



Federal Resource Management and Ecosystem Services Guidebook

National Ecosystem Services Partnership
nespguidebook.com

Section 2—Federal Agency Use and Examples



SECTION 2

FEDERAL AGENCY USE AND EXAMPLES

Agency Use of Ecosystem Services

- 2 Introduction to Agency Use
- 5 National Oceanic and Atmospheric Administration
- 10 Army Corps of Engineers
- 12 Bureau of Land Management
- 17 Fish and Wildlife Service
- 22 Forest Service

Exploration of Legal Authority

- 29 National Environmental Policy Act
- 44 Federal Land Policy and Management Act

Agency Examples

- 55 Bureau of Land Management
- 88 Environmental Protection Agency
- 95 Fish and Wildlife
- 125 Forest Service
- 183 National Oceanic and Atmospheric Administration
- 197 National Park Service



AGENCY USE OF ECOSYSTEM SERVICES

Introduction to Agency Use
Army Corps of Engineers
Bureau of Land Management
Fish and Wildlife Service
Forest Service

INTRODUCTION TO AGENCY USE

Authors – Lynn Scarlett, *The Nature Conservancy*; and Sally Collins, *Natural Resources Consultant*

Moving toward an Ecosystem Services Planning and Management Framework among Federal Agencies

In 2011, the President's Council of Advisors on Science and Technology (PCAST) issued a report calling for increased agency focus on the benefits to communities provided by natural systems.¹ The report reflected a growing recognition—among scholars, resource managers, and communities—that natural systems provide benefits to people in the form of ecosystem services such as water purification, coastal storm surge mitigation, flood protection, and temperature regulation.²

Federal agencies are enhancing their natural resource planning to better accommodate assessment and maintenance of ecosystem services. This guide supports those efforts by identifying relevant technical tools, valuation methodologies, and legal analyses. It also presents actual agency explorations and applications of an ecosystem services planning and management framework.

Why the Growing Interest in Ecosystem Services?

Agency motivations for including an ecosystem services approach to their natural resource planning and management vary by agency, location, and management issue but generally fall into five categories.

Enhancing Investment in Conservation and Natural Resources Management

Appreciation of ecosystem services could generate innovative forms of investment in resource restoration, conservation, and management. That perception prompted the National Oceanic and Atmospheric Administration (NOAA) to support scientific, policy, and economic understanding of carbon sequestration (“blue carbon”) in coastal wetlands.³ This work helped establish the first Verified Carbon Standard for blue carbon in voluntary carbon markets. The U.S. Forest Service used ecosystem services concepts to establish new partnerships, including the Denver Water Watershed Management Partnership, and conservation incentives for private forest owners (Cool Soda All Lands Restoration Proposal).⁴

¹ President's Council of Advisors on Science and Technology, *Sustaining Environmental Capital: Protecting Society and the Economy*, Working Group Report, 2011, http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_sustaining_environmental_capital_report.pdf.

² Gretchen C. Daily, “Introduction: What Are Ecosystem Services?” In *Nature's Services: Societal Dependence on Natural Ecosystems*, edited by Gretchen C. Daly (Washington, D.C.: Island Press, 1997); Barton H. Thompson, Jr., “Leaders.” *William and Mary Environmental Law and Policy* 25 (2000): 261.

³ A. Sutton-Grier, “Operationalizing and Leveraging an Ecosystem Services Framework for Habitat Conservation: Coastal Blue Carbon,” in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁴ N. Smith, “Sustaining Ecosystem Services across Public and Private Lands: The Cool Soda All Lands Restoration Proposal,” in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

Enhancing Cost-Effectiveness

Evaluation of ecosystem services could increase the cost-effectiveness of resource management decisions. The U.S. Fish and Wildlife Service is examining ecosystem services in the context of identifying funding opportunities at the San Diego National Wildlife Refuge, an effort that could help refuge managers take advantage of one local government's potential dedication of revenue from a sales tax increase to investments in open space.⁵ If refuge managers can develop a credible ecosystem services model for regional planning, it could assist local governments in identifying available parcels that provide the most benefits for dollars spent.

Improving Agency Decisions

Assessment of ecosystem services could improve decisions, particularly those involving disparate impacts on multiple ecosystem services, trade offs between use and non-use values, or conflicts among resource users. The Bureau of Land Management (BLM) undertook a comparative analysis of ecosystem services assessment methods and tools in the context of three management scenarios involving mesquite removal, urban growth, and water augmentation in the San Pedro watershed of southeast Arizona.⁶ It used the methods and tools (including ARIES and InVEST) to assess changes in carbon sequestration, water provisioning, biodiversity, and cultural (recreational and aesthetic) benefits. A second BLM study involves the application of ecosystem services assessment methods to examine water availability and scenic values in support of an oil and gas development in eastern Utah.

An ecosystem services decision-making framework could help agencies prioritize projects and build partnerships to support those priorities by more formally identifying direct and indirect benefits and impacts with respect to affected stakeholders and communities. Managers at the Great Dismal Swamp National Wildlife Refuge could use that framework to make the case that restoring water flows in the refuge could reduce the frequency and duration of wildland fires, generating multiple benefits.⁷ At the refuge, a history of modification to natural hydrology, coupled with more recent increases in the incidence of droughts, has led to more frequent, more severe, and longer wildfires in the peat bogs. The resulting smoke has been linked to increases in hospital admissions in downwind communities. Reducing this fire risk would be beneficial for the listed species for which the refuge is managed as well as for nearby residents, whose exposure to smoke has resulted in an increase in hospital visits. An ecosystem services decision-making framework could also help communities better understand their co-dependence in terms of upstream and downstream actions and consequences and allow refuge managers to garner local support for refuge projects and investments.

Enhancing Resilience

Examination of ecosystem services and their changing ecological conditions could enhance resilience of lands, water, and wildlife in a context of climate change by pointing to worthwhile investments in the protection or restoration of floodplains, sea marshes, forested watersheds, or other natural systems. In an effort to begin stabilizing particularly vulnerable shorelines and enhancing the ecological health and resiliency of estuarine habitats, NOAA partnered with The Nature Conservancy, the Louisiana State University Agricultural Center, and Coastal Environments Inc. to create a living shoreline (artificial oyster reef) project along highly eroding marsh coastline in southeast Louisiana.⁸

⁵ L. Scarlett and E. Mailett, "Incorporating Consideration of Ecosystem Services into Plans for the San Diego National Wildlife Refuge," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁶ J. Bagstad et al., *Ecosystem Services Valuation to Support Decisionmaking on Public Lands: A Case Study of the San Pedro River Watershed, Arizona*, Scientific Investigations Report 2012-5251, <http://pubs.usgs.gov/sir/2012/5251/>.

⁷ L. Scarlett and E. Mailett, "Incorporating Consideration of Ecosystem Services into Plans for the Great Dismal Swamp National Wildlife Refuge," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com

⁸ "Louisiana: Restoring Oyster Reefs at Grand Isle and St. Bernard Marsh," The Nature Conservancy, accessed February 1, 2016, <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/louisiana/restoring-oyster-reefs-at-grand-isle-and-st-bernard-marsh.xml>.

Supporting Public Involvement in Natural Resource Management

Attention to ecosystem services may also support public involvement in natural resource management by explicitly addressing public values and benefits in project proposals. Early engagement in project visioning can increase transparency and trust, thereby increasing the potential for successful project implementation. The U.S. Forest Service has used ecosystem services to drive public involvement in its Marsh project in the Deschutes National Forest. By examining management alternatives through an ecosystem services lens, the public at large and local communities have been able to actively and effectively engage in the project's planning.

Federal Policy Setting and Decision Making

Numerous federal statutes, regulations, and practices include requirements, tools, or aspirations support measurement of, assessment of damage to, and creation and protection of ecosystem goods and services. In particular, the National Environmental Policy Act (NEPA) offers a foundation for undertaking ecosystem services evaluation.⁹ In addition, federal agency resource management plans provide another, related context for applying a landscape-scale ecosystem services framework.¹⁰ Yet another foundation for ecosystem services evaluation is provided by the Clean Air Act (Section 302(h)), which describes adversity to public welfare caused by air pollutants as including impacts to soils, water, vegetation, animals, and wildlife.¹¹ Regulators at the Environmental Protection Agency (EPA) are finding value in incorporating ecosystem services into new air quality standards. For example, nitrogen and sulfur deposition (from airborne NO_x and SO_x) can increase acidification and nutrients (eutrophication) of streams and lakes, affecting fishing, boating, and swimming as well as aesthetic values. The EPA is updating NO_x and SO_x standards to account for such impacts.¹²

Guidance Document

Many analytic tools, legal underpinnings, and other information can assist agencies in using an ecosystem services framework in their planning and decision making. This online guidebook is intended to provide a home for sharing tools, examples, and information. It provides an analytical framework as a foundation for the further use of ecosystem services in federal planning and management.

