gov/programs/hfrp/proginfo/index.html

Conservation Security Program (CSP). CSP provided financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands included cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. CSP was not reauthorized in the 2008 Farm Bill and is no longer available.
http://www.nrcs.usda.gov/programs/csp/

7.1 Public Payments to Landowners

7.1.1 Federal Programs

The federal government has instituted a number of policy mechanisms to encourage private landowners to adopt stewardship practices that enhance ecosystem services and other values. Collectively, the desired goals of these policies include improving forest productivity, retaining lands in forest or undeveloped uses, protecting soil and water quality, enhancing and preserving wetlands, and improving wildlife habitat. The primary incentives offered to landowners include cost-share payments, rental payments for easements, and technical assistance in developing management plans.

The Farm Bill has been the primary mechanism for authorizing most Federal agricultural and forestry cost-share and management assistance programs, starting with the 1985 Farm Bill, when Congress introduced resource conservation policies and programs in response to concerns with the environmental impacts of rural land use. The Wetlands Reserve Program was created in the 1990 Farm Bill which also included a forestry title (Title XII, The Forest Stewardship Assistance Act) that authorized the Forest Legacy Program, the Forest Stewardship Program, and the Stewardship Incentives Program (SIP). Since then, the Farm Bill has been the primary avenue for renewing or promoting new forestry incentive programs.

We identified 8 Federal programs that pay landowners to manage their forestlands (or to plant trees on non-forest land) to enhance the production of a bundle of ecosystem services: CRP, CREP, WRP, FLEP, FLP, EQIP, HFRP and CSP. Box 2 provides a brief summary of these programs.

Figure 15 shows the total payments for bundled forest-based ecosystem services by program.[17] CRP and WRP dominate the government payments for forest-based bundled services. In 2007, CRP payments accounted for 52% and WRP for 38% of all government payments for bundled services. The remaining programs for which we had data, FLEP, FLP, and EQIP, comprise less than 10% of all government payments.

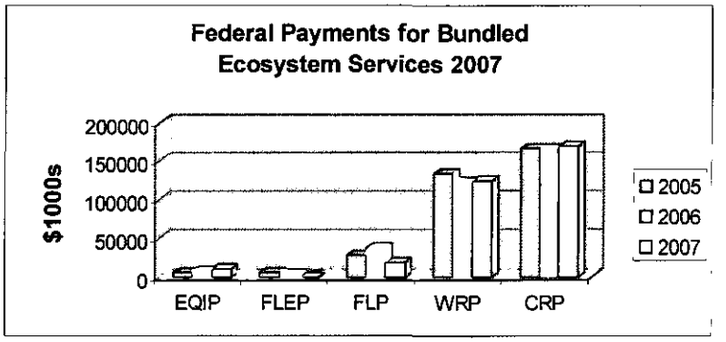
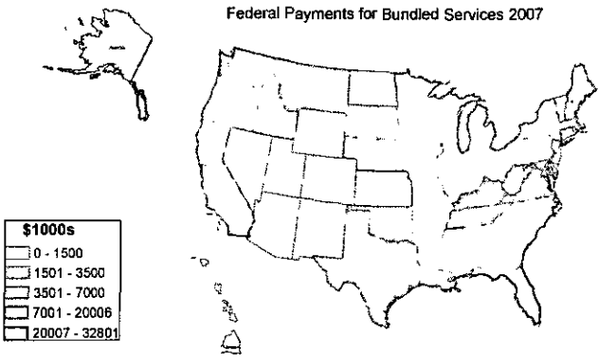


Figure 15. Payments for Bundled Ecosystem Service by Environmental Quality Incentives Program (EQIP), Forest Land Enhancement Program (FLEP), Forest Legacy Program (FLP), Wetlands Reserve Program (WRP) and Conservation Reserve Program (CRP) (in 1000s of Constant 2005$)

[17] Data was not available for the CSP or HFRP.

Figure 16 shows how government payments for bundled services are distributed across the states in terms of total payments and payments per acre of the states' private forestland. Government incentive payments averaged $7 million per state in 2007 with a median payment of $4.5 million. Fifteen states (nine southern and 6 Midwestern farm states) received more than $10 million in 2007. Six of the top ten are in the South and four are in the Midwest. The top four states were Mississippi ($33 million), Florida ($28 million), Illinois ($23 million) and Iowa ($20 million) and the bottom four were Nevada (no federal payments), Hawaii ($15,000), Alaska ($55,000) and Arizona ($145,000). The distribution changes when evaluated as payments per acres of forestland in each state (16b). The highest payments per acre are dominated by the Midwestern farm states due to the large CRP payments for reforesting marginal farmlands and relatively small amount of forestland. Only two southern states (Mississippi and Florida) are in the top ten for payments per acre of private forest land. Average government payment for bundled services per acre of forestland was $0.62 in 2007 with a median payment of $0.67/acre. States with the largest payments per acre were Nebraska ($12/acre), Iowa ($9/acre), Illinois ($6/acre) and South Dakota ($5/acre) while the lowest occurred in Nevada (none), Alaska ($0.0004/acre), Hawaii ($.01/acre), West Virginia ($0.01/acre) and Arizona ($0.03/acre).

