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Stacking Ecosystem Services Payments
Risks and Solutions

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Both authors contributed equally to this paper; senior authorship is shared

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Executive Summary

Healthy ecosystems provide a number of different services to society, including water filtration, biodiversity, habitat protection, and carbon sequestration. A wide variety of incentive programs and markets have arisen to pay landowners for providing these services.[2] This has led to questions about whether landowners can receive more than one payment for the ecosystem services they provide from the same parcel, a practice known as *stacking*.

In this paper, we discuss some of the benefits of stacking of ecosystem service payments, as well as potential problems that can arise due to stacking. While stacking can provide multiple revenue streams for landowners and encourage them to manage their lands for multiple ecosystem services, it can also lead to a net loss of ecosystem services. Because some ecosystem service projects are meant to offset or mitigate pollution or other environmental impacts, it is important that projects stacking multiple credits fully account for all of the impacts their projects allow.

Stacking is currently a topic of debate among policy makers, businesses, researchers, and other stakeholders involved in the management, development, or assessment of ecosystem services programs in the United States, but there has been little research or policy written on the subject. This paper is designed to help define terms, clarify the concerns that have been raised, summarize the state of legal guidance for existing programs in the United States, and begin to answer the questions about potential problems and how they can be avoided.

In this paper, we outline the different types of ecosystem service credits that can be stacked. We then introduce a conceptual framework that can help policy makers and project developers to determine if a stacked project is meeting the objective of replacing or enhancing ecosystem services. We also identify three specific circumstances in which stacking can lead to a negative outcome for ecosystem services, as well as specific policy proposals to address these issues.

1. Introduction

Healthy ecosystems provide a number of different services to society, including water filtration, biodiversity habitat protection, and carbon sequestration.[3] Payments and markets for ecosystem goods and services are on the rise around the globe.[4] They hold the potential to promote sustainable resource use and provide a stream of revenue to landowners that encourages conservation and improved land management decisions. In theory, payments for ecosystem service provision can make trees more valuable standing than cut down and could potentially make farms more valuable than suburban sprawl because of the wide range of other services they provide.[5]

A wide variety of payments and markets for several different ecosystem goods and services have arisen, driven by various environmental laws, government programs, and voluntary commitments.[6] As payments

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[2] In this paper the authors differentiate ecosystem services markets and programs from environmental markets. We consider ecosystem services programs those which pay for goods and services provided by landscapes and ecosystems rather than those generated by facilities or point sources.

[3] *See generally* GRETCHEN DAILY (ed.), NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS (1997) (describing the various services natural ecosystems provide to society), Kai M. Chan, M. Rebecca Shaw, David R. Cameron, Emma C. Underwood, and Gretchen C. Daily, *Conservation Planning for Ecosystem Services*, 4 PLOS BIOL. 2138 (2006), Elena M. Bennett, Garry D. Peterson, and Line J. Gordon, *Understanding relationships among multiple ecosystem services*, 12 ECOL. LETT. 1394 (2009).

[4] Ecosystem goods and services are ecological processes, products, and qualities that directly or indirectly improve human welfare, for example, by cleaning air and water, protecting biological diversity, and regulating nutrients and hydrologic flows.

[5] In addition to payments for ecosystem services, information about the value of ecosystem services can affect policy and business decisions to protect or enhance services.

[6] *See infra* Section 2 for more description of specific ecosystem service markets and payment programs.

and markets for ecosystem services have developed and begun to demonstrate success,[7] they have gained more attention from landowners. This leads to the question of whether and how landowners can participate in multiple markets—specifically, whether a landowner can combine multiple ecosystem service payment streams from the same parcel, which is known as *stacking*.

There are certain potential problems with ecosystem services markets, including difficulties in measuring service provision, concerns over spatial redistribution of services,[8] and tradeoffs in which an increase in one service decreases provision of another.[9] These problems are present even in single-service transactions, and stacking itself does not necessarily have a positive or negative effect on them. In this paper we focus specifically on issues directly affected or caused by stacking.

There are several positive arguments for stacking, including that it could be a means to integrate across the various laws, policies, and voluntary programs that focus on the protection of one resource at a time (e.g., water quality or biodiversity). The incentives provided by stacking multiple credits could push landowners to manage for all of the ecosystem services their lands provide, rather than just focusing on a single service.[10]

Stacking is also seen as a way to encourage greater participation in ecosystem services programs and increase ecosystem service provision. Individual markets or payment programs may not pay enough to make projects cost-effective.[11] This is one reason many support stacking: to have multiple payments to help meet the landowner's opportunity costs.

Stacking could encourage landowners to develop higher-quality projects, such as restoring a wetland for water quality instead of planting a vegetative buffer. This might not be cost-effective with a single payment stream. Using stacking as a way to achieve greater ecosystem services outcomes could be a important benefit of stacking. However, it is difficult to assess the potential for these opportunities in theory; we need to begin collecting on-the-ground examples.

Stacking is not without its critics, however. Ecosystem services payments that come from the sale of offsets or mitigation credits allow others to impact the environment. Thus offset and mitigation projects must ensure that the ecosystem services they provide are sufficient to fully mitigate all the impacts they allow. Stacking multiple credits can complicate this accounting.

Another concern sometimes raised about stacking, particularly for those involved with carbon or greenhouse gas (GHG) markets, is that stacking could result in payments to landowners that are above

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[7] *See, e.g.,* Tara O'Shea and Lydia Olander, *Finding Successful Ecosystem Service Projects and Programs in the United States*, Nicholas Institute (2011) and D. Evan Mercer, David Cooley, and Katherine Hamilton, *Taking Stock: Payments for Forest Ecosystem Services in the United States*, Forest Trends' Ecosystem Marketplace and U.S. Forest Service (2011) (showing that payments to landowners for ecosystem services from forests in the United States equaled almost $1.9 billion in 2007).

[8] *See e.g.,* J.B. Ruhl and James Salzman, *The Effects of Wetland Mitigation Banking on People*, 28(2) NAT'L WETL. NEWSL 1, 8-13 (2006) (demonstrating that wetland mitigation banks redistribute ecosystem services from urban to rural areas).

[9] *See e.g.,* Robert B. Jackson et al., *Trading Water for Carbon with Biological Carbon Sequestration*, 310 SCI. 1944, 1944 (2005) (finding that planting trees for carbon sequestration can reduce available water quantity, decreasing stream flow in some cases).

[10] Many papers in the scientific literature demonstrate that managing for one ecosystem service does not necessarily result in increased provision of other services. *See, e.g.,* Bennett, *supra* note 3, and Benis Egoh, Belina Reyers, Mathieu Rouget, David M. Richardson, David C. Le Maitre, and Albert S. van Jaarsveld, *Mapping ecosystem services for planning and management*, 127 Agric., Ecosys., and Env't 135. *See also* Daniel F. Morris, *Ecosystem Service Stacking: Can Money Grow on Trees?* Resources for the Future, Weathervane blog, available at http://www.rff.org/wv/archive/2009/08/03/ecosystem-service-stacking-can-money-grow-on-trees.aspx, and Defenders of Wildlife, *Bundling and Stacking Ecosystem Service Credits*, http://www.defenders.org/programs_and_policy/biodiversity_partners/ecosystem_marketplace/mfn/bundling_and_stacking.php.

[11] Nicholas Bianco, *Stacking Payments for Ecosystem Services,* World Resources Institute Fact Sheet, 2 (2009) http://pdf.wri.org/factsheets/factsheet_stacking_payments_for_ecosystem_services.pdf.

and beyond what they need to initiate the project.[12] This is known as the so-called "additionality" concern, meaning any payment should be associated with an increment of additional services that would not have been supplied without the payment. For example, it may not be considered cost-effective to give a second payment to a project if the landowner would have required only one payment to proceed with the conservation action. As we discuss below, there is nothing necessarily wrong with a landowner earning a profit on his or her ecosystem service project. But some ecosystem service payments come from entities trying to effect conservation or management change with scarce resources; these entities seek assurance that they will get the most environmental benefit out of the resources spent.

There is relatively little published literature on the topic of stacking. The World Resources Institute has published a brief fact sheet on the additionality concerns of credit stacking;[13] Jessica Fox laid out some of the basic concepts in an earlier paper,[14] and she and others have conducted a survey of ecosystem service practitioners on the state of credit stacking in the United States;[15] J.B. Ruhl wrote a brief overview of some of the legal and policy issues with stacking;[16] and Richard Woodward has published a paper on the economics of stacking multiple ecosystem payments.[17] In addition, the firm Kieser and Associates has issued a concept paper on selling multiple ecosystem services,[18] and Suzie Greenhalgh has also written a paper the related topic of bundling.[19] While there are many other papers that briefly mention stacking, this is largely the extent of the papers in academic journals and gray literature that focus specifically on stacking.

However, stacking remains a topic of interest among policy makers, researchers, and practitioners, who have engaged in an active conversation about what constitutes stacking and whether it should be encouraged or discouraged. U.S. policy makers at the state and federal levels are grappling with the design and implementation of policies to address stacking. Project developers and landowners face significant uncertainties about the validity of current projects and the potential for future eligibility in new ecosystem programs. There is growing confusion and contention about stacking and how policies and regulations should address it.

In this paper, we present a conceptual model for differentiating cases in which stacking poses few or no problems from those in which it is more likely problematic. In section 2, we provide a description of the ecosystem markets and payment programs in the United States and a survey of how these policies address stacking; section 3 provides an overview of the types of markets and programs that are stacked and how they are stacked; section 4 introduces a conceptual framework to inform discussion of how stacking impacts environmental objectives for ecosystem service markets and payment programs; section 5 discusses economic considerations of stacking; section 6 discusses policy implications; and we conclude in section 7.