⁹ D. Bear, "Integration of Ecosystem Services Valuation Analysis into National Environmental Policy Act Compliance: Legal and Policy Perspectives," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

¹⁰ P.B. Smyth, "Application of an Ecosystem Services Framework for BLM Land Use Planning: Consistency with the Federal Land Policy and Management Act and Other Applicable Law," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

¹¹ *Clean Air Act, U.S Code 42* (1970), §7401 et seq.

¹² C. Davis, "Making Ecosystem Services the Focus of Determining Adversity to Public Welfare in Review of NO_x and SO_x Secondary Air Quality Standards," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

APPROACH OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Authors – Micah Effron, I.M. Systems Group; Doug Lipton, NOAA; Tracy Rouleau, NOAA; Giselle Samonte, Earth Resources Technology, Inc. / NOAA; and Peter Wiley, NOAA

Contributing Authors – Kate Barba, Marie Bundy, Helen Chabot, Rita Curtis, Peter Edwards, LaToya Myles, Paul Sandifer, Ariana Sutton-Grier, and Katya Wowk

Historical Context

The National Oceanic and Atmospheric Administration (NOAA) serves the American public by providing environmental intelligence from the outer edges of the solar system to the very depths of Earth's oceans. Through NOAA's science, service, and stewardship, the agency provides information on a wide swath of ecosystem services critical to management efforts aimed at protecting and enhancing these services for current and future generations. For example, sea level rise projections inform coastal planning to protect valuable infrastructure and recreational opportunities; climate and weather forecasts enable farmers to maximize their land's productivity and shipping companies to navigate safely; stock assessments help provide fishermen with access to productive fishing grounds now and in the future; and habitat protection and restoration results in the direct production of many important ecosystem services as well.

To maximize the delivery of ecosystem services to society, NOAA has long recognized the importance of using an ecosystem-based management (EBM) framework. It has made great strides in integrating EBM principles into its management of coastal resources. For fisheries, NOAA has gradually moved away from single-species management to more holistic ecosystem-based strategies that reflect how species interact with each other and the environment and that rely on a wide variety of ecological information and management approaches. Of particular importance were the 1996 amendments to the Magnuson-Stevens Act, which strengthened NOAA's ability to protect and conserve "essential fish habitat."¹³ NOAA's habitat protection and restoration efforts, however, provide many benefits in addition to fisheries, including improved water quality, recreational opportunities, coastal protection from storms, and carbon sequestration. NOAA also utilizes EBM principles in managing marine protected areas and its national marine sanctuaries, which support commercial, recreational, environmental, cultural, and academic objectives. Similarly, its Coastal Zone Management Program, mandated through the Coastal Zone Management Act, provides a framework for states to pursue integrated management of competing uses of the U.S. coastline while ensuring maintenance of ecological processes and sustainable uses of natural resources.

NOAA conducts and supports wide-ranging research to inform its EBM efforts. This research investigates many ecosystem attributes and functions, including how climate shifts affect marine food webs, how nutrients cycle within wetlands, how harmful algal blooms initiate and proliferate, and how oceanographic currents affect the dispersal of fish larvae. More specifically, NOAA's Integrated Ecosystem Assessment (IEA) program supports EBM efforts by tapping into multiple perspectives and types of expertise to understand how marine ecosystems work, what benefits flow from them, what may be driving the degradation of benefits, and what options exist to stem this decline.

NOAA also has a long history of conducting and funding non-market valuations of ecosystem services relevant to its programs. The purpose of these valuations range from informing natural resource damage assessments after oil and other toxic spills, to informing coastal planners about public preferences related to conservation, restoration, and management to providing marine and coastal managers with information about the value society places on recreational fishing, beach recreation, water quality, and the protection of endangered species. NOAA also provides economic statistics associated with commercial and recreational fisheries and other ocean-dependent industries, coastal recreation, and weather and climate impacts.

Analysis of how federal management actions affect the production and delivery of ecosystem services helps

¹³ Magnuson-Stevens Fishery Conservation and Management Act as amended through October 11, 1996, Public Law 94-265 (1996).

guide those actions to prioritize and maximize services deemed important to specific stakeholder groups and society at large. To conduct this analysis, NOAA and its federal partners need to take research on ecosystems and connect it with the values that society places on ecosystem services. This task entails some challenges. They include the availability and transferability of ecological and social data across spatial and temporal scales as well as specific policy guidance and legal mandates to use the ecosystem services approach to carry out EBM efforts.

In implementing EBM efforts, NOAA faces yet other challenges unique to its mission of science, service, and stewardship. First, it is subject to more than 140 federal laws involving at least six departments of the federal government and dozens of federal agencies. Second, it lacks the high-resolution, spatially explicit data needed for EBM efforts in the U.S. Exclusive Economic Zone (EEZ)—the largest in the world at 11 million square kilometers of ocean. Third, unlike the federal land management agencies, NOAA focuses on managing particular resources (e.g., fisheries and protected resources such as corals) and providing technical services (e.g., weather forecasts and climate outlooks) over vast areas at a broad scale, which feed into its own and its partners' management strategies. Fourth, NOAA intensively manages some relatively small but very important protected places (e.g., national marine sanctuaries, national estuarine research reserves). All EBM efforts require collaboration, but the nature of NOAA's mandates and the fact that other government agencies may have responsibilities in the same areas requires NOAA to work very closely with partners to approach its management responsibilities from an ecosystem services perspective.

Decision Contexts

NOAA recognizes the potential for ecosystem services (ES) approaches to help it make better management decisions within an EBM framework. In three broad decision contexts, highlighted below, NOAA is moving toward a more quantified, spatially explicit consideration of ecosystem services and a better understanding of how they are affected by different management alternatives. The three decision contexts are

- Fisheries ecosystem-based management
- Regional place-based management, which includes fisheries management, coastal protection, climate mitigation and adaptation, damage assessments, and habitat restoration, among other NOAA mission areas; and
- Local place-based management.

For fisheries management, an ES approach is useful to understand how different management approaches affect the services that flow from productive, sustainable fisheries. For regional and local place-based management, an ES approach is useful to maximize the delivery of a suite of benefits.

Decision Context 1: Fisheries Ecosystem-Based Management

NOAA provides scientific advice in the way of fish stock assessments and other studies as part of the fisheries management process undertaken by regional fisheries management councils. Fishing quotas and other regulatory measures are adopted to prevent overfishing and ensure that the optimum yield is obtained from our fishery resources. Similarly, recommendations are made to protect fish habitat in light of ecosystem considerations such as interactions among species and by-catch issues.

Key Players

NOAA's fisheries science centers are responsible for conducting fish stock assessment and ecosystem surveys and for producing some of the scientific peer-reviewed publications used in the management process. Often, partnerships with commercial and recreational fishing interests are developed to contribute to the research, which is provided to regional fisheries management councils.

Legal and Management Context

NOAA has historically been concerned with the management and protection of living marine resources. It has direct management authority under the Magnuson-Stevens Fisheries Conservation and Management Act for fishery stocks principally found within federal waters. It has additional management interactions with interstate commissions responsible for species managed in state waters. Other key pieces of legislation are the Fish & Wildlife Coordination Act, Endangered Species Act and NEPA.¹⁴

Methods, Tools, and Capacity

NOAA couples fishery-independent stock assessments with industry catch and effort data and recreational catch and effort data. It often supplements these sources with data collected by states and university partners (e.g., through Sea Grant). Core capacity to conduct the science exists at each of the fisheries science centers and satellite laboratories, and with partner state and academic organizations. NOAA is expanding its efforts to incorporate understanding of ecosystem services into fisheries management, the recovery and protection of protected species, and habitat conservation and management. These efforts include the use of integrated ecosystem assessments and the use of large-scale ecosystem models such as Ecopath w/Ecosim and the Atlantis model.¹⁵

Decision Context 2: Regional Place-Based Management

NOAA has long realized that target (i.e., commercial and endangered) species are part of ecosystems that provide benefits such as storm protection, climate mitigation, and water quality—benefits that need to be quantified. Valuing ecosystem services enables NOAA to leverage stakeholders and partners' commitment to invest in habitat conservation to secure a better future for coastal communities and economies.