16a)



16b)

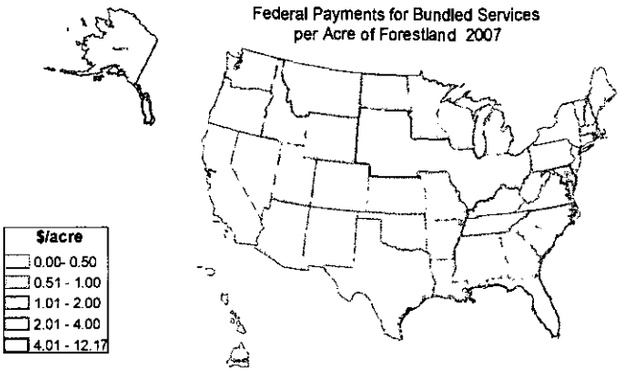


Figure 16. a) Total Federal Payments for Bundled Ecosystem Services ($1000s) and b) Total Federal Payments per Acre of Private Forest Land in 2007

7.1.2 State Programs

A number of states (mostly in the South) initiated forestry cost-share programs in the 1970s, primarily focused on timber productivity. However, the states began to expand the programs in the late 1980's to provide incentives for retention of agricultural and forestry land uses, protection of riparian areas and wetlands, enhancement of wildlife habitats, and water quality and soil conservation. Most state programs are similar to the Federal programs and focus on development of management plans and cost-share assistance. Most state programs have prohibited payments from both federal and state sources for the same practice, but some allow both sources of funding up to 100 percent of the cost of installing the practice.

7.2 Voluntary Payments

The primary source of voluntary payments for bundled services comes from the purchase of conservation easements, which are legally binding agreements between landowners and land trusts or government agencies to sell or donate one or more attributes of land ownership—for example, the right to develop or subdivide the land—to the agency or land trust. In most cases, the conservation easement restricts the owner's (and future owner's) ability to develop the property, which preserves its forested character. They can also prevent or restrict commercial timber harvest, farming, spraying pesticides, altering water courses, building new fences, and harvesting native plants. Conservation easements can also bring significant federal tax benefits for landowners, including deductions up to 50% of adjusted gross income for donations of qualified conservation easements, and eligible farmers, ranchers, and forest landowners can deduct up to 100% of their adjusted gross income.[18] Furthermore, many states offer income tax credits, as well as property and other tax incentives, for donated easements (Parker 2005).

Land trusts, nonprofit organizations that enhance or preserve ecosystem services on private land, are among the most important purchasers of conservation easements. Results from the Land Trust Alliance (2005) census of land trusts found that the number of land trusts increased more than 300% in 21 years, from 535 land trusts in 1984 to 1667 in 2005. These include local and regional land trusts, as well as the four largest land trust organizations - The Nature Conservancy, Ducks Unlimited, The Conservation Fund, and The Trust for Public Land. The number of acres protected by conservation easements increased by almost four million acres between 2000 and 2005. The reasons land trusts acquired conservation easements included the preservation of: natural areas and wildlife habitat, which accounted for 39% of the area conserved by land trusts, followed by open space (38%), and water resources, especially wetlands (26%) (Land Trust Alliance 2005). Analysis of a random sample of 119 conservation easements held by the largest nonprofit easement holder, The Nature Conservancy, between 1985 and 2004 found that almost all were designed to reduce development. Nearly half (46%) of the eased properties were working landscape easements, allowing ranching, forestry, or farming (Rissman, et al. 2007).

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[18] The tax law defines a farmer or rancher as someone who receives more than 50% of their income from "the trade or business of farming" which includes the planting, cultivating, caring for, or cutting of trees, or the preparation (other than milling) of trees for market.

Figure 17a shows the distribution of total payments for new conservation easements in 2007. The average payment for new conservation easements in 2007 is estimated to be $6.3 million per state with a median of $1.6 million. The top three states in terms of total payments for newly eased forest acres were Maine ($89 million), Colorado ($65 million) and Georgia ($23 million). Figure 17b presents the revenues from selling conservation easements per acre of the states' forested lands in 2007. Revenues averaged about $1 per acre of forest in 2007 with the top three states being Colorado ($19/acre), Maine ($5/acre) and Nebraska ($4/acre).

17a)

17b)

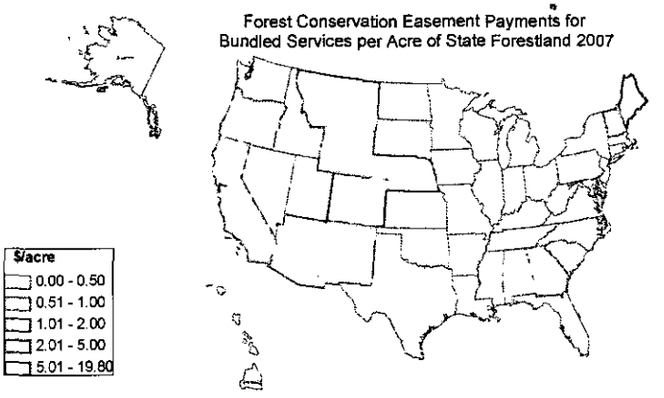


Figure 17. a) Total Payments to Forest Landowners for Conservation Easements, and b) Payments per Acre of Private Land per State in 2007 (in Constant 2005$)