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[12] This is sometimes described as financial additionality in carbon offset protocols.
[13] Nicholas Bianco, *supra* note 11.
[14] Jessica Fox, *Getting Two for One: Opportunities and Challenges in Credit Stacking*. Ch.11 in Conservation and Biodiversity Banking: A Guide to Setting up and Running Biodiversity Credit Trading Systems. Ed. R. Bayon. London. Earthscan Publications (2007).
[15] Jessica Fox, Royal C. Gardner, and Todd Maki, *Stacking Opportunities and Risks in Environmental Credit Markets*, 41 ELR 10121 (2011).
[16] J.B. Ruhl, *Stacking and Bundling and Bears, Oh My!* NAT'L WETL. NEWSL. 24-25 (January-February 2010).
[17] Richard Woodward, *Double Dipping in Environmental Markets*. 61 J. OF ENVT'L ECON. AND MANAG. 153-169 (2011).
[18] Kieser and Associates, *Ecosystem Multiple Markets: A White Paper* (2004) Available at http://www.envtn.org/uploads/EMM_WHITE_PAPERApril04.pdf.
[19] Suzie Greenhalgh, *Bundled Ecosystem Service Markets—Are They the Future?*, Selected paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27–29, 2008, Available at http://ageconsearch.umn.edu/bitstream/6166/2/467628.pdf.

2. Description of U.S. Policies Governing Ecosystem Service Markets, Payment Programs, and Stacking

Stacking of ecosystem service markets and payments has only become an issue because landowners are beginning to have multiple opportunities to receive payments for the ecosystem services they provide. Ecosystem service markets and payment programs can be roughly divided into two categories: (1) offsets and mitigation credits, which allow other entities to impact the environment and (2) conservation payments and incentives, which are designed to promote conservation or improved management. In each case the entity making the payment can be the government, a private entity, or a nonprofit organization. In this section, we discuss the different types of ecosystem service markets, payments, and incentives in the United States.

2.1. Offsets and mitigation credits

The United States has a somewhat fragmented approach to environmental protection, in which separate agencies oversee different pollutant loads or management actions on the same ecosystems. In addition, separate laws have been enacted to protect specific aspects of environmental quality, such as the Clean Water Act[20] and the Endangered Species Act.[21] Federal agencies have implemented each of these laws, so that regulated entities have the option to meet compliance by offsetting or mitigating their impacts to the environment through payments for ecosystem services. These laws have each driven the development of different markets with different ecosystem service credit types. Some of the credits represent individual ecosystem services, such as water quality protection, while others are bundled credits, such as wetland credits, which are meant to represent all of the services provided by a particular ecosystem. Some credits are designed to offset impacts from a point source, such as a smokestack or effluent pipe from a facility, while others (bundled credits) are designed to mitigate an ecosystem services impact, such as damage to a stream. For all types of offsets and mitigation credits landowners are paid to generate ecosystem services that are used to compensate for environmental damages elsewhere. Because there can be uncertainty in the amount of ecosystem services provided by projects, some markets use conservative crediting or trading ratios[22] to ensure that projects provide enough services to adequately cover the impacts they offset or mitigate.

Although federal agencies have issued guidance documents[23] concerning these various ecosystem service markets, there are few actual regulations governing how projects are developed and credits are issued. The following explains the major categories of ecosystem service credits available in the United States. In Table 1 we show the scale of these programs.

Water quality credits are an optional tool for compliance with the Clean Water Act (CWA). The CWA regulates point source polluters, such as wastewater treatment plants or industrial facilities, through NPDES permits,[24] but many watersheds face significant water quality problems from nonpoint sources, such as agriculture, which are not regulated as point sources.[25] In some watersheds where stringent regulation of point sources has not been sufficient to achieve necessary water quality improvements, regulators will continue permitting point sources only under the condition that they pay for pollutant reductions from nonpoint sources. This type of water quality trading involves an entity with a regulatory

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[20] 33 U.S.C. §§ 1251, *et seq.* (2009).

[21] 16 U.S.C. §§ 1531-1544 (2009).

[22] Trading ratios require project developers to supply more credits than is strictly necessary to offset or mitigate the impact. For example, if a water quality trading program has a trading ratio of 2:1, then offset purchasers must pay for two pounds of pollution reduction for each pound of credit they receive. Such ratios are common in water quality trading and wetland and stream mitigation.

[23] Guidance documents contain helpful information provided by agencies, but unlike regulations, they do not carry the force of law.

[24] National Pollution Discharge Elimination System. *See* 33 U.S.C. § 1342 (2009).

[25] 33 U.S.C. § 502(14) (2009).

compliance obligation and a landowner who does not have a compliance obligation, but participates in the trade voluntarily. For example, a facility with a NPDES permit could meet compliance in part by paying a farmer who does not have a compliance obligation to plant a forested riparian buffer to capture nitrogen flowing off her crop fields before it enters the waterway. In this way, nitrogen pollution from the facility is offset by the decrease in pollution by the farmer, and the overall amount of pollution in the waterway remains unchanged. Water quality trading programs that allow nonpoint trading have been established in at least nine states for a variety of pollutants, including nitrogen, phosphorus, and water temperature.[26] However, many of these programs have had few trades, and several are funded through grants rather than by point sources, and thus are voluntary on both sides.[27] If nonpoint sources were covered by nutrient regulations, then trading would be between two entities with regulatory compliance obligations. However, we have not identified any water quality trading systems in the United States that have taken this approach.

Wetland and stream credits are used to achieve compliance with section 404 of the Clean Water Act,[28] under which developers may only impact a wetland or stream if those impacts are offset through the restoration, creation, or enhancement of another wetland or stream elsewhere. Wetland and stream credits are a type of bundled credit, which is designed to offset a range of critical functions and services lost to the impacted wetland.[29] This is one of the only ecosystem service markets governed by actual regulations, rather than guidance documents, which state that mitigation projects "should be located where it is most likely to successfully replace lost functions and services."[30] In practice, regulators typically identify a subset of ecosystem functions and services to assess for compliance. For example, the North Carolina Wetland Assessment Method (NC WAM) assesses three wetland functions: hydrology, water quality, and habitat.[31]

Endangered species habitat credits are used to achieve compliance with section 10 of the Endangered Species Act (ESA)[32] which allows landowners to impact endangered species habitat with a permit from the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS). FWS has implemented this policy by allowing the establishment of conservation banks, which restore, create, or otherwise protect endangered species habitat.[33] Landowners who seek to impact endangered species habitat may purchase credits from conservation banks to offset their impacts. Similar to wetland credits, species or habitat credits are a type of bundled credit, because the credited habitat is expected to have all of the critical elements of that habitat that help it to support populations of the endangered species. Strictly speaking, conservation banking might not be considered an ecosystem services market, because the banks are intended to benefit endangered species and not necessarily to benefit humans.[34] However, these banks can be included in stacks of other, more human-oriented environmental markets, and thus are still relevant to this discussion.

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[26] *See* Environmental Protection Agency, Water Quality Trading, List of All Trading Programs, available at http://water.epa.gov/type/watersheds/trading/upload/tradingprograminfo.xls (accessed January 12, 2011).
[27] *See* Kurt Stephenson and Leonard Shabman, Rhetoric and Reality of Water Quality Trading and the Potential for Market-like Reform, 47 J. AMER. WATER RES. ASSN. 15-28 (2011) (for more information on water quality trading, including a discussion of important legal and institutional barriers to implementing trades between point and nonpoint sources that make trading programs less market-like in practice than many researchers and policy makers suggest).
[2828] 33 U.S.C. § 1344 (2009).
[29] 33 C.F.R.§ 332.3(b)(1) (2010).
[30] *Id.*
[31] N.C. Dept. of Trans., Corps of Engineers, N.C. Dept. of Env't and Nat. Res., EPA, U.S. Fish and Wildlife Service, North Carolina Wetland Assessment Method User Manual (2010). Available at http://portal.ncdenr.org/web/wq/swp/ws/pdu/ncwam [hereinafter NC WAM].
[32] 16 U.S.C. § 1539 (2009).
[33] U.S. Fish and Wildlife Service. Guidance for the Establishment, Use, and Operation of Conservation Banks (2003), [hereinafter GUIDANCE FOR CONSERVATION BANKS].
[34] *See supra* note 4.

Carbon offsets are ecosystem payments for actions that sequester or avoid emissions of carbon dioxide or other greenhouse gases (GHGs), which are not currently required by federal law.[35] However there are two programs in the United States (one state and one regional) that place a cap on GHG emissions from some sources, while allowing those capped entities to purchase carbon offsets from uncapped sources as an option for meeting compliance. California has developed a cap-and-trade program under Assembly Bill 32,[36] which allows a range of land management-based offsets, including forest management and avoided forest conversion,[37] and it is considering some activities involving improved agricultural management. Ten states in the Northeast and Mid-Atlantic have joined to form the Regional Greenhouse Gas Initiative (RGGI), which limits carbon emissions from the power sector and allows land management-based offsets including afforestation and agricultural manure management.[38] In practice, however, offsets have not been an active part of the RGGI program due in part to low allowance prices. There is also an active voluntary market in which individuals and businesses can offset their carbon footprints.[39] These markets support a wide range of activities that increase sequestration or avoid emissions of greenhouse gases (GHGs) such as planting trees, changing livestock manure management, or changing fertilizer use.[40] The credits generated by these projects can be sold to businesses or other entities to offset their GHG emissions.