In recent years, NOAA has focused on larger restoration efforts that affect an entire watershed versus smaller projects scattered along the coast. NOAA received \$167 million from the American Recovery and Reinvestment Act of 2009 to restore coastal areas throughout the country. The idea was to scale up successful restoration efforts to include entire watersheds or larger areas identified as environmentally important and beneficial to the economy. The resulting 50 restoration projects are some of the most noteworthy large-scale restoration projects in the United States, and they embody current efforts to address ecosystem restoration in an integrative and dynamic manner, on a large spatial scale, and with complex stakeholder and public roles.

One such project—led by The Nature Conservancy (TNC) in partnership with NOAA, Louisiana State University Agricultural Center (LSU AgCenter), and Coastal Environments Inc.¹⁶ (CEI)—created a living shoreline (artificial oyster reef) along highly eroding marsh coastline in southeast Louisiana. Funded by an American Recovery and Reinvestment Act grant through NOAA, this project is an important step toward stabilizing particularly vulnerable shorelines and enhancing the ecological health and resiliency of the estuarine habitats near Grand Isle and Fifi Island and in St. Bernard Marsh.

Other projects help guide expenditures for ecological restoration activities so as to achieve the most ecosystem services benefits from specific investments. One ongoing fisheries habitat restoration project, based in Cape Fear, North Carolina, is valuing the water quality benefits that the project brings to municipal water users. This information could be used to further refine habitat restoration as well as water resources management objectives and guide the selection of alternative management actions.

As the premier federal source of scientific information on the marine environment, NOAA is relied on to

¹⁴ *Fish and Wildlife Coordination Act*, U.S. Code 16 (1980), § 661-666c. *Endangered Species Act of 1973*, U.S. Code 16 (1973), §1531-1544.

¹⁵ "Ecopath with Ecosim," Ecopath, accessed February 1, 2016, <http://www.ecopath.org/>.

¹⁶ "Louisiana: Restoring Oyster Reefs at Grand Isle and St. Bernard Marsh," The Nature Conservancy, accessed February 1, 2016, <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/louisiana/restoring-oyster-reefs-at-grand-isle-and-st-bernard-marsh.xml>.

develop and maintain data sets relating to ecosystem/habitat health and supporting ecosystem valuation and decision making. These data sets are published in easily digestible formats to facilitate use by various stakeholders, including academic researchers, community organizations, and public policy officials. As society becomes increasingly cognizant of the inextricable links between societal wellbeing and environmental health, NOAA will deliver information that drives more informed and targeted natural resource management decisions.

Results of the above-noted oyster reef study and others like it help fill knowledge gaps regarding economic values of different habitat types in different regions. But these results at the project level need to be scaled up to inform program planning and decisionmaking. Identifying critical information gaps in ecological and social data in existing inventories is critical to achieve this goal. Just as important are clarifying, communicating, and prioritizing stakeholder needs to improve the flow of benefits and to generate support for additional stewardship work across the country.

Decision Context 3: Local Place-Based Management

NOAA's place-based conservation and research provide critical information for coastal decisionmakers. NOAA's mandates, such as the National Marine Sanctuaries Act and the Coastal Zone Management Act, allow NOAA to examine the relationship between ecosystem health and function and the services that ecosystems provide at specific locations around the country and under different conditions of human-induced and natural stressors. One of NOAA's objectives for its place-based work in national marine sanctuaries (NMS) and the National Estuarine Research Reserve System (NERRS) has been a better understanding of this relationship. Ecosystem services research can increase the need for a better understanding of the connection between the health of ecosystems and the benefits humans derive from them. NOAA relies on ecosystem services approaches in local place-based management of national marine sanctuaries, and national estuarine research reserves.

Management contexts in the sanctuaries and research reserves are different but complementary. The sanctuaries are geographically defined areas of coastal, ocean, and Great Lakes waters that are legally designated for management and protection under the NMSA. In managing sanctuaries, NOAA works with partners and stakeholders to promote responsible, sustainable ocean uses that ensure the health of coastal and marine resources within sanctuary boundaries. Partners include industry representatives, state personnel, non-governmental organizations, and fishery managers. Many activities in sanctuaries rely on healthy ecosystem resources and the ecosystem goods and services that they provide. In the past, NMS condition reports have provided information on pressures on sanctuary resources, current conditions and trends, and management responses to human activities. More recently, the reports have incorporated the benefits that humans receive from healthy sanctuary resources and characterized those benefits in the ecosystem services framework.

The management emphasis for reserves is to practice and promote the stewardship of coasts and estuaries through research, education, and training under the Coastal Zone Management Act (CZMA).¹⁷ NERRS management is also heavily reliant on interactions with local stakeholders and decisionmakers, including planners, emergency managers, and NGOs. Staff members interact with their partners through research, education, and training. Long-term monitoring of water quality, weather, and habitat changes provides critical data on ecosystem status and change. Each reserve serves as a living laboratory and classroom where research methods and management approaches can be piloted and applied to issues of local, regional, and national importance. For example, a research effort in the Wells National Estuarine Research Reserve incorporates the input of stakeholders in illuminating the relative benefits of development and the value of protected riparian buffer lands. The project aims to quantify tradeoffs in ecosystem services in the context of land use decisions. The Waquoit Bay National Estuarine Research Reserve is studying the impacts of land-based nutrients on coastal marshes and the value of the carbon sequestered therein.

Methods for valuing NOAA's place-based functions are heavily dependent on whether the need is for use or non-use values, market or non-market values, and the stakeholders involved. For example, for an estimate of the recreation benefits of alternative sanctuary regulations related to healthier sanctuary resources NOAA might use the travel cost method. In another case, it might use a survey of the entire local population. NOAA will use whatever tools and methods are appropriate for the questions to be addressed, stakeholders involved, and the nature of the ecosystem services and values evaluated.

¹⁷ *Coastal Zone Management Act, U.S Code 16 (1972), § 1461 et seq.*

The explicit consideration of biological functions that contribute to ecosystem goods and services is a relatively new concept for NOAA's place-based management. Although this concept has been used in NOAA fisheries applications (e.g., bio-economic modeling), NOAA's place-based functions are just beginning to apply it with some consistency and regularity. Values for some of the direct connections between ecological health and societal benefits could play a role in place-based management. Decision making based explicitly on information that incorporates ecological health is a paradigm that fits well with both the ONMS and NERRS frameworks, but such decision making will require greater capacity on the part of NOAA and greater understanding on the part of stakeholders and decisionmakers.

Because NOAA has diverse functions, it has no single decision-making framework for identifying needed ecosystem services information. NOAA's place-based functions could utilize such information to support management decisions, characterize the benefits of NOAA products and services, understand the relative benefits of restoration options, and prioritize those options. Although these different applications may call for slightly different data needs, the data with the broadest applicability to NOAA's decision making should be identified.

Institutional Context

For many years, NOAA has been making progress in transitioning to an ecosystem-based management approach, and more recently has been moving to advance a strategic approach to integrating ecosystem services and their values into decisions. NOAA's strategic vision of "healthy ecosystems, communities, and economies that are resilient in the face of change" articulates the connection between ecosystems and the communities that rely on them. That connection is highlighted in NOAA's strategic goals, which couple its science, service, and stewardship activities related to weather, climate, oceans, and coasts with the needs of and benefits to society. Nonetheless, social science remains only partially integrated into NOAA's decisionmaking, and its adoption across multiple lines of science, service, and stewardship is inconsistent. Integrating the social sciences with natural sciences has become a leadership priority. As NOAA continues to make strides in this area, its capacity to advance ecosystem services work will grow in turn.

Regardless of the challenges, NOAA's efforts to advance a strategic approach to integrating ecosystem services are adaptive, collaborative, incremental, and, in many cases, innovative. Collaboratively developed management strategies are tailored to unique conditions and issues, and strategies are adapted and combined for an integrated approach. Further, mechanisms are in place to share information and receive feedback and to include stakeholders in decisionmaking based on both environmental and social factors. NOAA is using an innovative ecosystems services approach to advance coastal community resilience from weather and climate hazards and is beginning to incorporate understanding of ecosystem services such as structural protection (coastal green infrastructure) into preparedness and recovery from coastal storms and climate hazards. NOAA is also advancing understanding and use of coastal blue carbon in decisionmaking, connecting coastal restoration activities with climate change adaptation and mitigation.