7.3 Compliance-Driven Payments

7.3.1 Wetland and Stream Mitigation

Compensatory wetland and stream mitigation allows developers (once they have taken steps to avoid and minimize wetland loss) to compensate for wetlands losses during land development by either creating their own mitigation (e.g., permittee-responsible mitigation) or purchasing credits from wetland mitigation banks or in-lieu fee programs in order to receive permits to alter existing wetlands. The primary driver behind compensatory mitigation is § 404 of the Federal Water Pollution Control Act of 1972 (Clean Water Act or CWA, 33 U.S.C. §§ 1251 *et seq.*). Compensatory mitigation today is guided by the regulation "Compensatory

Mitigation for Losses of Aquatic Resources," released in 2008 by the US Environmental Protection Agency and the US Army Corps of Engineers (US EPA and US ACE 2008).

Wetland mitigation banks were originally developed by permittees seeking to create credits for their own permitted projects, but in the early 1990s, free-standing entrepreneurial banks were developed solely for the purpose of selling credits to multiple customers. Prior to 1990 there was a clear regulatory preference for on-site wetland mitigation, but failures to safeguard wetland functions and protect the environment eventually produced a shift in preference for off-site, larger-scale mitigation (Ruhl and Gregg 2001). This shift enabled permittees to aggregate or "bank" multiple mitigation projects and thereby create or restore larger tracts of wetlands. The 2008 compensatory mitigation regulations now give a stated 'preference hierarchy' of mitigation from banks (first preference), in-lieu fee programs (second), and permittee-responsible offsets (third) (US EPA and US ACE 2008).

In 1992, 46 banks had been created, which were almost all publicly sponsored single-user banks that stockpiled wetland credits for their own use (EPA 2009). By 1994, commercial banks had begun to sell credits to other permittees. The number of commercial mitigation banks increased from 13 banks in 1995, to 176 in 2001, 305 in 2005, and 431 in 2009.[19] About 20 percent of all approved commercial mitigation banks had sold out their credit capacity by 2005, more than half of which were within in the Mississippi Valley Division. In 2009, there were another 182 mitigation banks working their way through the US ACE approval process (Madsen, et al. 2010). Despite the 375% increase in mitigation banks over 14 years, banks only accounted for 35% of all wetland mitigation in 2009. Permittee-responsible on-site mitigation comprised about 59% and in-lieu fee programs about 6% of wetland mitigation. In 2005, 72.2% of the mitigation banks were sponsored by private entrepreneurs or companies, 14.2% were run by state agencies; 7% were sponsored by local government agencies; and the balance was run by federal agencies and non-profit organizations (Wilkinson and Thompson, 2005).

Scant data on area of wetland and stream mitigation required are available for 2005-2007, and the data that are available generally do not specify the types of land on which the wetland or stream mitigation occurred. Madsen, et al. (2010) estimate that an average of 24,178 acres of wetlands are mitigated annually in 34 states and the average price is $74,535 per acre and that sales of wetland and stream mitigation credits (from mitigation banks, in-lieu fee programs, and permittee-responsible mitigation) totaled $1.3 - 2.2 billion in 2008, but this included both forested and non-forested wetlands, and private and public banks. Using data on the number of banks in each state, the relative percentage of forested to non-forested wetlands in each state, and assuming 72% of banks were privately owned we estimate that developers paid a total of $727 million annually to 173 privately owned, forested wetland mitigation banks between 2005 and 2007. Distribution of payments is shown in Figure 18. Payments per state ranged from 0 (in 16 states) to $87 million in Virginia.

[19] Reporting of the number of banks is complicated by "umbrella banks," which have multiple mitigation sites, but are governed by a single mitigation bank instrument.

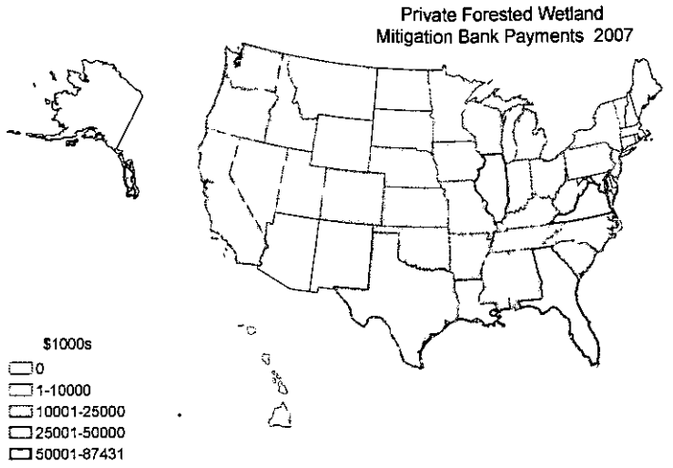


Figure 18. Estimated Payments Received by Private Forested Wetland Mitigation Banks in 2007