There are also a few examples of other emerging voluntary markets for ecosystem services. The American Forest Foundation and World Resources Institute have developed a crediting system for gopher tortoise habitat, which is not yet regulated under the ESA.[41] The Willamette Partnership in Oregon is developing credits for restoration of prairie habitat, which currently lacks a policy driver.[42] The Business and Biodiversity Offset Program is developing pilot projects in which businesses offset their impacts to biodiversity, including one project in the United States.[43] The Bonneville Environmental Foundation has created a voluntary market for Water Restoration Credits, to provide incentives for water rights holders to leave water in water-scarce ecosystems.[44] And Walmart has joined with the National Fish and Wildlife Foundation to create the Acres for America program, in which Walmart pledges to protect one acre of important habitat or open space for every acre occupied by Walmart's U.S. facilities.[45]

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[35] There have been several bills introduced in Congress to address climate change in recent years, including the American Clean Energy and Security Act (H.R. 2454, 2009), the Clean Energy Jobs and American Power Act (S. 1733, 2009), and the American Power Act (Discussion draft, 2010, available at http://kerry.senate.gov/imo/media/doc/APAbill3.pdf). Each of these bills would have placed a limit on GHG emissions, while allowing regulated entities to purchase offsets from land use and other activities.
[36] California Health and Safety Code §§ 38500, *et seq.* (2010).
[37] California Environmental Protection Agency, Air Resources Board, Proposed Regulation to Implement the California Cap-and-Trade Program Part V: Staff Report and Compliance Offset Protocol: U.S. Forest Projects (2010) Available at http://www.arb.ca.gov/regact/2010/capandtrade10/cappt5.pdf.
[38] Regional Greenhouse Gas Initiative Model Rule, 91 (2008).
[39] Kate Hamilton, Molly Peters-Stanley, and Thomas Marcello, *Building Bridges: State of the Voluntary Carbon Markets 2010*, Ecosystem Marketplace (2010).
[40] Details on the various offset types found in the voluntary markets can be found on the registry websites: Climate Action Reserve (CAR) www.climateactionreserve.org; Voluntary Carbon Standard (VCS) www.v-c-s.org; American Carbon Registry (ACR) www.americancarbonregistry.org. Note that CAR offers voluntary credits in addition to compliance-grade credits for use in the California cap-and-trade program.
[41] Willamette Partnership, *Measuring Up: Synchronizing Biodiversity Measurement Systems for Markets and Other Incentive Programs,*17 (2011) Available at http://willamettepartnership.org/measuring-up/Measuring Up w appendices final.pdf.
[42] Willamette Partnership, Upland Prairie Habitat, http://willamettepartnership.org/ecosystem-credit-accounting/prairie/copy_of_upland-prairie-habitat.
[43] Business and Biodiversity Offset Program, http://bbop.forest-trends.org/.
[44] Bonneville Environmental Foundation, http://www.b-e-f.org/business/products/wrcs/.
[45] As of 2010, Walmart had committed $35 million, conserving 625,000 acres. http://walmartstores.com/Sustainability/5127.aspx (Accessed January 14, 2010). Other examples of voluntary biodiversity offsets include the Business and Biodiversity Offsets Program (BBOP), which has a pilot project in which the city of Bainbridge Island, Washington is protecting important habitat on the island to offset impacts from residential development. http://bbop.forest-trends.org/guidelines/low_bainbridge-case-study.pdf (Accessed January 13, 2011).

Table 1. Number of ecosystem markets and projects in the United States.

Ecosystem service market	Number of projects
Water quality trading	14 trading programs[46]
Wetland and stream mitigation banks	797 banks[47]
Endangered species/conservation banks	116 banks[48]
Carbon offsets	73 projects[49]

2.2. Conservation payments and incentives

The federal government and various state governments have developed numerous programs to incentivize conservation practices, including several conservation programs authorized by the Farm Bill.[50] These conservation incentive programs include both land retirement programs, such as the Conservation Reserve Program (CRP),[51] where land is taken out of agricultural production, and also working lands programs, such as the Environmental Quality Incentives Program (EQIP),[52] which offers incentives for improved management practices on working farms and forests. The lands participating in these incentive programs provide a variety of ecosystem services, and they may have the potential to participate in other ecosystem markets or payment programs.[53]

Some government incentives come not in the form of direct payments, but as loan guarantees, tax incentives, and other public financing options. A common tax incentive to encourage conservation is the *conservation easement*. Under a conservation easement, a landowner retains ownership of the land, but he or she cedes certain rights to develop the land. In general, conservation easements are very flexible instruments, and the details of allowed management can change from contract to contract. For example, most conservation easements preclude commercial or residential development, but some may allow agricultural use or periodic timber harvest.[54] While not always the case, easements often do not explicitly outline who owns the ecosystem services generated by the eased land—the landowner or the easement holder. Easements are often held by land trusts or other conservation organizations that manage the lands for a landowner. It is not clear whether a landowner who has sold a conservation easement retains rights to sell ecosystem services. While conservation easements are a ceding of development rights, that does not necessarily entail a ceding of the right to sell ecosystem services. This issue will not be resolved for existing contracts without a court decision interpreting the arrangement or statutory guidance; there has been no such legal clarification to date. Nevertheless, new conservation easements moving forward can be written so as to clarify which party retains ownership of the ecosystem services generated by the project.[55]

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[46] Envt'l Prot. Agency, State and Individual Trading Programs. Available at http://water.epa.gov/type/watersheds/trading/tradingmap.cfm. At least five of these "trading programs" appear to be one-time trades or deals. It is unclear how many projects have been developed within the other programs.
[47] Becca Madsen, Nathaniel Carroll, and Kelly Moore Brands. *State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide*, 11 (2010) Available at: http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf.
[48] *Id*. at 18. This number includes 19 sold-out banks and 20 pending banks.
[49] Climate Action Reserve, https://thereserve1.apx.com/myModule/rpt/myrpt.asp?r=111; The Climate Trust, http://climatetrust.org/sequestration.html; American Carbon Registry, http://www.americancarbonregistry.org/carbon-registry/projects. This vast majority of these projects are from the Climate Action Reserve, and most of those (65) are listed, but not fully registered.
[50] The Food, Conservation, and Energy Act of 2008 (P.L. 110-234) (2008).
[51] 7 C.F.R. §§ 1410.1, *et seq*. (2010).
[52] *Id,* at 1466.1, *et seq.* (2010).
[53] *See infra* note 68 and accompanying text.
[54] Land Trust Alliance, *Conservation Easements*, http://www.landtrustalliance.org/conservation/landowners/conservation-easements.
[55] *See* James L. Olmstead, *Carbon Dieting: Latent Ancillary Rights to Carbon Offsets in Conservation Easements*, 29 J. LAND, RES., AND ENVTL LAW 121-141 (2009) (for a discussion of potential language to be inserted into conservation easements intended for carbon offsets projects).

There are also examples of voluntary payments for biodiversity. For example, the Nature Services Exchange, a project of the University of Rhode Island and EcoAsset Markets Inc., allowed people who valued grass-nesting bird species, such as the bobolink, to pay farmers to delay hay harvest until after the nesting season.[56]

2.3. Stacking policies

There has been very little policy written to address stacking of ecosystem service payments in U.S. programs. In the absence of such policy, some have suggested viewing stacking through the lens of property rights. Under traditional common law, owning real property comes with a series of rights, colloquially referred to as the "bundle of sticks." One has a right to exclude others from her land, to use her property as she wishes, and to give away her property whenever and to whomever she wishes. There are more "sticks" that enable the harvest of natural resources. As long as one use does not harm another, a landowner can sell rights to mine on her land, can give another the right to grow crops on her land, and can let someone build windmills to harvest energy on her land. Under this traditional property definition, a landowner's ability to stack ecosystem service credits would be unlimited as long as the generation of one service does not harm any other services. The right to sell carbon sequestration, wetland acres, or water quality credits would each be a distinct, fundamental property right accompanying the ownership of land. Without any other policy, this would be the underlying default legal position on stacking; stacking would be implicitly allowed in all cases, whether it is beneficial or problematic. However, the ecosystem services credits are not like other property. While a landowner may have the right to sell ecosystem service credits, these credits only have value because demand for them is driven by government regulations, which could contain various restrictions on rights.

The federal guidance on water quality trading programs in the United States is largely silent on the issue.[57]

Regulations for wetland and stream mitigation banking[58] and guidelines for conservation banking[59] address the question of stacking with other ecosystem services payments largely indirectly. Wetland and stream banking regulations state that that "where appropriate, compensatory mitigation projects … may be designed to holistically address requirements under multiple programs and authorities for the same activity."[60] This language appears to leave the door open to the possibility of stacking. In particular, the regulations state that "[c]ompensatory mitigation projects may also be used to provide compensatory mitigation under the Endangered Species Act."[61] However, both wetland and stream banking regulations[62] and guidelines for conservation banking[63] clearly disallow stacking mitigation credits on top of restoration projects that have already received funding from a federal payment program.

In terms of the carbon market, guidance and protocols from the voluntary carbon market, rules for RGGI and the California program under the Climate Action Reserve, and the proposed federal program under the American Clean Energy and Security Act (ACES)[64] are all also silent on this issue. Only the proposed federal American Power Act (APA)[65] states that projects are not necessarily excluded from providing

[56] Nature Services Exchange, available at http://www.natureservicesexchange.com/ (accessed May 3, 2011).
[57] Environmental Protection Agency, 2003 Water Quality Trading Policy. http://water.epa.gov/type/watersheds/trading/tradingpolicy.cfm (Accessed November 3, 2010).
[58] 33 C.F.R. § 332.1 *et seq.* (2010).
[59] GUIDANCE FOR CONSERVATION BANKS, s*upra* note 33.
[60] 33 C.F.R. § 332.3(j)(1)(ii) (2010).
[61] *Id*. at 332.3(j)(3) (2010).
[62] *Id*. at 332.3(j)(2) (2010).
[63] GUIDANCE FOR CONSERVATION BANKS, 6, s*upra* note 33. Conservation banks only partly funded by federal money can generate credits proportional to the nonfederal funds used to establish the bank. For example, a bank funded 50 percent by federal funds would only receive half of the credits that it would otherwise receive.
[64] H.R. 2454 (2009).
[65] Available at http://kerry.senate.gov/imo/media/doc/APAbill3.pdf (accessed October 27, 2010).

carbon offsets if they receive payments for providing other ecosystem services, including government conservation payments. However, it also instructs the EPA and USDA to develop procedures and guidelines for determining eligibility for such projects.[66] The carbon markets typically include rules for additionality to ensure that credited activities would not have occurred in the absence of the project, which may preclude stacking in some cases. For example the Climate Action Reserve does not allow projects to generate credits if the land was covered by a conservation easement for more than one year before the start of the project.[67]

By contrast, regulations concerning almost all of the Farm Bill conservation incentive programs, including the Conservation Reserve Program (CRP) and the Environmental Quality Incentives Program (EQIP), expressly allow the sale of environmental credits from enrolled lands.[68] Each program has slightly different language, but in general, the regulations state: "USDA recognizes that environmental benefits will be achieved and environmental credits may be gained [by landowners] by implementing conservation practices and activities funded through these payment programs. USDA asserts no direct or indirect interest in these credits. However, USDA retains the authority to ensure that the requirements of their program are met."

3. What Is Being Stacked, and How

We use this section to present the wide range of different credits and payment types that could be stacked and the different ways stacking can happen and to define the terms that we use in this paper. We acknowledge that our discussion and definition of stacking is broader and more inclusive than many others, but we find this a helpful starting place to assess how all of the various programs and markets interact.