These efforts are largely driven through strong partnerships, which are evolving to demonstrate the value that coastal and ocean ecosystems provide to the U.S. economy and industry. For example, the National Sea Grant Program partners with thousands of organizations to leverage efforts, providing a source of funding opportunities for research and application of ecosystem services valuation. The program also tracks several metrics relevant to ecosystem services as part of its national performance measure system. Partners such as NOAA's sister federal agencies, state and local governments, academia, and NGOs are critical to NOAA's efforts and success.

Agency Examples

NOAA has developed two agency examples for this guidebook:

A Heuristic Framework for Evaluating Ecosystem Services in Coastal and Marine Environments: Marine InVEST describes a research project that explores the importance of using an ecosystem services framework to include the effects of watershed-based activities and climate change in management of marine coastal

resources. Using Marine InVEST, the project developed a set of linked watershed-marine models with ecosystem service outputs to evaluate management strategies for coastal resources in several U.S. locations. In each case, the researchers compare the strength and influence of watershed activities on key ecosystem services and ask how outcomes of marine resource management strategies are affected by the strategies' inclusion of watershed processes.¹⁸

Operationalizing and Leveraging an Ecosystem Service Framework for Habitat Conservation: Blue Coastal Carbon describes NOAA's efforts, primarily domestically but also internationally, to support the scientific, policy, and economic framework needed to increase use of information on coastal wetland's carbon sequestration ("blue carbon") potential in coastal management. It describes NOAA's formation of an interagency blue carbon team and the team's collaboration with non-profit partners to evaluate how existing federal laws can support blue carbon accounting and management. The team supported a project that provided scientific information on how nitrogen pollution affects sequestration rates, thereby helping establish the first Verified Carbon Standard for restored wetlands for voluntary carbon markets.¹⁹

APPROACH OF THE U.S. ARMY CORPS OF ENGINEERS

Authors – Christy Ihlo, Nicholas Institute for Environmental Policy Solutions; and Lydia Olander, Nicholas Institute for Environmental Policy

Reviewers – Janet A. Cushing, U.S. Army Corps of Engineers

Historical Context

Historically, the role of the U.S. Army Corps of Engineers in water resources management has focused on water-borne navigation and flood control with the aim of balancing economic and environmental concerns. With increases in competition among water uses and growing fiscal constraints, the Corps has become interested in ecosystem services concept as a way to assess the benefits of its activities. This concept aligns well with its water resources mission of "providing innovative and environmentally sustainable solutions to the nation's water resources challenges."²⁰ Some restoration projects have begun to investigate the possibility of considering ecosystem services in their plans. At the same time, the Corps is exploring a systematic, agency-wide approach to incorporating ecosystem services into planning processes.²¹

Institutional Context

The Corps initiated a work unit tasked with exploring the challenges and opportunities of integrating ecosystem services into the Corps' planning efforts. The ultimate goal of the unit is to develop a practical framework for incorporating analysis of ecosystem services in planning processes and for evaluating management alternatives.²²

¹⁸ M. Plummer, M. Effron, and H. Townsend, "A Heuristic Framework for Evaluating Ecosystem Services in Coastal and Marine Environments: Marine InVEST," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

¹⁹ A. Sutton-Grier, "Operationalizing and Leveraging an Ecosystem Services Framework for Habitat Conservation: Coastal Blue Carbon," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

²⁰ <http://www.erdc.usace.army.mil/Missions/WaterResources.aspx>

²¹ D. Tazik, J. Cushing, E.O. Murray, and L. Wainger, *Incorporating Ecosystem Goods and Services in Environmental Planning: A Literature Review of Definitions, Classification and Operational Approaches*, ERDC/EL TR-13-17, U.S. Army Engineer Research and Development Center, 2013.

In 2013, the Corps released two documents that represent initial efforts to tackle this goal. The first, “Incorporating Ecosystem Goods and Services in Environmental Planning: A Literature Review of Definitions, Classification and Operational Approaches,” lays the foundation for meeting the goal by reviewing key concepts and best practices and outlining how they may be best applied to existing Corps processes.²³ The second report, “Using Information on Ecosystem Goods and Services in Corps Planning: An Examination of Authorities, Policies, Guidance, and Practices,” reviews existing Corps policies, authorities, and guidance that may allow or impede incorporation of ecosystem services into planning processes.²⁴ According to this report, one impediment could be a project’s purpose. The purpose of aquatic restoration projects, for example, is to restore degraded ecosystems to more natural conditions. Under current guidance, these projects’ measurable outputs are related to species and habitat, potentially putting other ecosystem services, even significant ones, outside the scope of the projects’ purpose.²⁵ Prior to presentation of a framework for integrating ecosystem services assessments into planning efforts, prospective reports will examine available tools and models, present case studies of Corps projects that involve ecosystem services assessments, and discuss interagency coordination.²⁶

²² D. Reed, M. Lynn, and J.A. Cushing, “Using Information on Ecosystem Goods and Services in Corp Planning: An Examination of Authorities, Policies, Guidance, and Practices” (Working Paper 2013-R-07, Institute for Water Resources; U.S. Army Corps of Engineers, 2013), http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/EGS_Policy_Review_2013-R-07.pdf.

²³ D. Tazik, J. Cushing, E.O. Murray, and L. Wainger, *Incorporating Ecosystem Goods and Services in Environmental Planning: A Literature Review of Definitions, Classification and Operational Approaches*, ERDC/EL TR-13-17, U.S. Army Engineer Research and Development Center, 2013.

²⁴ D. Reed, M. Lynn, and J.A. Cushing, “Using Information on Ecosystem Goods and Services in Corp Planning: An Examination of Authorities, Policies, Guidance, and Practices” (Working Paper 2013-R-07, Institute for Water Resources; U.S. Army Corps of Engineers, 2013), http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/EGS_Policy_Review_2013-R-07.pdf.

²⁵ D. Reed, L. Martin, and J. Cushing, *Using Information on Ecosystem Goods and Services in Corps Planning: An Examination of Authorities, Policies, Guidance, and Practices*, 2013-R-07, U.S. Army Corps of Engineers, 2013.

²⁶ D. Tazik, J. Cushing, E.O. Murray, and L. Wainger, *Incorporating Ecosystem Goods and Services in Environmental Planning: A Literature Review of Definitions, Classification and Operational Approaches*, ERDC/EL TR-13-17, U.S. Army Engineer Research and Development Center, 2013.

APPROACH OF THE BUREAU OF LAND MANAGEMENT

Authors – Rebecca Moore, U.S. Bureau of Land Management; Rob Winthrop, U.S. Bureau of Land Management; Emily Schieffer, Nicholas Institute for Environmental Policy Solutions; and Lynn Scarlett, The Nature Conservancy

Historical Context

The Bureau of Land Management (BLM) manages some 245 million acres (100 million hectares) of land—about one-eighth of the United States—and 700 million acres (283 million hectares) of subsurface mineral resources. Most of these lands are located in the western United States, including Alaska, and are dominated by extensive grasslands, forests, high mountains, arctic tundra, and deserts.

This National System of Public Lands is managed for multiple uses, including conventional and renewable energy development, mining, grazing, recreation, and resource conservation. The BLM was established July 16, 1946, under the Reorganization Plan No. 3 of 1946 Act as a merger of the Department of Interior General Land Office (established 1849) and the Department of Interior Grazing Service (established 1934).²⁷ Its programs and management have evolved to address a wider range of values associated with public lands, reflecting changes in public priorities and the passage of various federal laws. The Taylor Grazing Act of 1934 mandated better management of grazing lands in the face of widespread overgrazing. The National Environmental Policy Act (NEPA) of 1969, applicable to all federal agencies, called for consideration of impacts to the broader environment (including the human environment) that would result from a federal action. The Endangered Species Act (1973) required agencies to ensure their actions would not jeopardize the continued existence of plant and animal species.²⁸

In 1976 the Federal Land Policy and Management Act (FLPMA) established a multiple use and sustained yield mission for the BLM.²⁹ That mission, as described by the agency, is to “sustain the health and productivity of the public lands for the use and enjoyment of present and future generations.”³⁰ To provide agency-wide recognition for conservation objectives, the National Landscape Conservation System (NLCS) was established in 2000 to include national monuments, national conservation areas, wilderness, and other distinctive areas that are administered by the BLM.³¹ The Omnibus Public Land Management Act of 2009 codified the mission of the NLCS: “to conserve, protect, and restore nationally significant landscapes that have outstanding cultural, ecological, and scientific values for the benefit of current and future generations” (123 Stat. 1095, sect. 2002(a)).³²

The BLM’s land allocation decision process typically considers a range of alternative management scenarios outlining varying levels of competing or multiple uses, including conservation uses. Under an approved land use plan, some land allocation decisions will allow commodity development, whereas other decisions may focus on conservation and recreation. In these contexts, managers need to understand the tradeoffs involved and—to the extent feasible—have a comprehensive view of the values of competing uses. For both reasons, applying the lens of ecosystem services—mapping their provision and valuing their benefits—makes good sense.