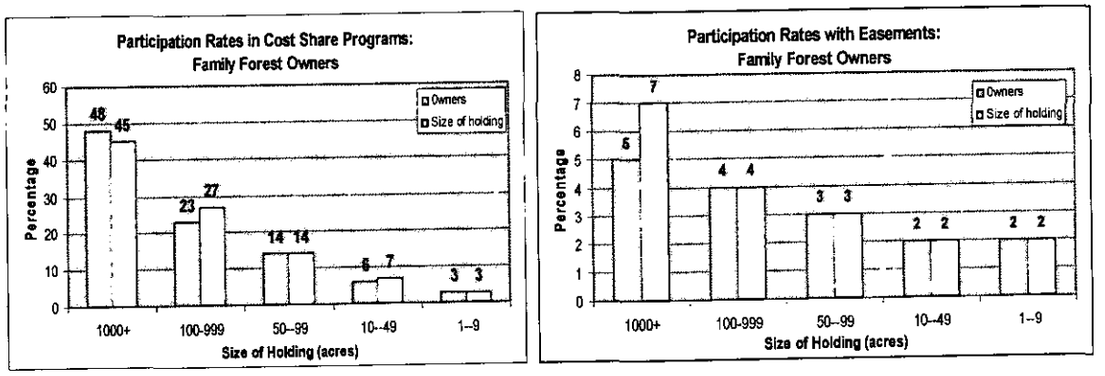
8. Distribution of Payments among Landowners

A very small percentage of private forest landowners receive payments for ecosystem services. For example, wetland mitigation accounted for the largest percentage of forest-based ecosystem service payments, with 38% of all payments in 2007. However, these payments were received by about only 173 private forest mitigation banks, about 0.00002% of all private forest landowners in the US. Between 2002 and 2006, the US Forest Service surveyed 15,400 family forest owners[20] who comprise 92 percent of all private forest owners and 62 percent of all private forest land in the United States. Only six percent of family forest owners, who own 21 percent of the family forest land, have ever participated in a cost-share program. Participation rates varied significantly by amount of forestland owned; 71% of cost-share participants owned forest tracts greater than 100 acres and 48% owned more than 1000 acres (Figure 19a). Only 2% of landowners (who own 4% of all family forest land), have easements on their lands.[21] Participation in easements, however, are more evenly distributed by size of forest land holding, with 9% of owners of more than 100 acres and 7% with less than 100 acres having some portion of their forest land under an easement (Figure 19b). Nationwide, only about 3% of private rural landowners received payments for hunting leases or entrance fees in 1995-96 compared to 8% in the South (Teasley et al. 1999)

[20] Family forest owners, a subset of NIPFs, are defined as individuals, trusts, estates, family partnerships, and other unincorporated groups of individuals that own forest land.

[21] Many respondents to the Butler, et al.'s (2005) questionnaire included rights-of-way and other easements in their responses so the statistics for easements should be interpreted as including conservation easements as well as all other easements.

19a) *19b)*



Adapted from Butler 2008.

Figure 19. Percentage of Family Forest Land and Family Forest Owners who Have Participated in (a) Cost-Share Programs and (b) Conservation Easements by Size of Forest Holdings

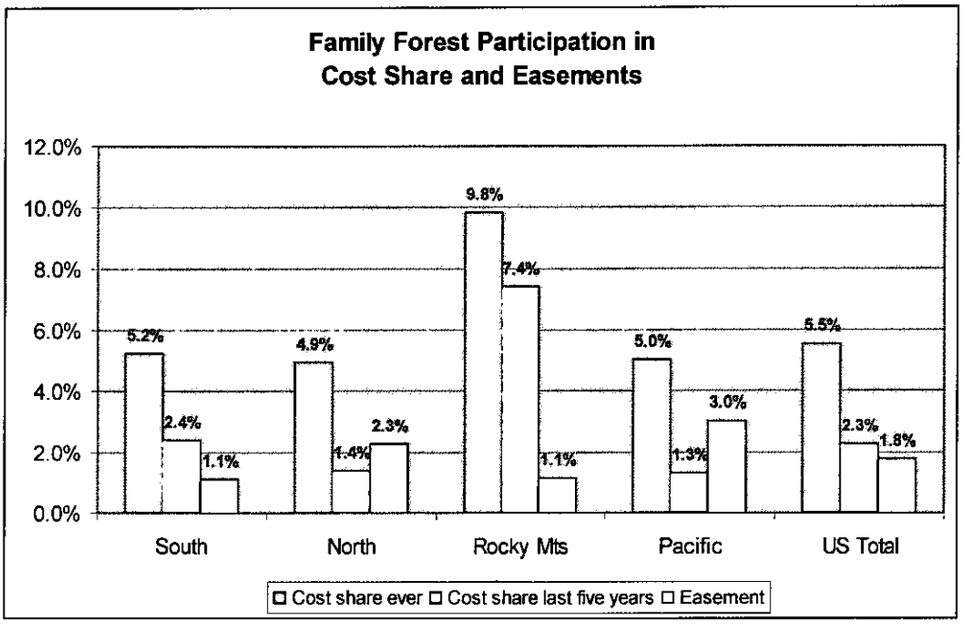
There are strong regional differences in participation rates. Figure 20 shows the percentage of family forest owners who participated in cost-share programs or conservation easement contracts by region. The Rocky Mountain region had the highest percentage of family forest owners that have ever participated in a cost-share, 9.8%. Participation rates in all other regions ranged from 4.9 to 5.2% close to the national rate of 5.5%. Participation rates in cost-share programs during the last five years were much lower, with a national rate of only 2.3%. The Rocky Mountain region is the outlier at 7.4% with 1.3% in the Pacific, 1.4% in the North, and 2.4% in the South. Only 1.8% of all family forest landowners had easements on their lands, with the highest percentage in the Pacific states (3%), followed by 2.3% in the North and 1.1% in the South and Rocky Mountains.