3.1. What is being stacked

As discussed above, ecosystem service markets and payment programs can be roughly divided into two categories: (1) offsets and mitigation credits and (2) conservation payments and incentives (hereinafter PES, for payments for ecosystem services). Offsets and mitigation credits are distinct from one another in that offsets are typically meant to offset emissions of a single pollutant, such as carbon dioxide emissions or discharge of nitrogen to a waterway, while mitigation typically refers to credits to offset impacts to whole ecosystems, such as wetland or endangered species habitat.

These types of credits and payments can be stacked in three different ways:

- *PES with PES*, which would not directly allow any environmental impacts elsewhere, and thus would have no negative effect on ecosystem services due to stacking;
- *PES with offsets or mitigation credits*; and
- *Offsets or mitigation credits with other offsets or mitigation credits*.

Offsets and mitigation credits can be further subdivided based on whether the credit seller or buyer is covered by government regulation.

- *Regulated-regulated* trades occur when a regulated entity sells emissions allowances that it does not need to another regulated entity. This could occur in a cap-and-trade system.

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[66] American Power Act § 735(f) (2010).
[67] Climate Action Reserve, Forest Carbon Protocol Version 3.2, 12 (2010).
[68] These programs include: The Conservation Reserve Program, 7 C.F.R. 1410.63(c)(6); the Grassland Reserve Program, 7 CFR § 1415.10(h); the Environmental Quality Incentives Program, 7 CFR § 1466.36; the Wetlands Reserve Program, 7 CFR § 1467.20(b)(1); the Conservation Stewardship Program, 7 CFR § 1470.37; the Farm and Ranch Lands Protection Program, 7 CFR § 1491.21(g); and the Wildlife Habitat Incentives Program, 7 CFR § 363.21.

- *Regulated-voluntary* trades occur when a regulated entity offsets its emissions by paying for reductions by an unregulated (or voluntary) entity.
- *Voluntary-voluntary* trades occur when an unregulated entity voluntarily purchases offsets from another unregulated entity. An example of this is the voluntary carbon market.

The carbon market currently has several *voluntary-voluntary* projects, and efforts to regulate greenhouse gases at the state or federal level could lead to *regulated-voluntary* projects if forests and other nonpoint sources are excluded from the cap, or *regulated-regulated* projects if they are included.

The water quality market has a few examples of *regulated-voluntary* trades, in which landowners voluntarily supply nutrient or temperature reductions to point sources, but much of the activity in this market has been *voluntary-voluntary*, since it has been funded by grants rather than driven by regulation. We have not identified any examples of *regulated-regulated* water quality projects, since nonpoint sources typically do not have regulatory compliance obligations.

Wetland, stream, and species banking are generally *regulated-voluntary* trades, in which a landowner voluntarily supplies wetland, stream, or species credits to those that need them. There are also some efforts to credit *voluntary-voluntary* species credits.

3.2. How credits are stacked

3.2.1. Stacking

Stacking occurs when a landowner receives more than one payment from an ecosystem service market or payment program on a single property parcel. There are three distinct types of stacking:

Horizontal stacking occurs when a project performs more than one distinct management practice on non-spatially overlapping areas and receives a single payment for each practice. For example, a landowner plants trees across his parcel, and receives nutrient credits from the forested buffer along a stream and carbon credits from the trees in the upland part of the property. Because the credits are sold from spatially distinct parts of the same property, some may not consider this to be true stacking.

Vertical stacking occurs when a project receives multiple payments for a single management activity on spatially overlapping areas, (i.e., in the same acre). For example, a project plants a forested riparian buffer to receive both water quality credits and carbon credits. This is similar to the general definition of stacking used by Fox, et al.: "Establishing more than one credit type on spatially overlapping areas, *i.e.* in the same acre,"[69] but that definition focuses only on stacking of credits from markets.

Temporal stacking is similar to vertical stacking in that the project involves only one management activity, but the payments are separated in time. For example, a project restores habitat to receive endangered species credits, and then later, when a carbon market develops, the same project receives carbon offset credits.

In any type of stacking, the payments can include credits from ecosystem service markets, public financing, or other incentives. Of the three types of stacking in our definition, horizontal stacking is the least controversial, because each management activity is only credited once. We spend the majority of this paper discussing vertical and temporal stacking.

3.2.2. Bundling

Bundling occurs when a project receives a single payment for providing multiple ecosystem services. With bundling, there is generally no attempt to add up the individual values of the ecosystem service to determine the payment levels. Wetland mitigation banking is an example of a bundled ecosystem service

[69] Fox et al., *supra* note 15.

credit: a single payment is made to a project for providing a variety of ecosystem services, including water quality improvements, biodiversity habitat, and hydrologic functioning, but the price of the credit is not necessarily based on the value of the individual services. Conservation easements are another example of a bundled credit, in which the purchaser protects all of the ecosystem services on the parcel with a single payment. Bundled credits in the United States have been developed to mitigate or offset full ecosystem impacts, like loss of a wetland or endangered species habitat. They are measured in units that encompass the services—like acres of wetland, for example—but they do not necessarily measure all of the services directly.

These different types of credits (PES vs. offsets or mitigation credits, regulated vs. voluntary, single service credits vs. bundles) can be stacked in many different ways (see Table 2 and Appendix). In the section below we explore the risks inherent in various combinations of stacking for ecosystem services outcome.

4. A Conceptual Framework for Assessing the Ecosystem Service Outcomes from Stacking

Given the general lack of existing law or policy to address stacking, and observing the growing concern and confusion about the subject, we have developed a conceptual framework to assess the ecosystem service outcomes from stacking that we hope will provide a starting place for productive discussion. The framework is constructed to address the primary objective of environmental markets and payment programs—replacement or enhancement of ecosystem goods and services. Our goal is to find common ground on cases where stacking offers few or no problems in achieving this objective, as well as on cases where it is likely to be more problematic. We hope this discussion will help clarify the stacking issue and help policy makers and program managers design more effective policies.

As mentioned above, there are certain problems with ecosystem services markets, which are present even in single-service transactions. In this paper we focus specifically on issues directly affected or caused by stacking.

4.1. Where stacking is never a problem

There are a few different types of stacking, some of which are clearly acceptable and some of which are more problematic. As described in the section above, stacking can be divided into horizontal, vertical, and temporal stacking. Horizontal stacking involves selling credits from distinct, non-spatially overlapping parts of a single property parcel. Because each part of the property is credited only once, this type of stacking is uncontroversial, and some may not even consider it stacking. In the discussion below, we focus on vertical and temporal stacking.

Stacking incentive payments with other incentive payments is also not problematic. Because none of the payments allows environmental impacts elsewhere, it cannot lead negative ecosystem service outcomes.

4.2. Where stacking might be a problem

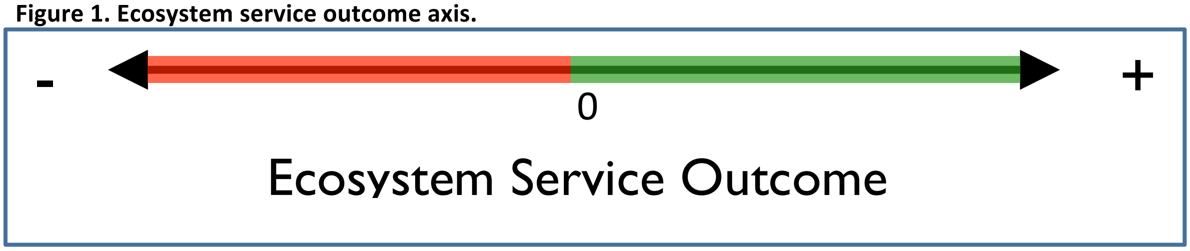
In vertical and temporal stacking, where offset and mitigation programs are part of the stack, there is potential for negative ecosystem service outcomes, because these credits allow others to impact the environment.

In order to determine the ecosystem service outcome of a stacked project, it is important to fully account for the environmental impacts allowed by the credits sold. We consider an axis of net ecosystem service outcome to assess whether stacking of various credits and payments can run into trouble meeting the primary objective of replacing or enhancing ecosystem goods and services (Figure 1). Where a stacked project falls along this axis is determined by the following equation:

$$Ecosystem\ Service\ Outcome = Ecosystem\ Services\ Created - Ecosystem\ Impacts\ Allowed$$

A stacked project in which the (negative) impacts allowed are greater than the services provided will produce a net negative outcome, and it will fall in the red area toward the left of the axis. A stacked project that provides enough services to completely offset all impacts would fall in the middle at the zero point, and a stacked project that provides more than enough services to offset impacts would be positive, falling in the green area to the right side of the axis.[70] In theory, most ecosystem services markets aim to replace ecosystem services lost to environmental impacts, which would place them at the zero point; however, with conservative crediting and trading ratios, it is possible that the transactions can lead to a net gain of ecosystem services, pushing a project—and a stack of which it is part—more to the green side of the axis.

Figure 1. Ecosystem service outcome axis.



Stacking multiple ecosystem service credits can complicate the task of accounting, making it more difficult to ensure that all damages have been fully mitigated, especially since ecosystem services are not always fully separable. Using this as an actual accounting framework would be possible for bilateral trades where the impact and mitigation activities are tied together, allowing regulators or project developers to track which impact each credit was intended to mitigate or offset. For example, if a project developer restores a coastal wetland and sells the resulting wetland mitigation credits directly to a party impacting the wetland, the project developer could potentially determine whether his wetland project provided "extra" ecosystem services,[71] such as GHG sequestration beyond that which is necessary to offset GHG emissions from the impacted wetland. These extra services could potentially be credited. Most bundled credits, such as wetland credits, tend to be bilateral trades, so it could be possible to do this accounting given sufficient metrics and data. This accounting is not easy to do even for single-credit transactions, given ecological complexity, interconnected functions, and scientific uncertainty about the ecosystem service provision resulting from different management or restoration activities.[72]

In a market-based system, however, credits are supposed to be fungible, and when they are traded, ownership is independent of the project that generated them. Credits trading in units such as tons of GHG

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[70] An important implicit assumption of evaluating different ecosystem services on the same axis is that they may be measured in the same units. If all of the services being stacked completely offset all of the impacts allowed, this assumption does not pose much of a problem. However, there could be situations in which a project results, for example, in a net positive gain for one of the services being stacked, such as carbon sequestration, and a net loss in another service, such as endangered species habitat. Using the equation above, the net gain in carbon sequestration could potentially be used to compensate for the habitat loss. Perhaps the most straightforward way to address this situation is to require that each individual service involved in a stacked transaction completely offset each impact it allows. However, policy makers could choose to take a more nuanced approach by establishing weights for each ecosystem service, based on stakeholder preferences, which could be used to evaluate tradeoffs between services in a stacked transaction. Therefore, a net gain in carbon sequestration could potentially compensate for habitat loss, if preference for carbon sequestration is weighted heavily enough. Discussion of such an approach, however, is beyond the scope of this paper.