The first step toward integrating an ecosystem services framework at the BLM came in recognizing the need to value those human benefits of public lands management that are not captured by conventional economic

²⁷ *Reorganization Plan No. 3 of 1946, U.S. Code 5* (2006), Supplement 4.

²⁸ *Endangered Species Act: Endangered Species Act of 1973, U.S. Code 16* (1973), §1531-1544.

²⁹ *Federal Land Policy and Management Act of 1976 as Amended, Public Law 94-579* (2001).

³⁰ http://www.blm.gov/wo/st/en/res/blm_jobs/blm_facts/multiple-use_mission.html

³¹ “National Conservation Lands,” U.S. Department of the Interior, Bureau of Land Management, last modified January 21, 2016, http://www.blm.gov/wo/st/en/prog/blm_special_areas/NLCS.html.

³² *Omnibus Public Land Management Act, U.S. Code 16* (2009), §1971 et seq.

measures: the field of nonmarket environmental values. In 1981, the BLM's Social and Economic Policy and Action Plan called for the agency to consider "nonmarket values of all goods and services produced on public lands." Nonetheless, from 1981 until recently, few of the BLM's socioeconomic impact analyses for land use plans or projects considered nonmarket values. During that time period, there was little agency guidance or internal expertise in the area of nonmarket valuation.³³

The 2005 revision of the BLM *Land Use Planning Handbook* (H-1601-1) recommended that planners "consider the significance of the non-market values associated with resources managed or impacts by the BLM when formulating the management alternatives."³⁴ In 2013, the BLM released policy and guidance on estimating nonmarket environmental values.³⁵ In 2012, to develop additional support for the consideration of nonmarket values, the BLM contracted with U.S. Geological Survey (USGS) to prepare four case studies on the application of nonmarket values to field office decisions for plans or projects, documenting the challenges and relevance for resource management decisions.

At an agency-wide level, an explicit recognition of the need to consider ecosystem services resulted from a 2008 review of the BLM's socioeconomic research needs, conducted jointly with the USGS. This review led to a series of pilot projects to assess the technical feasibility and usefulness of applying ecosystem services metrics to the BLM's plans and projects. The first pilot project, completed in 2012, involved a comparative analysis of ecosystem services methods and tools, applied to four services and several management scenarios in the San Pedro watershed of southeast Arizona.³⁶ Researchers used multiple methods and tools (including ARIES and INVEST) to evaluate three scenarios—mesquite removal, urban growth, and water augmentation—to assess changes in carbon sequestration, water provisioning, biodiversity, and cultural (recreational and aesthetic) benefits. The second, ongoing, study involves the application of ecosystem services methods to assess water availability and scenic values in support of an oil and gas development environmental impact statement in eastern Utah.

Decision Contexts

As an agency with a multiple-use and sustained yield mandate, the BLM recognizes that the public lands it administers provide many benefits to surrounding communities and the nation as a whole. Its management efforts are aimed at maintaining these natural systems for current and future generations. The BLM does not utilize an explicit ecosystem services approach bureau-wide to make decisions about natural resource planning and management. However, such an approach could be helpful in several contexts, including land-use plan decisions and implementation decisions.

Decision Context I: Land-Use Plan Decisions

The BLM's land-use plan decisions are made through development of resource management plans, which explain how the BLM will manage areas of public land over a period of time (typically 20 years). Most such plans are developed at the field office or district office level, though regional planning areas that cross field office boundaries may be established as needed. Resource management plans contain two types of land-use plan decisions: desired outcomes and allowable uses. Desired outcomes for the planning area are the goals and objectives for which resources in the area will be managed. These outcomes are informed by legal mandates, regulations, and policy as well as by the overall goal of managing public lands in a way that will best meet multiple use and sustained yield mandates.

³³ Bureau of Land Management, *Bureau of Land Management Socioeconomics Strategic Plan: 2012–2022*, BLM/WO/GI-13/010+1131 (Washington, D.C., 2013), http://www.blm.gov/style/medialib/blm/wo/blm_library/BLM_pubs.Par.40827.File.dat/BLMSocioeconomicStrategicPlan2012-2022.pdf.

³⁴ U.S. Department of the Interior, Bureau of Land Management, "Land Use Planning Handbook", (BLM Working Paper H-1601-1, Washington, D.C., 2005), http://www.blm.gov/pgdata/etc/medialib/blm/ak/aktest/planning/planning_general.Par.65225.File.dat/blm_lup_handbook.pdf.

³⁵ Bureau of Land Management Renewable Resources and Planning Assistant Director to All Washington Office and Field Office Officials, Instruction Memorandum No. 2013-131, Change 1, September 12, 2013.

³⁶ U.S. Department of the Interior, U.S. Geological Survey, U.S. Bureau of Land Management, *Ecosystem Services Valuation to Support Decisionmaking on Public Lands: A Case Study of the San Pedro River Watershed, Arizona*, by K.J. Bagstad, D. Semmens, R. Winthrop, D. Jaworski, and J. Larson, Scientific Investigations Report 2012-5251, U.S. Geological Survey (Reston, Virginia, 2012), <http://pubs.usgs.gov/sir/2012/5251/sir2012-5251.pdf>.

The second type of land-use plan decisions are comprised of allowable uses and management actions anticipated to achieve desired outcomes (goals and objectives). Allowable use decisions identify locations within the planning area where specific uses may be prioritized, allowable, restricted, or prohibited. For example, some surface land may be closed to fluid mineral development to protect significant wildlife values. Other areas, such as solar energy zones, may be identified as priority areas for renewable energy development. In addition to these allowable use decisions, land use plans identify management actions that may be necessary to meet desired outcomes, such as habitat restoration.

The nine steps of the planning process are described in the BLM's Land Use Planning Handbook and in the Code of Federal Regulations (CFR) at Title 43 § 1610. Some of the major steps are tied to the NEPA analysis process and include scoping, describing the current management situation and resource conditions, identifying management alternatives, and estimating and describing the effects of the alternatives on the human environment. Scoping is a public involvement process during which the BLM solicits comments and concerns from the public to assist in the identification of planning issues, such as potential resource conflicts, levels of resource use, and development and protection opportunities for consideration in the development of the resource management plan. An analysis of the management situation describes current resource conditions, the existing management situation, and management opportunities. On the basis of issues identified through scoping and analysis of the management situation, the BLM identifies a range of alternative management options for the planning area. These alternatives are then evaluated in terms of physical, biological, economic, and social effects.

Although not required by current regulations and guidance, use of an ecosystem services framework in the BLM's planning process offers several potential benefits. Because of the multiple-use and sustained yield mandate, the BLM's resource management plans involve tradeoffs among diverse resource values, including use and non-use values. The ecosystem services approach can provide a framework for systematically identifying and evaluating how services may change under different management alternatives. The framework provides a structure in which all resource uses are valued and should be explicitly defined and considered in the decision.

If adopted in land-use plan decisions, an ecosystem services approach could support and inform multiple aspects of the planning process. In scoping, ecosystem services language could be used to elicit stakeholder feedback on the relative value of resource uses. Because the ecosystem service approach explicitly connects the biophysical structure or ecological functions in a planning area to the human benefits generated, it will help planners connect the stakeholder-driven values identified in scoping to changing resource conditions. The ecosystem services framework is particularly helpful for integrating analyses across resource programs and for identifying the tradeoffs implicit in land-use plan decisions, which almost always involve tradeoffs between use and non-use values. When describing current resource conditions and evaluating the impacts of management alternatives, the ecosystem services approach frames the tradeoffs in a way that is inclusive of the many diverse resource values affected by the decisions and can therefore abate the tension that sometimes exists between resources uses with market value and those with primarily nonmarket value.

Key Players: Land Use Plan Decisions

Most individual plans are directed at the field or district office level, but the Washington Office Planning Program establishes national planning policy and guidance, assists field offices in the development of resource management plans, and provides planning expertise to other Washington Office program areas. Similarly, the Washington Office Socioeconomics Program provides national leadership and support for the BLM's social and economic needs, including participating in the RMP process and engaging in cross-cutting initiatives. Conveniently, the Washington Office Planning and Socioeconomics programs are both part of the BLM's Washington Office Division of Decision Support, Planning, and NEPA (WO-210), removing some institutional hurdles that might otherwise impede the use of ecosystem services in the land use planning process.