Following a thorough review of more than 50 years of literature and conducting focus groups of landowners across the US, Greene, et al. (2005) concluded that most financial incentives actually have little effect on forest owner behavior. In their meta-analysis of 41 econometric studies, Beach, et al. (2003) examined the impacts of four categories of factors that influence: forest management decisions, market drivers (e.g., prices, costs and returns to alternative investments), policy variables (tax incentives, cost-sharing and technical assistance), owner characteristics, and site conditions. Policy variables were the most likely to be significant when included (87%), followed by plot/resource conditions (79%), owner characteristics (77%) and market drivers (73%).

Both Beach, et al. (2005) and Greene, et al. (2005) conclude that non-industrial private forest landowners (NIPFs) more often respond to targeted government programs than to market prices or other financial incentives and that three approaches have consistently succeeded in changing forest management decisions by private landowners: technical assistance, cost-share payments, and direct contact with professional foresters or natural resource specialists. For example, as early as 1951, forest landowners were shown to prefer technical assistance over financial or tax incentives (James, et al. 1951). More recently, Greene and Blatner (1986), Baughman (2002), and Kilgore and Blinn (2004) found technical assistance to be the most effective way to change forest landowner behavior in both the US and Canada. One caveat too this conclusion is that incentives for biodiversity and wildlife habitat protection appear to have been more successful in changing land owner

behavior. However, even for biodiversity and wildlife conservation, landowner surveys repeatedly find that the programs pay many landowners for taking actions they would have done without the incentives.

This could be a problem for some PES programs in the US, many of which require projects to be additional, which means that they would not have occurred without the ecosystem service payment.



Adapted from Butler 2008.

South = (AL, AR, FL, GA, KY, LA, MS, NC, OK (east), TN, TX (east): North = North (CT, DE, IA, IL, IN, MA, MD, ME, MI, MN, MO, OH,NH, NJ, NY, PA, RI, VT, WI, WV); Pacific= (AK, CA, HI, OR, WA);
Rocky Mts = (AZ, CO, KS, ID, ND, NE, NM, NV, MT, SD, UT, WY)

Figure 20. Percentage of Family Forest Owners Who Have Participated in Cost-Share Programs and Conservation Easements by Region

9. Conclusions

Payments for forest-based ecosystem services have a long history in the US. Government-funded PES in the US was kick-started with the creation of the Conservation Reserve Program in the 1985 Farm Bill and has grown to encompass at least 14 different federal PES programs and a host of state programs. There also is a long history of non-government voluntary PES in the US, including the purchase of conservation easements by land trusts and other non-government conservation organizations and robust markets for hunting leases. Finally, there are also several markets for compliance-driven PES, including water quality trading markets, conservation banks, and wetland and stream mitigation banks.

Unfortunately, there have been scant efforts among government and non-government organizations to systematically collect financial data to allow a full accounting of the actual payments US forest landowners receive for producing ecosystem services. Particularly glaring is the lack of systematic efforts by government agencies to collect national level financial data on wetlands mitigation banking, conservation banking, water source protection, and federal and state tax incentives. Nevertheless, based on the available data, our analysis suggests that between 2005 and 2007, landowners received annual payments of at least $1.9 billion per year for forest-based ecosystem services. Due to limitations on available data, this estimate represents a lower bound of the full financial benefits landowners are receiving for producing ecosystem services from forests. In 2007, private forest landowners in the US received $727 million for wetland mitigation bank credits, $34 million for conservation bank credits, $1.7 million for sales of carbon offsets, $315 million for conservation easements, $410 million for hunting leases and $365 million in government incentive payments. Federal and state tax incentives provide an additional, large but unknown, amount of financial benefits to forest landowners for producing ecosystem services.