[71] In this example we assume that the wetland project is following the intent of the regulations to replace all services and thus the greenhouse gas impacts would be included. So, "extra" implies greenhouse gas benefits beyond those needed to replace services lost.

[72] *See e.g.*, Charles Abdalla, Tatiana Borisova, Doug Parker, and Kristen Saacke Blunk, *Water Quality Credit Trading and Agriculture: Recognizing the Challenges and Policy Issues Ahead*, 22 CHOICES 117, 120 (2007), and Shelley Burgin, 'Mitigation banks' for wetland conservation: a major success or an unmitigated disaster? 18 WETL. ECOL. MANAG. 49 (2010).

equivalents or pounds of nitrogen can exchange freely. Thus it would not be possible to directly link impacts at one site to mitigation at another, and this becomes a theoretical rather than a practical exercise. Nevertheless, it is still valuable in helping understand where and why there could be negative ecosystem service outcomes from stacking due to impacts not being fully mitigated.

There are a few accounting approaches under development that try to bridge these issues for both bilateral and market trading systems. The environmental engineering firm Parametrix has developed an approach called EcoMetrix, which divides each potentially creditable ecosystem service provided on the landscape into several component ecosystem functions, in an attempt to ensure that each underlying function is credited only once.[73] The Willamette Partnership has also examined selling multiple credits in several of its pilot projects.[74] In their approach, if a project is eligible to sell multiple credits—e.g., wetland, habitat, and water quality—those credits are linked together, such that if it sells, for example, half of its wetland credits, then the available habitat and water quality credits are reduced by half.[75] This approach could be considered a form of horizontal stacking in that the project area cannot sell more than 100% of any of its credit types.

Below we describe three different circumstances that can potentially lead to a negative ecosystem service outcome from stacking. First, we describe overlapping credit types, which lead to problems of "double dipping," where the same ecosystem service is sold twice to offset two separate impacts. Second, we describe incomplete coverage of impacts, or slippage of impacts, that are not covered by other programs and thus are not accounted for. The first problem is caused by the type of credits involved; the second is due to the way the impacts are regulated. Stacking under these specific circumstances could potentially lead to systematic loss of ecosystem services if left unaddressed. And finally, we address an issue identified by the carbon markets—additionality, where projects would have occurred without the carbon credit payment (utilizing the payment from the other stacked credit) and thus are not generating an additional reduction in GHGs to offset the point source emission. Following this discussion of stacking risks we will show how the various possible types of risk do or do not apply to different combinations (stacks) of credit types described above in section 3 (Table 2).

4.2.1. Overlapping credit types

Overlapping credit types occur when there are crediting systems that include redundant services. This is most likely to occur with bundles of services which then overlap with a single service or another bundle. One example is wetland mitigation credits and water quality credits. The wetland bundle would include the water quality services provided by the wetland. If a wetland mitigation project sells the bundled wetland credits to one buyer for a wetland impact and the single water quality credits to a different point source buyer for the water quality impact (Figure 2), there would only be one supply of water quality services to cover two impacts on water quality, resulting in a net negative ecosystem service outcome using our framework.

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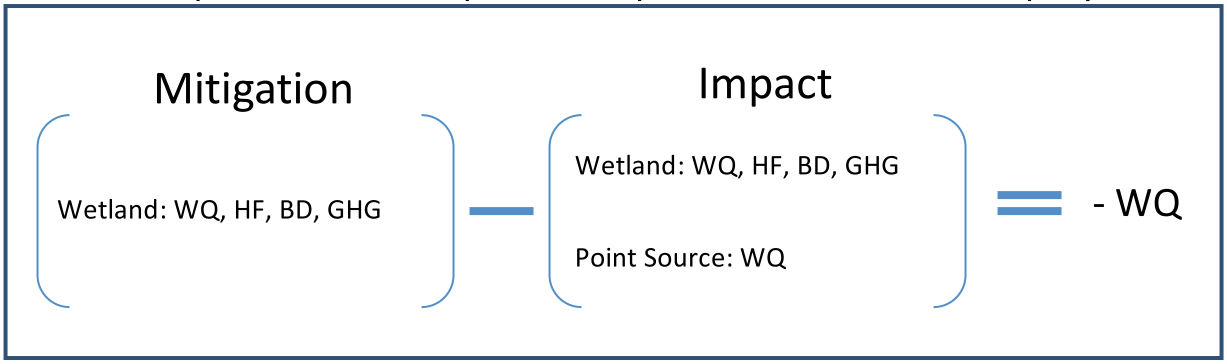
[73] This approach divides each ecosystem service into several component ecosystem functions, and then divides each ecosystem function in to several component ecosystem attributes (e.g., soil, vegetation), which are measured on the landscape. Some ecosystem services will have ecosystem functions in common with other services. In those cases, whenever one service is credited, all of its component functions are made ineligible for additional crediting in the transaction, such that if another service has that same function, the amount it is allowed to be credited is decreased. Parametrix, *EcoMetrix tool*, Available at http://www.parametrix.com/cap/nat/_ecosystems_ecometrix.html.
[74] Willamette Partnership, http://willamettepartnership.org/ecosystem-credit-accounting/pilot-projects. Accessed June 6, 2011.
[75] Devin Judge-Lord, Willamette Partnership, personal communication, June 3, 2011.

Figure 2. An example of a negative ecosystem service outcome due to overlapping credit types. Impacts to the wetland will have effects on several ecosystem services, including water quality (WQ), hydrologic functioning (HF), biodiversity (BD), and greenhouse gases (GHG). Because the mitigation site sells its WQ benefits twice-to offset both the impacted wetland and the point source impacts—there is a net loss of water quality.



There is at least one real-world example of this type of stacking problem. In 2000 a company[76] developed a project in eastern North Carolina to sell wetland and stream credits to the N.C. Department of Transportation to offset impacts to wetlands and streams from road building projects. In 2009 this company sold water quality credits from the same project—without performing any additional management activities—to the N.C. Department of Environment and Natural Resources to offset nitrogen impacts to the Neuse River Basin.[77] At the time, the state had no regulations governing this type of credit stacking. Estimates by local experts noted that if all other existing, already-sold mitigation sites were allowed to stack nitrogen credits, it would be possible to flood the market with 1.1 million pounds of nitrogen credits, exceeding all credits generated since the program began in 2001.[78] The state did not allow additional trades of this sort and has since developed a proposed rule that would completely disallow stacking of nutrient offset credits or buffer credits from projects that provide wetland credits.[79]

Allowing overlapping credit types can be problematic, thus programs and policies should consider additional environmental review, limiting projects to horizontal stacking (similar to the Willamette approach),[80] or even restrictions on stacking of bundles with other credits. Regulations and guidance need to be clear about what is and is not included in these bundles. Given that bundled credits tend to be part of bilateral trades, it may be possible to assess the ecosystem service outcomes on a project-by-project basis to determine if there are extra services that can be sold.

4.2.2. Incomplete coverage

Incomplete coverage of impacts occurs where programs and policies to cover various co-occurring ecosystem service impacts do not exist or are voluntary. When co-occurring impacts are not accounted for, they are not mitigated or offset. This could occur in a scenario where voluntary or regulatory programs cover certain types of nonpoint impacts but other nonpoint impacts remain outside the system. This would not be a problem if all sources of pollution and impact were covered by environmental regulations. The United States has made great strides in covering environmental impacts from point sources (with GHG emissions as a notable exception), but in most cases nonpoint sources remain unregulated, which can lead to incomplete coverage problems for stacking.

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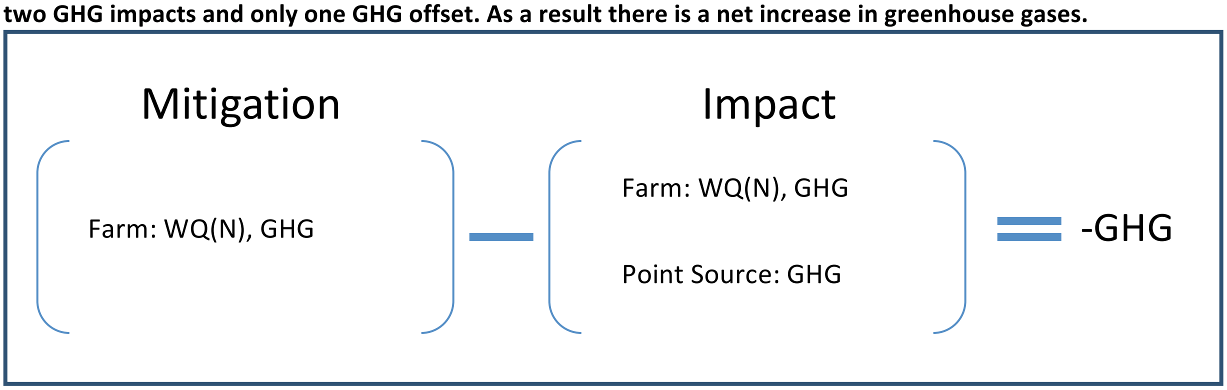
[76] Environmental Bank and Exchange (EBX).
[77] Dan Kane, *EBX is paid twice for wetlands work*, News and Observer, Dec. 8, 2009.
[78] Martin Doyle and Todd BenDor, *Stream restoration: Who really benefits?*, News and Observer, Dec. 16, 2009.
[79] 15A N.C.A.C. 02B .0295, Available at http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=1727035&name=DLFE-26311.pdf.
[80] *See supra* notes 74 and 75, and accompanying text.