Developing resource management plans is a collaborative process, requiring coordination with tribal, state, and local governments; federal agencies; resource advisory councils; other interested parties such as non-governmental organizations and environmental advocacy groups; and the general public. The process is typically directed by BLM field or district offices. The interdisciplinary team developing the plan includes planners and resource specialists representing the range of resources important in the planning area, including socioeconomic specialists. Often, the socioeconomic component of the planning process is completed by outside experts, including teams from other agencies and universities and consultants under contract to the government.

Legal and Management Context: Land Use Plan Decisions

Land use plan requirements are established by sections 201 and 202 of the Federal Land Policy and Management Act of 1976 (FLPMA, 43 U.S.C. 1711-1712) and the regulations in 43 Code of Federal Regulations (CFR 1600). Additional guidance for BLM planning is provided in the Land Use Planning Handbook (H-1601-1). This legal and management context is generally compatible with an ecosystem services approach.

Methods, Tools, Capacity: Land Use Plan Decisions

As described above, through a series of pilot projects and case studies, the BLM has considered and is currently evaluating multiple tools and approaches for incorporating ecosystem services concepts into the land use planning process.

An additional BLM effort that can help support the use of an ecosystem services framework in land use plans is the development of rapid eco-regional assessments (REAs).³⁷ These assessments collect and synthesize regional information to document key resource values, describe ecological trends, and provide a baseline characterization of the eco-region. This information could be used to model the ecological relationships supporting ecosystem services production.

The BLM's national socioeconomic program includes economists and other social scientists working in various units throughout the BLM who can provide assistance and guidance on the socioeconomic aspects of incorporating ecosystem services in land use plan decisions. The national program includes staff in multiple Washington Office programs, staff at the National Operations Center, four zoned socioeconomic specialists providing support across multiple states, and staff at some state and field offices. Bureau-wide, this group includes fewer than 20 socioeconomic specialists, a circumstance that presents some very real operational challenges to addressing socioeconomic needs. Because an ecosystem services framework requires integration of ecological and socioeconomic data and concepts, these challenges extend to an ecosystem services analysis as well. In light of these challenges, the BLM has developed strong relationships with outside partners, including other federal agencies and private contractors. In addition to relying on outside partners to complete components of resource management plans, these partnerships have been essential in the development and evaluation of tools and methods for ecosystem services evaluation.

Decision Context II: Implementation Decisions

Resource management plans identify the allowable uses on public lands across a planning area. Specific proposed actions at a given site are referred to as implementation decisions or activity-level decisions. These are the decisions that implement the actions provided for by land use plans. Activity-level or project-specific implementation decisions include site-specific NEPA analysis as appropriate, and provide final approval for specific on-the-ground actions. Implementation decisions can be for proponent-led projects, wherein a user proposes a specific action, or for BLM projects, wherein the BLM or another federal agency proposes an action. Implementation or activity-level plans can also identify a series of implementing actions, such as an allotment management plan or a recreation area management plan. These plans outline actions needed to meet plan objectives for a resource program.

As described above, resource management plans cover a wide range of resources and resource uses within a single decision context. Implementation decisions are typically focused on a single activity or project. As a group, implementation decisions cover the full range of resource uses managed by the BLM. Implementation decisions and plans include the following:

- Review of permit applications from companies interested in exploring, developing, and producing both renewable and nonrenewable energy from the public lands the agency manages. Land use plans identify areas open to energy development; implementation decisions are used to evaluate individual permits and leases with restrictions or conditions of approval.

³⁷ "Rapid Ecoregional Assessments (REAs)," U.S. Department of the Interior, Bureau of Land Management, last modified June 5, 2015, http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html.

- Decisions to issue permits and leases to ranchers wanting to graze their livestock on BLM-managed lands. Land use plans identify areas open or closed to grazing. In this context, an allotment management plan would identify implementation decisions for allotment-specific grazing management practices and livestock forage amounts to achieve desired outcomes.
- Decisions to grant a right of way for proposed electric transmission lines, communication sites, roads, trails, canals, pipelines, or other projects on public lands.

In some cases, implementation decisions have limited impacts that are easily characterized. In other cases, they involve significant tradeoffs among multiple resource uses, users, and values. An ecosystem services approach can be particularly useful for improving communications and generating better decisions in implementation plans that involve contrasting impacts on multiple ecosystem services, trade offs between use and non-use values, and conflicts among resource users.

Key Players: Implementation Decisions

Implementation plans may be developed for proponent-led projects or BLM-led projects. In either case, the analysis is often contracted out to an environmental services consultant. Adopting an ecosystem services approach would require BLM staff to be familiar with ecosystem services and the use of consultants knowledgeable about those services.

Legal and Management Context: Implementation Decisions

Implementation decisions are subject to appropriate NEPA analysis as described in the Council on Environmental Quality (CEQ) regulations under 40 CFR§ 1500-1508; Department of Interior (DOI) regulations under 43 CFR § 46 and the BLM NEPA Handbook (H-1790-1).³⁸ Additional regulations and policies may apply, depending on the type of project proposed.

Methods, Tools, Capacity: Implementation Decisions

Efforts to develop methods, tools, and capacity for land use plan decisions also apply to implementation decisions. Relative to land use decisions, implementation decisions are based on more specific proposed changes to a region, involve a smaller range of actions and resource values, and cover a smaller geographic scale. If the BLM is to use an ecosystem services approach to evaluating implementation decisions, it will need tools that can be used by non-specialists for routine analysis and guidance to help non-specialists identify when these “standard” tools are appropriate and when additional help from specialists is called for.

³⁸ Council on Environmental Quality, *Code of Federal Regulations 40, §1500-1508. Implementation of the National Environmental Policy Act (NEPA) of 1969; Final Rule, Code of Federal Regulation 43 (2008) §46*. U.S. Department of the Interior, Bureau of Land Management, *National Environmental Policy Act Handbook*, BLM Manual Handbook H-1790-1 (Washington, D.C., 2008), http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.24487.File.dat/h1790-1-2008-1.pdf.

Institutional Structure

A variety of institutional factors at the Bureau of Land Management both constrain and encourage the adoption of ecosystem services analysis as a routine operational activity. Limiting factors include declining staff levels, declining operational budgets, and a very heavy workload of proposed land and resource uses, primarily analyzed through thousands of environmental assessments (EAs) each year. At the field office level, where the overwhelming majority of land uses actions are decided, these factors severely constrain the time and money that can be spent to meet any added analytic requirements, such as ecosystem services modeling and valuation. Supporting factors include an organizational culture that encourages local innovation, and a strong ethos of working through partnerships with local governments, interest groups, and other federal agencies.

Agency Explorations and Applications

The BLM has developed two agency explorations and applications for this guidebook:

An Ecosystem Services Approach to Sage-Grouse Conservation: Upper Green River Conservation Exchange Program describes a collaborative effort to protect habitat for sage-grouse in advance of the species' potential listing by the Fish & Wildlife Service under the Endangered Species Act.³⁹ The program is being developed by a diverse partnership of stakeholders, including the BLM, state agencies, universities, oil and gas interests, private landowners, and environmental NGOs.

Protecting Ecosystem Services While Developing Renewable Energy: Bureau of Land Management Solar Energy Program describes a program that defines how utility-scale solar energy is considered and developed on BLM managed lands.⁴⁰ The program identified areas where solar energy development is the priority land use allocation and areas where utility-scale solar is not allowed. The goal is to site development in a way that minimizes threats to other ecosystem services.

APPROACH OF THE U.S. FISH AND WILDLIFE SERVICE

Authors – Edward Maillett, U.S. Fish and Wildlife Service; and Lynn Scarlett, The Nature Conservancy

History of Engagement

The U.S. Fish and Wildlife Service (Service) was formally established in 1940 when the Bureau of Fisheries and the Bureau of Biological Survey were combined. The Service's mission is to work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. In many ways, the Service's mission statement reflects an ecosystem services mindset, although the Service has never formally adopted such a framework for communications or decision making. In today's

³⁹ A. Reed and L. Scarlett, "An Ecosystem Services Approach to Sage-Grouse Conservation: Upper Green River Conservation Exchange Program," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁴⁰ A. Reed and L. Crane, "Protecting Ecosystem Services While Developing Renewable Energy: Bureau of Land Management Solar Energy Program," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

political, social, and economic environment, it is increasingly important that the Service ably communicate to partners, stakeholders, and oversight officials how its conservation work affects and benefits the public. Adoption of an ecosystem services framework could help the Service in this endeavor. Such a framework may also help the Service better understand and evaluate the full suite of benefits and impacts associated with different management options and choices regarding the siting and expansion of wildlife refuges.