Unfortunately, very few landowners participate in these programs. For example, wetland mitigation accounted for the largest percentage of forest-based ecosystem service payments, with 38% of all payments in 2007. However, these payments were received by only about 173 private forest mitigation banks, about 0.00002% of all private forest landowners in the US in 2005. Only 5.5% of family forest landowners report having ever received cost-share payments and only 1.8% have conservation easements on their property (Butler 2008) and only 3% of rural landowners sold hunting leases in 1995 (8% in the South) (Teasley et al. 1999). Furthermore, our analysis suggests that payments in 2007 averaged only about $5.44 per acre of privately owned forestland in the US. All of this suggests that the economic and social forces that have led to forest fragmentation and loss in the US are so strong that PES payments have so far not had a significant impact on forest land use at the regional or national level (Newman 2008). Although there are a number of oft cited PES success stories in the US (e.g., the New York City and Seattle watershed protection projects, and local efforts to preserve endangered species habitat such as for the gopher tortoise in Alabama), changes in government and corporate policy will be critical for PES to result in large enough financial returns to effectively compete with development and other economic drivers of land use in the US in order to have a significant impact on the provision of forest-based ecosystem services.

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Appendix A.

Summary of Federal programs providing payments to landowners for provision of ecosystem services from forests.

Program	Agency	Description	Inception Date	FY 2008 Funding Level (Thousands)	Cumulative Acres Protected	Data Obtained?
Conservation Reserve Program (CRP)	USDA-FSA	Targets marginal crop and pasture lands to reduce soil erosion, reduce sedimentation in streams, and lakes, improve water quality, establish wildlife habitat, restore floodplains, and enhance forest and wetland resources.	1985	$1,860,929	33,879,482	YES
Conservation Reserve Enhancement Program (CREP)	USDA-NRCS	Sub-program of CRP tailored to meet specific environmental needs of individual states.	1997	Included in CRP above	Included in CRP above	YES (included in CRP data)
Forest Land Enhancement Program (FLEP)	USDA-FS	Provides cost-share assistance to help private forest landowners implement sustainable forestry management objectives.	2002	Not renewed	1,700,000	YES
Forest Legacy Program (FLP)	USDA-FS	Protects private forest lands from conversion to non-forest uses via acquisition of conservation easements.	1990	$52,317	1,579,348	YES
Healthy Forests Reserve Program (HFRP)	USDA-FS	Provides financial assistance to protect, restore, and enhance forest ecosystems to promote the recovery of endangered species, improve biodiversity, and enhance carbon sequestration.	2003	$2,055	197,826	No Funds Currently Distributed to land owners
Environmental Quality Incentives Program (EQIP)	USDA-NRCS	Offers incentive payments and cost-shares to implement conservation practices with an approved plan.	1996	$1,004,926	41,700 contracts	YES
Wetlands Reserve Program (WEP)	USDA-NRCS	Protects, restores, and enhances wetlands through conservation easements, and cost-share restoration agreements.	1985	$227,631	2,000,169	YES

Program	Agency	Description	Inception Date	FY 2008 Funding Level (Thousands)	Cumulative Acres Protected	Data Obtained?
Wildlife Habitat Incentives Program (WHIP)	USDA-NRCS	Provides technical and financial assistance to improve upland, wetland, riparian, and aquatic habitat areas.	1996	$57,811	646,491	YES
Conservation Security Program (CSP)	USDA-NRCS	Provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life.	2002	$237,345	2,107,730	YES
Private Stewardship Program (PSP)	DOI-FWS	Provides direct funding to benefit federally listed, proposed, or candidate species, or other at-risk species on private lands.	2003	N/A	N/A	YES
Landowner Incentives Program (LIP)	DOI-FWS	Offers direct funding and technical assistance to enhance, protect, or restore habitats that benefit "species-at-risk" on privately owned lands.	2003	Not renewed	1,333,619	NO
Partners for Fish and Wildlife (PFW)	DOI-FWS	Offers direct funding and technical assistance to support restoration of wetlands and other fish and wildlife habitats on private land.	1987	N/A	N/A	YES
North American Wetlands Conservation Act Program (NAWCA)	DOI-FWS	Targets long-term protection of wetlands and associated uplands habitats, including forests, needed by waterfowl and other migratory birds in North America.	1989	$83,484	6,331,999	YES
The National Coastal Wetlands Conservation Grant Program	DOI-FWS	Provides direct financial assistance for acquisition, restoration, management, or enhancement of coastal wetlands.	1990	$20,500	244,000	NO

Appendix B.

Carbon offset providers/aggregators providing payments to forest landowners.

Offset Provider/Aggregator	Data Availability	Website
AgraGate Forestry	no	http://www.agragate.com
American Forest Foundation	no	http://www.forestfoundation.org/carbon.html
American Forests	no	http://www.americanforests.org/
Be Green	no	http://www.begreennow.com
Beartooth Capital	no	http://www.beartoothcap.com/
Carbon Caring	no	http://www.carboncaring.com/
CarbonFund	**yes**	http://www.carbonfund.org/
CarbonNeutral	no	http://www.carbonneutral.com/
Clean Air Conservancy	no	http://www.cleanairconservancy.org/
Climate Clean	no	http://climateclean.net/
Conservation Fund	no	http://www.conservationfund.org/
Delta P2/E2 Center	**yes**	http://deltacarbon.org/offsets/
Ducks Unlimited	**yes**	http://www.ducks.org/
e-Blue Horizons	no	http://www.e-bluehorizons.com/
Environmental Resources Trust Ecolands	no	http://www.ert.net/ecolands/full.html
Environmental Synergy Inc	no	http://www.environmental-synergy.com/main.html
FORECON	no	http://www.foreconinc.com/EcoMarket/
GroPower	no	http://www.gropower.net/
Live Neutral	no	http://www.liveneutral.org/
Lugar Stock Farm Inc	no	http://lugar.senate.gov/
National Carbon Offset Coalition	**yes**	http://www.ncoc.us/
Pacific Forest Trust	no	http://www.pacificforest.org/
Semper Virens	**yes**	http://www.sempervirens.org/
Standard Carbon		http://www.standardcarbon.com/professional.html
Terra Global Capital		http://terraglobalcapital.com/
The Climate Trust	**yes**	http://www.climatetrust.org/
TNC	no	http://www.nature.org/
Trust for Public Land	**yes**	http://www.tpl.org/

Appendix C.