For example, consider a hypothetical future scenario where there is nonpoint regulation for nitrogen releases into waterways, but no regulation for nonpoint greenhouse gas emissions. In this case Farmer Brown must mitigate any water quality impacts from increasing nitrogen fertilizer use, but he does not have to address the resulting increased emissions of nitrous oxide, a potent greenhouse gas. Farmer Brown purchases water quality credits from Farmer Green, another farmer in the watershed who reduces her nitrogen fertilizer use. In addition to selling nitrogen credits to Farmer Brown, Farmer Green also sells the GHG offsets she earns for reducing nitrous oxide emissions to a power plant, which uses them to offset its GHG emissions (Figure 4). Because Farmer Brown was not obligated to offset his GHG impact (but it still occurred), this stacked transaction would result in the supply of one quantity of GHG reduction (from Farmer Green) to cover two quantities of GHG emissions (from Farmer Brown and the power plant), resulting in a net negative ecosystem service outcome.

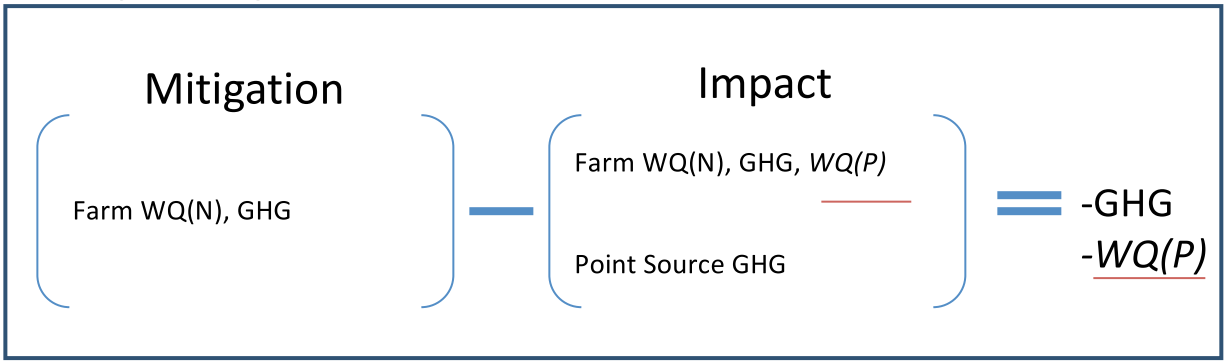
Figure 4. An example of a negative ecosystem service outcome due to incomplete coverage of impacts involved in credit trading. Increased fertilizer use on the farm will have multiple effects, including water quality impacts from increased nitrogen loading (WQN) and increased nitrous oxide greenhouse gas emissions (GHG). Because the offsetting site sells its greenhouse gas benefits to a separate buyer than its water quality benefits, there are two GHG impacts and only one GHG offset. As a result there is a net increase in greenhouse gases.



The ecosystem service outcome axis (Figure 2) deals only with ecosystem services that are being directly credited or otherwise paid for. Projects may positively or negatively affect other ecosystem services that are not included in any of the stacked payments—so called "co-benefits" or tradeoffs. The examples we show above account only for those services that are being stacked by a project. Yet there can be incomplete coverage of impacts that are not included in the stacked credit trades.

Consider the example above, with one additional caveat. Farmer Brown's farm, which is generating the impact, is on a soil that also loses significant phosphorus into the waterway through surface runoff. The shift in practice, which is going to increase nitrogen loading and nitrous oxide emissions, will also increase phosphorus loading. If Farmer Green's farm were on a similar soil and her offsetting activity would reduce phosphorus loading along with nitrogen and nitrous oxide, *and* Farmer Green did not sell that phosphorus benefit to another buyer, then the unaccounted-for phosphorus impact would balance out because Farmer Green provides a co-benefit that she does not get compensated for. However, if Farmer Green's farm did not produce this phosphorus benefit, there could be a phosphorus impact that is not accounted for in the system and is not mitigated by the offset project, leading to a net negative ecosystem service outcome (Figure 5). In addition, Farmer Green's offset project could also provide additional positive co-benefits that do not offset any environmental impacts on Farmer Brown's farm or elsewhere, such as improved biodiversity or pollinator habitat.

Figure 5. An example of a negative ecosystem service outcome due to incomplete coverage of impacts including those outside of credit trading. The farm with the impact has a side effect of increasing phosphorus loading into the water (WQP), which is not offset by the other farmer's actions to address nitrogen loading (WQN) and nitrous oxide emissions (GHG). As a result there is a net increase in phosphorus in the water in addition to increased greenhouse gases.



Incomplete coverage of impacts is a problem where regulation of impacts is incomplete. Thus it is not likely to be a problem when stacking offsets to point source impacts, most of which are captured by one regulation or another. This is the primary type of credit currently traded. There may however be a transitional problem when stacking nonpoint source credits if the regulatory programs for nonpoint sources develop at different times or in an uncoordinated fashion.

4.2.3. Additionality

For programs and markets focused on carbon or greenhouse gases, additionality has been a key criterion for project eligibility. The purpose is to ensure that carbon offsets are generated only from activities that would not have occurred in the absence of the payment.[81] For carbon credits to be considered real and to compensate for emissions from point sources they must go beyond business as usual (the baseline)—beyond what would have happened anyway. For GHG programs—both regulatory and voluntary markets—additionality is the primary concern related to stacking.[82] Additionality has not been a fundamental tenant of other ecosystem service programs, but it may still be an important consideration.

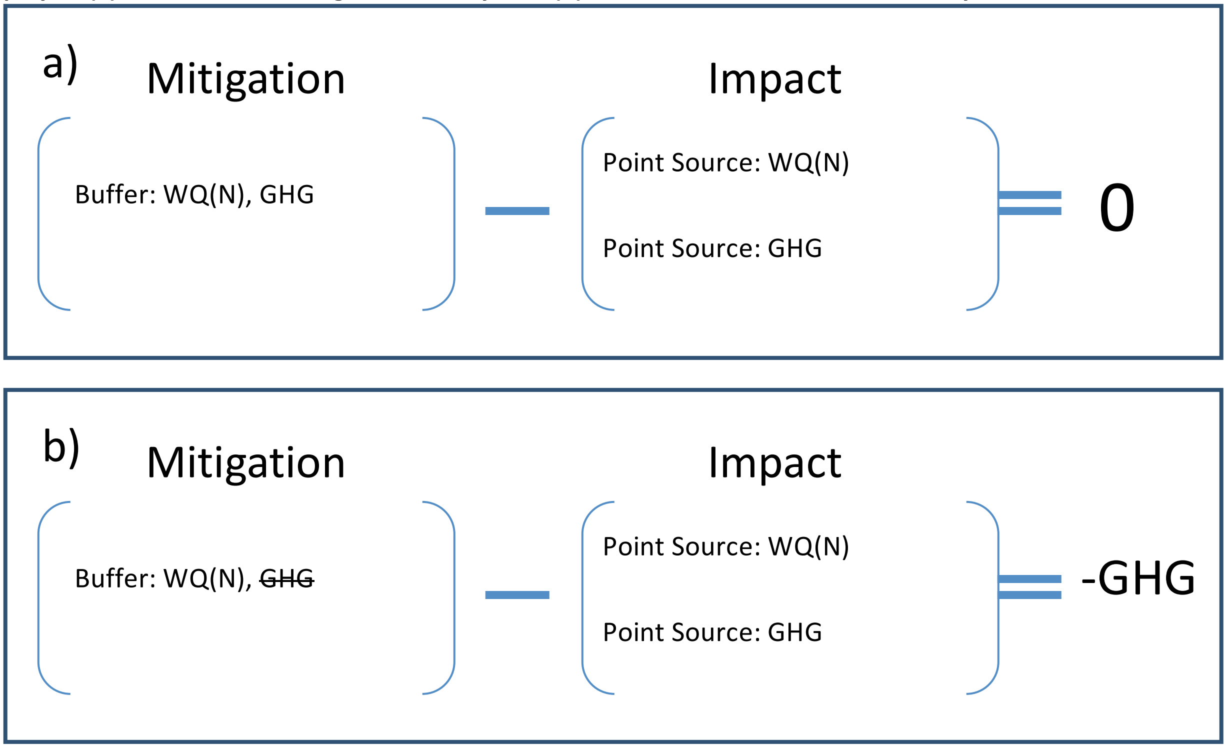
As with the issue of incomplete coverage, there would be no problem with additionality if there were complete regulatory coverage; additionality is a criterion required only for projects that are outside of the regulatory cap. There can be business-as-usual activities that receive credits under a regulatory cap, and while this does reduce the environmental benefits of the cap, it is often done for political reasons with the assumption that the cap with be ratcheted down over time, eliminating the free riders. (This phenomenon has been called "hot air" in the development of the Kyoto Protocol).[83]

For an example of how additionality can result in a net ecosystem service outcome, consider a project that is creating a stream buffer that will generate reductions in nitrogen for a water quality benefit and sequester carbon. If we consider this project in the context of our environmental axis without considering the additionality criteria, our framework shows that all impacts are offset with a net ecosystem service outcome of zero (Figure 6a). However, if the water quality program provides sufficient payment for the project to move forward on its own, the project did not need a carbon payment. The carbon payment

[81] *See e.g.* Mark Trexler, Derik Broekhoff, and Laura Kosloff, *A Statistically-Driven Approach to Offset-Based GHG Additionality Determinations: What Can We Learn?,* 6 SUSTAINABLE DEV. L. & POL'Y 30, 31 (2006).
[82] *See* Bianco, *supra* note 11.
[83] *See, e.g.,* Christoph Böhringer, Ulf Moslener and Bodo Sturm, *Hot air for sale: a quantitative assessment of Russia's near-term climate policy options,* 38 ENVT'L RES. ECON. 545 (2007).

would not generate *additional* carbon storage to offset the *additional* GHGs emitted, so there would be GHGs released into the atmosphere that were not offset, resulting in a net negative ecosystem service outcome (Figure 6b). If the project generated additional carbon storage that would not have been generated by the activity associated with the water quality credit—for example, by planting hardwood trees when that was not required to receive the water quality payment—then this becomes more of a horizontal stacking case and is not a problem for additionality.

Figure 6. Examples of accounting for net ecosystem service outcome on an ecosystem services buffer project stacking water quality nitrogen and greenhouse gas credits where one payment is sufficient to pay for the project (a) without considering additionality, and (b) with consideration of additionality.