The Service does not explicitly use an ecosystem services framework to make decisions about natural resource planning, management, and land acquisitions and protection. However, in many contexts, such a framework could potentially help the Service improve its prioritization of conservation projects at both a local and national scale by more formally identifying direct and indirect benefits to and impacts on affected stakeholders and communities. Such understanding may potentially enhance support for conservation actions, improve outcomes of resource management and protection decisions, and point to nontraditional sources of funding to support these activities.

Decision Context: Refuge Planning

The National Wildlife Refuge System's mission is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations. The mission guides all activities, including resource planning and management undertaken at more than 560 refuges nationwide.

Several key statutes shape and guide refuge management:

- **Refuge Administration Act:** This act serves as the “organic act” for the National Wildlife Refuge System. It establishes a unifying mission for the system, a process for determining compatible uses of refuges, and a requirement for preparing comprehensive conservation plans. It affirms that the system's primary mission is wildlife conservation, and it identifies six priority wildlife-dependent recreation uses. The act also reinforces and expands the “compatibility standard” of the Refuge Recreation Act, which authorizes use of refuge areas for any purpose, including hunting, fishing, public recreation, and accommodations, and access if the use is compatible with the major purposes for which the refuges were established.
- **Refuge Recreation Act:** The Recreation Act requires that recreational uses of the National Wildlife Refuge System be “compatible” with the primary purpose(s) for which a refuge was acquired or established.⁴¹
- **Endangered Species Act:** The Endangered Species Act (1973), as amended, affects management activities within the National Wildlife Refuge System by directing federal agencies to take actions that would further the act's purposes and to ensure that actions implemented, authorized, or funded do not jeopardize endangered species or their critical habitat.⁴² The act also provides authority for land acquisition. Conservation of threatened and endangered species is a major objective of both land acquisition and refuge management programs.
- **Fish and Wildlife Act:** The Fish and Wildlife Act of 1956 establishes a comprehensive national fish, shellfish, and wildlife resources policy with emphasis on the commercial fishing industry but also notes the inherent right of every citizen and resident to fish for pleasure, enjoyment, and betterment and to maintain and increase public opportunities for recreational use of fish and wildlife resources.⁴³ The 1998 amendments to the act modified the powers of the Secretary of Interior with regard to volunteer service, community partnerships and education programs.⁴⁴

Consistent with these laws, the National Wildlife Refuge System has identified four challenges for refuges across the country. A constrained fiscal climate means that the system lacks the necessary resources to undertake all of the necessary actions to fully address these challenges. Projects must be selected with consideration of the returns on investment, and the system will be held accountable to the American public for effective use of scarce resources. The four key challenges are

⁴¹ *Refuge Recreation Act, U.S. Code 16 (1962), § 460k-460k-4.*

⁴² *Endangered Species Act of 1973, U.S. Code 16 (1973), §1531-1544.*

⁴³ *Fish and Wildlife Act of 1956, U.S. Code 16 (1973), §742a-742m.*

⁴⁴ *Fish and Wildlife Act of 1956, U.S. Code 16 (1973), §742f.*

- **Climate Change**—Climate change is resulting in widespread, large-scale transitioning of ecosystem composition, structure, and functioning, which has implications for refuge purposes and refuge system policies. One of the primary proposed mitigation strategies for climate change is carbon sequestration. The refuge system sequesters a substantial amount of carbon through wetlands, grasslands, and forested areas, and it further contribute to carbon sequestration through habitat protection, management, and restoration.
- **Water Quantity and Quality**—The system experiences competition for water availability, which is becoming an increasingly critical issue for maintaining healthy habits for fish and wildlife. Water quality is also a concern both in terms of clean water for wildlife and the quality of water entering and leaving refuges. As states identify impaired waters, refuges may be asked to alter management operations, such as limiting wetland drawdowns after a certain date to help the impaired water body from exceeding maximum pollutant loads, but doing so can affect the quality and quantity of refuge aquatic habitat.
- **Invasive Species**—Refuge lands now host more than 2.3 million acres of invasive plants and more than 4,400 invasive animal populations. Invasive species, along with habitat loss and human exploitation, are the chief causes of decline in global biodiversity. The Service identified some \$166 million in unfunded invasive species projects in fiscal year 2007. The Service will have to prioritize projects to ensure that the selected projects provide the greatest returns in addressing invasive species threats and associated ecosystem services.
- **Conservation Biology and Landscape-Level Conservation**—The confluence of global environmental and ecological changes is stressing natural systems and posing a growing challenge to conservation of Fish and Wildlife Service trust resources. Refuges are increasingly threatened from pressures “beyond the borders.”

Having a better understanding of the physical relationship between refuge lands and how they are managed in light of the associated impacts to surrounding communities would help the Service bring more diverse partner organizations into the planning and management process and would foster support for the mission of the Service and the refuge system. Development of an ecosystem services framework tailored to a local level would help the Service address this challenge.

At a local scale, refuge management must balance multiple options for management actions against management objectives, including how refuge-specific management objectives comport with national challenges. In these situations, using an ecosystem services approach to planning would allow the refuge program to also consider how conservation-related management actions affect surrounding communities and stakeholders. For example, restoration of native vegetation undertaken to enhance habitat for native species may also provide water quality improvements or reductions in fire risk that would benefit downstream or downwind communities. Improved understanding and communication of such co-benefits, though not required of the refuge system, could lead to opportunities for cross-jurisdictional collaboration.

One refuge where an ecosystem services perspective illuminates co-benefits and thus partnership opportunities is the Great Dismal Swamp National Wildlife Refuge.⁴⁵ At that refuge, modification to natural hydrology, coupled with increases in the incidence of drought, has led to more frequent, more severe, and longer wildfires in peat bogs. The resulting smoke has been linked to increases in hospital admissions in downwind communities. Reducing the fire risk would be beneficial both for the listed species for which the refuge is managed and for nearby residents.

Enhanced cross-jurisdictional collaboration could achieve co-benefits at the San Diego National Wildlife Refuge as well.⁴⁶ The refuge and the surrounding communities could jointly benefit from an improved ecosystem services framework that would help promote collaboration between the Department of the Interior and the U.S. Forest Service to better evaluate how potential land parcels contribute to specific, shared goals (such as air and water quality improvements or carbon sequestration) on a landscape scale.

An ecosystem services framework could guide large-scale landscape conservation plans and designs for the Silvio O. Conte National Wildlife Refuge, which encompasses the entire Connecticut River watershed within the four states of New Hampshire, Vermont, Massachusetts, and Connecticut.⁴⁷ This refuge must be managed through a multi-partnership collaboration in which the Service is a leader but not the sole decision maker

⁴⁵ L. Scarlett and E. Mailett, “Incorporating Consideration of Ecosystem Services into Plans for the Great Dismal Swamp National Wildlife Refuge,” in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁴⁶ L. Scarlett and E. Mailett, “Incorporating Consideration of Ecosystem Services into Plans for the San Diego National Wildlife Refuge,” in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

regarding land use or management actions. An ecosystem services framework could help communities better measure and understand how physical changes in the landscape or in land management actions affect the watershed in terms of water quality, flood control, and increased biodiversity and could help them better understand the payoff from conservation-related investments. Such a framework could also help communities better understand their co-dependence on one another in terms of upstream and downstream actions and consequences and could allow community leaders to garner local support for projects and investments that may flow to others in the watershed. Landscape-level planning within a watershed with such divergent and independently organized communities and multiple land uses is a difficult task. An ecosystem services framework could help unify the communities around a shared vision of how they want to interact with their natural environments to achieve multiple social, economic, and environmental goals.

Key Players: Refuge Planning

If the National Wildlife Refuge System were to utilize an ecosystem services framework in resource planning and management activities, multiple parties would be involved at different levels, depending on the scale of the analysis. For planning that takes place at the refuge scale, key staff would include refuge management and planners. Local partners would vary by location but could include local governments, regional mobility authorities, non-profit and community organizations focused on public health or environmental issues, landowners, and local, state, and federal resource or regulatory agencies. In the context of regional collaborations, such as joint planning and prioritization efforts at a large landscape scale, refuge staff would likely help form teams of stakeholders to develop jointly acceptable strategies to accomplish shared goals and missions.