States that provided financial incentives for private forest landowners: property tax incentives, payments for ecosystem services, and other forestry programs (Greene, et al. 2010).

State	Property Tax Incentives	Ecosystem Service Payments	Other Forestry Programs	Data Available?
Alaska	X			
Alabama	X	X	X	Yes
Arkansas	X		X	No
Arizona	X			
California	X	X	X	No
Colorado	X			
Connecticut	X			
Delaware	X		X	No
Florida	X	X	X	No
Georgia	X			
Hawaii	X	X	X	No
Iowa	X	X	X	Yes
Idaho	X	X	X	No
Illinois	X	X	X	Yes
Indiana	X	X	X	Yes
Kansas	X		X	No
Kentucky	X			
Louisiana	X	X	X	No
Massachusetts	X		X	No
Maryland	X	X	X	Yes
Maine	X		X	
Michigan	X			
Minnesota	X		X	
Missouri	X	X	X	No

State	Property Tax Incentives	Ecosystem Service Payments	Other Forestry Programs	Data Available?
Mississippi	X	X	X	No
Montana	X			
North Carolina	X	X	X	Yes
North Dakota	X	X		No
Nebraska	X	X	X	Yes
New Hampshire	X		X	
New Jersey	X			
New Mexico	X	X	X	No
Nevada	X			
New York	X			
Ohio	X		X	
Oklahoma	X	X	X	Yes
Oregon	X	X		No
Pennsylvania	X	X		Yes
Rhode Island	X			
South Carolina	X	X	X	Yes
South Dakota	X			
Tennessee	X	X		No
Texas	X		X	
Utah	X			
Virginia	X	X	X	Yes
Vermont	X			
Washington	X	X	X	No
Wisconsin	X	X	X	No
West Virginia	X			
Wyoming	X			

Appendix D.

Total payments for ecosystem services from Federal and State agencies and non-government organizations and individuals from 2005 to 2007 (in 1000s of constant 2005$), and total payments per acre of all forestland in the state.

	$(1000s)			$/acre		
	2005	2006	2007	2005	2006	2007
AK	420	430	428	0.003	0.003	0.003
AL	91,195	93,036	101,211	4.236	4.321	4.701
AR	60,853	59,246	54,312	4.055	3.948	3.619
AZ	5,204	5,502	7,745	1.257	1.328	1.870
CA	63,888	66,639	68,245	4.595	4.793	4.909
CO	59,060	63,847	84,607	17.957	19.412	25.724
CT	2,340	3,169	2,938	1.372	1.857	1.722
DE	1,676	1,649	2,346	4.922	4.842	6.888
FL	138,866	143,126	157,685	10.906	11.241	12.384
GA	159,362	162,363	172,805	7.279	7.416	7.893
HI	738	538	615	0.434	0.317	0.362
IA	25,320	25,368	28,305	11.003	11.023	12.300
ID	6,519	10,722	9,829	1.627	2.676	2.453
IL	92,753	91,273	87,936	23.486	23.111	22.266
IN	18,924	14,368	15,869	4.958	3.765	4.158
KS	4,169	4,191	3,958	2.691	2.705	2.554
KY	16,306	16,486	15,675	1.551	1.569	1.491
LA	116,412	117,249	114,664	8.728	8.791	8.597
MA	4,064	7,106	6,000	1.525	2.666	2.252
MD	11,843	11,393	13,246	4.998	4.808	5.590
ME	52,031	65,337	96,825	2.953	3.708	5.495
MI	34,323	33,281	38,895	2.054	1.992	2.328
MN	21,650	24,586	19,500	1.324	1.503	1.192
MO	36,681	36,038	42,838	2.923	2.872	3.413