It is not possible to completely solve the additionality issue, because it would require knowing what would have happened without the program or market in place. There are, however, a number of tests used to help programs exclude non-additional projects.[84] One of these tests is a timing test. If the project was already in place and then applies for carbon credits, it probably didn't need the extra funding, so it would not be considered eligible. So for stacking, if a project was created using funding from one type of credit in the past, it would not be eligible for carbon credits too (this is a case of temporal stacking). A second test is a financial additionality test, which requires determining whether a project needs a payment in order to be financially viable. If a project is eligible for two ecosystem service markets, and one credit type is sufficient to pay the full costs of the project, it would fail this additionality test. If, however, neither credit type alone provided sufficient funding, additionality would not be an issue, and stacking would be allowed.

Additionality can be considered in program design. When establishing a new program, regulators can see what types of projects are occurring with the existing credits, and assume that those projects would occur without additional payment from their new program and not allow stacking for that subset of projects. This is complicated by market dynamics, in that adding an additional credit market can bring down credit

[84] *See generally* Trexler *et al.*, *supra* note 81.

prices (see Section 5 for detail). Different project types will differ in their costs and thus in their need for multiple payments. If programs are coming online simultaneously or if a new project type is being assessed, programs will have to use existing data on costs to best assess whether a project type needs payments from multiple credits or not. If not, a program can accept only those projects that give up rights to sell the other credits, basically creating a bundle out of the co-benefits from the project.

Everyone recognizes the imperfections of offsets markets and additionality, and many continue to work toward improved approaches for implementation. Circumstances change over time, moving the baseline of what is considered business as usual, what projects need multiple payments, and thus what is really additional or not. This is particularly problematic for investors who expect to stack additional payments to meet costs for projects. Given the complexities in addressing additionality in program implementation, programs may choose to explore different policy approaches including discounting or system-wide adjustments, but these add different complexities and create different winners and losers in the system.[85]

4.3. Stacking Problems for Different Credit Combinations

There are types of programs and credits where stacking will not pose problems for ecosystem service outcomes. These include horizontal stacking, and stacking of incentive payments with other incentive payments. However, we also identified instances where stacking can lead to systemic loss of ecosystem services. Vertically or temporally stacked offset and mitigation credits—where programs are designed to replace losses to ecosystem services—can sometimes be problematic. There are many possible combinations of credit types, and three potential issues with stacking that we identified. In Table 2 we list all of the combinations of the major ecosystem service credit types available now and under future consideration in the United States and show which specific combinations are susceptible to which problems.

In general we found:

- Stacking bundled mitigation credits with other offsets can result in overlapping credit types (often called "double dipping").
- Stacking single ecosystem service offset credits can result in incomplete coverage.
- All transactions involving offsets and mitigation credits can affect additionality, except those involving *regulated-to-regulated* trades. Only activities outside a cap (unregulated/voluntary) need to demonstrate additionality.

[85] Brian C. Murray and W. Aaron Jenkins, Designing Cap and Trade to Account for "Imperfect" Offsets, Duke Environmental Economics Working Paper EE 10-03, Duke University, at 10 (2010).

Table 2. Possible combinations ecosystem service credits, including conservation incentives and payments (noted here as payments for ecosystem services or PES) and offsets or mitigation credits, along with the types of stacking risks they may face. *M* indicates that there *may be* a net loss of ecosystem services resulting from the stacking combination; however, in each of these cases this is dependent on specific circumstances.

Credit #1	Credit #2	Overlapping Credit Types	Incomplete Coverage	Additionality
PES	PES			
PES	Offsets/Mitigation (Bundled)			M
PES	Offsets/Mitigation (Single service)			M
Offsets/Mitigation (Bundled)	Offsets/Mitigation (Bundled)	M		M
Offsets/Mitigation (Bundled)	Offsets/Mitigation (Single Service)	M		M
Offsets/Mitigation (Single Service)	Offsets/Mitigation (Single Service)		M	M

5. Economic Considerations for Stacking

In the sections above we discuss how stacking may impact the ecosystem services outcome of ecosystem service programs and markets. Here we describe some of the economic implications of stacking, including how stacking can affect the costs and revenues of projects and programs.

5.1. Can stacking lead to "overpayment" of projects?

For offsets programs consideration of financial additionality seems to suggest a problem of paying too much, but it is really a problem of paying when no additional offset is produced, so it is an environmental rather than a cost concern. In contrast, for payment or incentive programs (PES), where funding may be limited, stacking may raise concerns of paying more than is needed. For an incentive program, seeking to conserve lands or incentivize improved management with limited resources, each dollar spent paying a project above what it needs to recoup its costs stops inducing behavioral change for that project, and is a dollar that cannot be spent to fund another ecosystem service project. However, from a project perspective, there is no problem with projects receiving more payment than is necessary—that is, earning a profit— as long as the environmental objective is met. Any "overpayment" of a project simply represents a "rent" or transfer of funds from one entity to another, which is not necessarily economically inefficient.

5.2. How does stacking affect the value of credits?

Another interesting consideration is how stacking can change the value of credits. Allowing stacking can increase the overall supply of ecosystem service credits and reduce their prices. A landowner, who previously could only sell one of his ecosystem services, can now sell multiple services from the same project, and at a lower price compared with the price he would accept if he could only sell one. This could drive down the price that landowners receive for each credit, so that while landowners are able to tap into multiple payment streams, the price they receive for each payment stream could decrease.[86] For example, if most landowners who plant a forested riparian buffer receive both water quality payments and carbon offsets, then the supply of each credit type will increase, and the price they will need and receive for each will decrease. Indeed, the example of stacking from North Carolina illustrates this; if all existing wetland

[86] *See* Woodward, *supra* note 17 and accompanying text.

restoration projects were allowed to sell water quality credits, then the supply of water quality credits would increase dramatically, and their price would crash.[87]

Ecosystem services programs can be designed to be more responsive to shifts in credit prices. Mitigation or conservation banks or offset programs that use administratively set credit fees (e.g., in-lieu fee systems) will likely not adjust pricing, or adjust slowly. If the programs instead set their credit prices through competitive bidding, the price of credits would likely respond quickly as would more open market programs. Similarly for incentive programs that have flexible payment schedules, such as a bidding system or reverse auction, stacking could reduce the overall costs of the program or allow them to extend payments to a wider range of landowners.[88]

This has implications for additionality. If stacking brings down prices, adding a new ecosystem service market into the system can change what is considered additional; projects that initially could cover their costs by selling one credit may need to sell two credit types if prices drop. So some projects, which were originally considered non-additional because their costs were covered by one credit stream, may later be additional. As credit prices adjust to stacking, more projects will need to stack payments to meet costs, and thus fewer projects will be non-additional.

Project developers and landowners need ecosystem services payments that meet or exceed opportunity costs so they can break even, and hopefully profit. While stacking may seem a great idea to help landowners profit from the services they provide, they should realize that it can bring down credit prices so that they may have to engage in more credit markets over time.[89]

5.3. Can stacking be used to conserve land at risk of conversion?

Some landowners or conservation-minded organizations, like land trusts, may look to stacking of ecosystem services credits as a means to allow landowners to generate enough revenue to prevent conversion of land to other uses. Many ecosystem services programs target shifts in land management (e.g., adding buffers, changing forest stocking) and thus are likely to provide funding sufficient only to meet the opportunity costs of shifting management. Stacking these to try to meet the opportunity costs of avoided conversion is likely an inefficient approach. Areas at risk of conversion tend to have high land prices; therefore, the opportunity costs of conversion faced by projects may be too high to be met by stacking credits focused on changes in management. A better approach would be to design a program targeting avoided conversion. There are a few examples of this credit type, such as avoided forest conversion projects that can be developed through the Climate Action Reserve,[90] and continuing efforts to build international programs to reduce emissions from deforestation. These are high-value projects on forest lands with high aboveground carbon stocks where the funds are provided upfront, assuming avoided loss of all of the carbon. Thus the value is high enough to avert conversion of these forests. These programs will only help conserve lands with high carbon stocks, not necessarily land with other conservation priorities (e.g., hydrological, spiritual, biodiversity services). Including other conservation priorities would require a new policy that would target conservation of land for these other values or for the bundled value. Currently conservation tends to be addressed more through payment for ecosystem services programs and tools like tradable development rights, rather than through ecosystem services markets.

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[87] *See* Doyle and BenDor, *supra* note 78.

[88] Perhaps recognizing this, the Natural Resources Conservation Service and the Farm Services Agency currently allows stacking of ecosystem service credits on top of most of their payment programs. *See supra* note 68.

[89] *See* Woodward, *supra* note 17 and accompanying text.

[90] The Climate Action Reserve currently has nine avoided conversion projects registered, none of which has earned any offset credit yet. http://www.climateactionreserve.org/how/projects/ (accessed January 10, 2011).

6. Policy Implications of Stacking

Many different agencies and laws regulate, manage, and incentivize ecosystem services, and this has resulted in the development of numerous credit types. Here we discuss some initial ideas for potential policy solutions to the stacking issues identified above. Conservative crediting and trading ratios can help reduce negative ecosystem services outcomes from stacking, but many ecosystem service markets already use such measures to reduce risk from scientific or measurement uncertainty. It is not clear whether the ratios would be sufficient to cover the additional risk of ecosystem services lost from stacking.

7.1. Policy for overlapping credit types

Overlapping credit types occur where one of the credit types being stacked is designed to mitigate impact to a full ecosystem, requiring a bundle of services, like wetlands or endangered species programs. Any other credit type stacked with such a bundle will overlap with one of the services that should be covered in the bundle. Thus, there can be two separate impacts and only one offset, leading to a net loss of ecosystem services.

Given that ecosystem service programs are run by different agencies at different levels of governance, regulators may need to clarify program guidance for bundled mitigation programs to ensure that only extra service generation (more than those expected to be damaged) can be stacked, or they may need to disallow stacking altogether. Current regulations and guidance for bundled mitigation in most states do not require regulators to check if a project is being stacked.