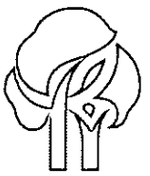
	$(1000s)			$/acre		
	2005	2006	2007	2005	2006	2007
MS	99,136	99,337	92,818	5.917	5.929	5.540
MT	12,248	18,251	17,516	2.267	3.379	3.242
NC	52,175	49,903	59,802	3.376	3.229	3.869
ND	1,183	1,173	951	2.536	2.515	2.039
NE	16,426	15,298	20,102	20.227	18.837	24.753
NH	6,629	5,798	10,395	1.700	1.487	2.666
NJ	16,797	16,390	16,727	10.469	10.215	10.425
NM	5,454	9,204	11,854	0.996	1.680	2.164
NV	1,458	1,458	1,437	4.643	4.644	4.577
NY	33,470	38,806	35,417	1.902	2.205	2.012
OH	20,766	21,903	23,178	2.874	3.032	3.208
OK	13,028	12,694	13,829	1.768	1.723	1.877
OR	24,671	29,828	31,274	1.937	2.342	2.456
PA	23,308	24,181	28,552	1.491	1.547	1.827
RI	1,009	1,883	1,221	2.700	5.039	3.267
SC	68,735	61,987	63,669	6.158	5.554	5.705
SD	2,801	2,728	2,808	5.568	5.423	5.581
TN	62,802	60,437	60,443	5.251	5.054	5.054
TX	67,530	64,865	63,820	6.363	6.112	6.013
UT	3,542	5,680	4,393	1.888	3.028	2.342
VA	100,756	100,274	100,771	7.644	7.607	7.645
VT	7,980	10,232	11,172	1.932	2.478	2.706
WA	25,813	25,924	24,868	2.031	2.040	1.957
WI	40,175	35,529	38,597	3.806	3.366	3.656
WV	2,343	2,318	2,601	0.161	0.160	0.179
WY	1,393	1,262	1,819	1.468	1.330	1.917

Appendix E.

Total payments (in 1000s of constant 2005$) from all sources by type of service between 2005 and 2007.

	CARBON Total Payments $(1000s)			BIODIVERSITY Total Payments $(1000s)			BUNDLED SERVICES Total Payments $(1000s)		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
AK				93	111	274	327	318	153
AL	0.02	0.11	0.10	49,825	49,197	49,855	41,369	43,839	51,356
AR	21.19	25.90	38.65	18,766	18,968	19,452	42,066	40,251	34,822
AZ				932	1,046	1,064	4,272	4,456	6,682
CA		147.77		35,318	35,068	35,172	28,571	31,423	33,073
CO				853	1,333	1,356	58,207	62,514	83,251
CT				1,922	2,008	2,109	418	1,161	829
DE				999	980	1,034	677	670	1,312
FL				65,775	65,553	66,188	73,091	77,574	91,497
GA				50,205	49,461	50,360	109,157	112,902	122,445
HI				664	500	559	74	38	57
IA				406	1,431	1,298	24,914	23,936	27,006
ID				477	734	731	6,043	9,987	9,098
IL	167.88	181.01	201.46	4,495	3,888	4,003	88,090	87,205	83,732
IN	3.35	3.16	3.45	1,258	581	600	17,663	13,783	15,265
KS				349	469	433	3,820	3,723	3,524
KY				2,124	1,959	2,162	14,182	14,527	13,513
LA	363.40	1182.12	1434.60	42,914	43,235	43,855	73,135	72,832	69,374
MA				3,494	4,011	3,931	570	3,095	2,069
MD				5,974	6,088	6,207	5,870	5,305	7,039
ME				2,224	2,630	2,627	49,807	62,708	94,198
MI	11.59	11.67	13.52	7,519	7,196	7,499	26,793	26,073	31,383
MN				7,332	7,578	7,524	14,318	17,008	11,976
MO				6,924	6,958	7,048	29,757	29,080	35,791
MS				19,315	20,052	20,275	79,821	79,285	72,543

	CARBON			BIODIVSERSITY			BUNDLED SERVICES		
	Total Payments $(1000s)			Total Payments $(1000s)			Total Payments $(1000s)		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
MT				717	1,078	970	11,531	17,172	16,546
NC				12,033	11,925	12,061	40,142	37,979	47,741
ND				278	435	414	905	738	537
NE				387	611	581	16,039	14,686	19,521
NH				1,233	1,436	1,135	5,395	4,362	9,260
NJ				3,548	3,116	3,100	13,249	13,274	13,627
NM				423	123	94	5,030	9,082	11,760
NV				25	39	43	1,433	1,419	1,395
NY				17,530	17,962	18,874	15,939	20,844	16,543
OH				847	1,106	1,226	19,919	20,797	21,952
OK				5,596	5,531	5,610	7,431	7,163	8,219
OR				1,877	2,133	2,176	22,794	27,694	29,098
PA				6,431	6,455	6,561	16,878	17,726	21,991
RI				488	544	422	521	1,339	799
SC				26,327	26,513	27,315	42,408	35,474	36,354
SD				488	278	267	2,313	2,450	2,541
TN				36,375	36,756	37,479	26,428	23,681	22,965
TX				29,877	30,264	30,613	37,653	34,601	33,206
UT				780	678	720	2,762	5,002	3,673
VA				8,011	8,478	8,710	92,745	91,796	92,061
VT				776	811	696	7,204	9,421	10,476
WA				3,752	4,660	4,347	22,061	21,265	20,521
WI				8,570	8,110	8,349	31,605	27,419	30,248
WV				1,383	1,358	1,398	959	959	1,203
WY				319	31	25	1,074	1,230	1,794
TOTAL	**567**	**1,552**	**1,692**	**498,226**	**501,467**	**508,801**	**1,237,429**	**1,271,266**	**1,376,021**



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