Federal regulations for compensatory mitigation seem to suggest that full coverage of services is intended, as developers are instructed "to successfully replace lost functions and services";[91] this would seem to argue against stacking credits in such cases. Yet other regulations and guidance seem to leave the door open for stacking.[92] Neither the law nor the guidance addresses stacking with offset credits directly, and no legal cases have questioned the intent of the law on whether stacking would be allowed to provide clarifying precedent. State and regional guidance documents used for implementing these programs are more specific, but can increase confusion by directly assessing some services within the bundle, while not assessing others. This could suggest that those unassessed services might not be included as part of the bundle. For example, guidance for the North Carolina Wetland Assessment Method specifies that the services being replaced include hydrologic services, water quality, and biodiversity, but does not mention greenhouse gases.[93] With growing interest in coastal wetland restoration as a potential greenhouse gas mitigation approach for offsets markets, stacking for coastal restoration may become a real issue for coastal wetlands.[94]

7.2. Policy for incomplete coverage

Incomplete coverage of impacts results when services are not covered by a regulatory program; because the services are not accounted for when impacted, they may not be replaced.

Given the fairly strong regulatory network covering point sources in the United States, this is less of a problem for point source impacts than nonpoint sources, which are mostly unregulated. Most of the trading occurring in the United States now involves nonpoint-point source trading; however, there has been discussion of regulation for nonpoint impacts, leaving the door open for nonpoint-nonpoint trading.

[91] 33 C.F.R. § 332.3(b) (2010).
[92] *Id*. at 332.3(j)(1)(ii) (2010).
[93] NCWAM, *supra* note 31.
[94] *See* Philip Williams and Associates, Ltd., *Greenhouse Gas Mitigation Typology Issues Paper: Tidal Wetland Restoration* (2009). Available at http://www.climateactionreserve.org/how/protocols/future-protocol-development/#tidalwetland.

One example is the state of Maryland's proposed policy of no net loss of forest resources.[95] This and other attempts to extend coverage of environmental policies to nonpoint impacts should consider that extending coverage for only some impacts but not others could lead to a net loss of ecosystem services if credit stacking is allowed. This problem would be solved with a more integrated approach to environmental management of nonpoint impacts in the United States.

7.3. Policy for additionality

The inclusion of additionality as a criterion for carbon or GHG offset markets is designed to ensure that the payment or project was required for the project to move forward. If credit types are stacked but only one payment was needed, it can be argued that the second set of credits is nonadditional, and the impacts they allow would result in a net negative ecosystem service outcome.

The cleanest way to avoid problems with additionality is to include all impacts (sources) under the regulatory cap. However, where that is not politically feasible, programs use tests or rules of thumb to help avoid nonadditional projects when stacking. There is no perfect policy solution for additionality, but research continues to explore new ways to design programs to reduce the impacts of non-additional credits.

7. Conclusions

Stacking could provide a way to integrate across the various laws, policies, and voluntary programs that have emerged in the United States. It could help landowners to manage for the multiple ecosystem services their lands provide and avoid risks of focusing on a single service. Those optimistic about the growth of ecosystem services programs and markets suggest that stacking could also be a way for landowners to gain sufficient revenues from their land so that ecosystem services production would become a profitable alternative to more traditional types of land management.

While stacking of various credit types can, in theory, lead to systematic losses of ecosystem services, there are ways to avoid these risks. In addition, many existing ecosystem service programs have bilateral trades, where credits are sold and then retired to meet voluntary targets or mandatory requirements. In this case it may be possible to do the direct accounting of ecosystem service outcomes and to ensure that stacking of credits results in no net loss of ecosystem services. Bundled projects could ensure that they are generating the stacked service in excess of that lost at the original impact site. And where nonpoint impacts are the target, impacts to other ecosystem services can be tracked to make sure they are replaced by the mitigation project. It is important to note how difficult and expensive it can be to do this type of accounting to ensure that all impacts are addressed. Metrics for measuring various ecosystem services are in various stages of development and are often fairly rough.[96] This is a focus of significant attention in the ecosystem services community and an active area of research. Because ecosystem service credits and payments are governed and regulated by a variety of different agencies, accurately accounting for the services provided and impacts allowed by stacked projects will require significant coordination across agencies and across levels of government. One option could be to create a database of all ecosystem service projects, which would allow regulators to identify which projects are participating in multiple markets or programs.

Although current policy is largely silent with regard to stacking, we know where problems are likely to arise and can address them by clarifying the policies for overlapping credit types, by avoiding nonpoint source impacts in stacked trades until we have more integrated coverage of nonpoint sources, and by

[95] Md. Ann. Code Natural Resources Article 5-104.

[96] *See generally* James Boyd and Spencer Banzhaf, *What are ecosystem services? The need for standardized environmental accounting units*, 63 ECOL. ECON. 616 (2007), and Christian Layke, *Measuring Nature's Benefits: A Preliminary Roadmap for Improving Ecosystem Service Indicators*, World Resources Institute Working Paper (2009) available at http://pdf.wri.org/measuring_natures_benefits.pdf.

applying additionality tests where required. Where bilateral trades are the norm, acceptable metrics are needed to track ecosystem services impacts and offsets in order to avoid net environmental loss. Stacking can provide many benefits, especially in a fragmented regulatory environment, so good policy may suggest allowing stacking, but doing so with some additional safeguard and guidance.

Appendix

Table A1. All possible combinations of the major ecosystem service credits available now or under consideration in the United States, including conservation incentives and payments (noted here as payments for ecosystem services or PES) and offsets or mitigation credits, along with the types of stacking risks they may face.[*] *M* indicates that a stacked project *might* face that stacking risk; ✓ indicates that a stacked project will likely face that risk. Additionality can be viewed in terms of each credit in the stack; PES and *reg-reg* credits do not face requirements to show additionality. For this reason, additionality has been divided into two columns. "Reg or vol" indicates whether the trade is *regulated-regulated*, *regulated-voluntary*, or *voluntary-voluntary. W/S* stands for wetland or stream mitigation credits; *WQ* stands for water quality credits, which can include nitrogen, phosphorus, temperature, or other pollutants.

Credit #1			Credit #2			Overlapping Credit Types	Incomplete Coverage	Additionality	
Credit type	***Service***	***Reg or Vol***	***Credit type***	***Service***	***Reg or Vol***			***Credit #1***	***Credit #2***
PES	n/a	n/a	PES	n/a	n/a				
PES	n/a	n/a	Offsets/Mitigation	W/S	Reg-vol				M
PES	n/a	n/a	Offsets/Mitigation	WQ	Reg-reg				
PES	n/a	n/a	Offsets/Mitigation	WQ	Reg-vol				M
PES	n/a	n/a	Offsets/Mitigation	WQ	Vol-vol				M
PES	n/a	n/a	Offsets/Mitigation	Carbon	Reg-reg				
PES	n/a	n/a	Offsets/Mitigation	Carbon	Reg-vol				M
PES	n/a	n/a	Offsets/Mitigation	Carbon	Vol-vol				M
PES	n/a	n/a	Offsets/Mitigation	Species	Reg-vol				M
PES	n/a	n/a	Offsets/Mitigation	Species	Vol-vol				M
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	WQ	Reg-reg	M		M	
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	WQ	Reg-vol	M		M	M
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	WQ	Vol-vol	M		M	M
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	Carbon	Reg-reg	M		M	
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	Carbon	Reg-vol	M		M	M
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	Carbon	Vol-vol	M		M	M
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	Species	Reg-vol	M		M	M

Credit #1			Credit #2			Overlapping Credit Types	Incomplete Coverage	Additionality	
Credit type	***Service***	***Reg or Vol***	***Credit type***	***Service***	***Reg or Vol***			***Credit #1***	***Credit #2***
Offsets/Mitigation	W/S	Reg-vol	Offsets/Mitigation	Species	Vol-vol	M		M	M
Offsets/Mitigation	Species	Reg-vol	Offsets/Mitigation	WQ	Reg-reg	M			M
Offsets/Mitigation	Species	Reg-vol	Offsets/Mitigation	WQ	Reg-vol	M		M	M
Offsets/Mitigation	Species	Reg-vol	Offsets/Mitigation	WQ	Vol-vol	M		M	M
Offsets/Mitigation	Species	Reg-vol	Offsets/Mitigation	Carbon	Reg-reg	M		M	
Offsets/Mitigation	Species	Reg-vol	Offsets/Mitigation	Carbon	Reg-vol	M		M	M
Offsets/Mitigation	Species	Reg-vol	Offsets/Mitigation	Carbon	Vol-vol	M		M	M
Offsets/Mitigation	Species	Vol-vol	Offsets/Mitigation	WQ	Reg-reg	M		M	
Offsets/Mitigation	Species	Vol-vol	Offsets/Mitigation	WQ	Reg-vol	M		M	M
Offsets/Mitigation	Species	Vol-vol	Offsets/Mitigation	WQ	Vol-vol	M		M	M
Offsets/Mitigation	Species	Vol-vol	Offsets/Mitigation	Carbon	Reg-reg	M		M	
Offsets/Mitigation	Species	Vol-vol	Offsets/Mitigation	Carbon	Reg-vol	M		M	M
Offsets/Mitigation	Species	Vol-vol	Offsets/Mitigation	Carbon	Vol-vol	M		M	M
Offsets/Mitigation	WQ	Reg-reg	Offsets/Mitigation	Carbon	Reg-reg		M		
Offsets/Mitigation	WQ	Reg-reg	Offsets/Mitigation	Carbon	Reg-vol		✓		M
Offsets/Mitigation	WQ	Reg-reg	Offsets/Mitigation	Carbon	Vol-vol		✓		M
Offsets/Mitigation	WQ	Reg-vol	Offsets/Mitigation	Carbon	Reg-reg		✓	M	
Offsets/Mitigation	WQ	Reg-vol	Offsets/Mitigation	Carbon	Reg-vol		✓	M	M
Offsets/Mitigation	WQ	Reg-vol	Offsets/Mitigation	Carbon	Vol-vol		✓	M	M
Offsets/Mitigation	WQ	Vol-vol	Offsets/Mitigation	Carbon	Reg-reg		✓	M	
Offsets/Mitigation	WQ	Vol-vol	Offsets/Mitigation	Carbon	Reg-vol		✓	M	M
Offsets/Mitigation	WQ	Vol-vol	Offsets/Mitigation	Carbon	Vol-vol		✓	M	M

* Combinations not listed are unlikely to occur (or impossible) in the United States