Legal and Management Context: Refuge Planning

The primary guide for management activities by the National Wildlife Refuge System is the system's mission to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations. To implement this mission, each refuge develops a management plan that advance the refuge's identified goals and objectives. Development of these plans is open to public input, but they little reflect how management actions affect communities and natural environments outside refuge boundaries. Future plans will have to better reflect how refuges fit into the broad landscape in terms of services they provide and non-refuge habitat areas that are equally important for the survival of trust resources. Moreover, they will likely have to include strategies to reach out to other landowners, both public and private, to encourage land stewardship. Use of an ecosystem services framework could help the refuge managers better understand how their actions not only affect fish and game populations but also provide ancillary benefits to themselves and their neighbors. A credible ecosystem services framework could also help identify beneficiaries who might contribute funding or other resources to implement such actions at a level commensurate with expected ecosystem service benefits.

Any use of ecosystem services approaches within the Service must be consistent with the agency's mandate and activities. Beyond these requirements, state or local guidelines or concerns could influence an individual refuge's implementation of such approaches. For example, in California, state legislation requiring reductions in greenhouse gas emissions could serve as an incentive for a refuge to assess its potential to produce carbon offsets. Local desires for shoreline protection, water and air quality improvements, or additional green space could similarly encourage a refuge to assess its potential to provide such benefits.

⁴⁷ L. Scarlett and E. Mailett, "Using an Ecosystem Services Management Framework to Pursue Watershed-Wide Project Priorities in the Silvio O. Conte National Fish and Wildlife Refuge and Connecticut River Watershed," in Federal Resource Management and Ecosystem Services Guidebook (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

Methods, Tools, Capacity: Refuge Planning

Refuges have a wealth of data and expertise related to species and habitat but limited resources for engaging stakeholders and considering the value of ecosystem services. With no onsite social scientists and economists, they rely on a small number of economists at the Service's headquarters. Refuges may also have limited capability to undertake GIS (spatial) and data analysis in new ways. In a recent survey of refuges in the western United States, many respondents requested assistance with such analysis. In some cases, staff may be able to augment their own resources with local and regional data developed by partners (e.g., regional planning agencies, municipalities, NGOs, universities). The FWS Division of Economics has conducted some pilot studies of ecosystem services valuation and the benefits that refuges provide to nearby populations and has deep experience with a variety of economic issues. The concept of ecosystem services is relatively new for the agency, however, and training on both the ecological and the economic/social sides of ecosystem services analysis would be useful.

Agency Explorations and Applications

The FWS developed three agency explorations and applications for this guidebook:

Incorporating Consideration of Ecosystem Services into Plans for the Great Dismal Swamp National Wildlife Refuge describes refuge contributions to recreation, air and water quality, climate regulation, public health, and tourism in surrounding communities and the potential of an ecosystem services approach to affect these co-benefits while pursuing its primary responsibility of implementing a habitat management plan.

Incorporating Consideration of Ecosystem Services into Plans for the San Diego National Wildlife Refuge describes partnering opportunities and explores the ways that an ecosystem services approach to planning could help the partners achieve multiple shared goals.

Using an Ecosystem Services Management Framework to Pursue Watershed-Wide Project Priorities in the Silvio O. Conte National Fish and Wildlife Refuge and Connecticut River Watershed describes the considerable effort devoted to developing and organizing partnerships throughout the Connecticut River watershed to protect and enhance that ecological system and all of the native species dependent on it. That effort entails development of an ecosystem services framework to show how communities are receiving both direct and indirect services from the watershed and to illuminate the actual value of these services so that active management of the underlying resources can be promoted and supported.

APPROACH OF THE U.S. FOREST SERVICE

Authors – Sally Collins, *Natural Resources Consultant*; Emily Weidner, *U.S. Forest Service*; Kawa Ng, *U.S. Forest Service*; Nikola Smith, *U.S. Forest Service*; Greg Arthaud, *U.S. Forest Service*; and Lydia Olander, *Nicholas Institute for Environmental Policy*

Reviewers – Peter Gaulke, Karen Liu, Evan Mercer, Chris Miller, Regis Terney

Historical Context

The United States Forest Service (USFS) mission is to “sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.”⁴⁸ This mission aligns well with the concept of ecosystem services, which highlights connections between natural systems and human wellbeing.⁴⁹

The ecosystem services approach within the USFS builds on decades of research by resource economists such as Michael Bowes and John Krutilla, who described and evaluated public benefits arising from multiple use management of federal forests.⁵⁰ The Forest Service was established to protect and manage natural resources—specifically water and timber—because of their importance to national security and for the significant public benefits they provide.⁵¹ After World War II, the Forest Service emerged as a primary supplier of natural resource commodities, including timber and rangeland for grazing livestock.⁵² Socioeconomic changes, coupled with new legislation passed during the 1960s, 1970s, and 1980s, broadened the range of agency activities and objectives beyond water and timber, including outdoor recreation, range, timber, watershed, and wildlife and fish purposes with “sustained yield of the several products and services obtained therefrom” (Multiple-Use Sustained Yield Act of 1960).⁵³ These changes also expanded the scope of the agency’s work beyond National Forest management to include work with state forestry agencies and private landowners to protect private forest lands and to support forestry research.

Still more recently, the agency has clarified that the mission set forth by Congress includes healthy functioning forest ecosystems, which are considered critical to maintaining public welfare.⁵⁴ Although the Forest Service mission has evolved to broadly serve the public good, the agency’s performance measures and public engagement in planning did not overtly incorporate the values provided by the National Forest System’s regulating, cultural, and supporting services.⁵⁵ The 2012 Planning Rule was approved to incorporate these values and to provide resource specialists with new ways to approach planning and decision making.⁵⁶

⁴⁸ U.S. Department of Agriculture, Forest Service, “USDA Forest Service Strategic Plan for Fiscal Years 2007–12,” FS-880, USDA FS, Washington, D.C., 2007.

⁴⁹ The historical context section is paraphrased from N. Smith, R. Deal, J. Kline, D. Blahna, T. Patterson, T.A. Spies, and K. Bennett, “Ecosystem Services as a Framework for Forest Stewardship: Deschutes National Forest Overview,” Gen. Tech. Rep. PNW-GTR-852, USDA Forest Service, Pacific Northwest Research Station, 2011.

⁵⁰ M. Bowes and J. Krutilla, *Multiple-Use Management: The Economics of Public Forestlands* (Washington, DC: Resources for the Future and Johns Hopkins University Press: 1989).

⁵¹ The Organic Act of June 4, 1897 (16 U.S.C. 473-475, 477-482, 551) established National Forests “to protect and improve the forests for the purpose of securing a permanent supply of timber for the people and insuring conditions favorable to continuous water flow.”

⁵² U.S. Department of Agriculture, Forest Service, “100 Years of Conservation... for the Greatest Good,” FS-819. Washington, D.C., 2005.

⁵³ *Multiple-Use Sustained Yield Act of 1960, U.S. Code 16* (1960), §528–531.

⁵⁴ U.S. Department of Agriculture, Forest Service, “USDA Forest Service Strategic Plan for Fiscal Years 2007–12,” FS-880, USDA FS, Washington, D.C., 2007.

⁵⁵ The Millennium Ecosystem Assessment classified ecosystem services in terms of regulating, cultural, supporting, and provisioning services. See Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Synthesis* (Washington, DC: Island Press: 2005).

⁵⁶ U.S. Department of Agriculture, Forest Service, “National Forest System Land Management Planning (Planning Rule),” 36 CFR Part 219; FR 77(68): 21260–21276, 2012, http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362538.pdf.

Decision Contexts

In response to growing interest in ecosystem services, the USFS is identifying needs and opportunities for supporting and further developing an agency-wide ecosystem services program. The Forest Service National Ecosystem Services Strategy Team (NESST, chartered in 2013) identifies three opportunities for taking an ecosystem services approach:

- Analysis and decision making (considering a broad suite of ecosystem services in analysis, decisionmaking, and priority setting),
- Measurement and reporting (quantifying and communicating in terms that matter to people), and
- Investing in ecosystem services (connecting providers and beneficiaries of ecosystem services through partnerships, incentives, and markets).

The agency's work on the latter two opportunities has focused on protocol development for environmental markets and investments in watershed services.

Described below are three USFS analysis and decision-making efforts: (1) forest planning in the context of the 2012 Planning Rule, (2) project-level NEPA decision making, and (3) state-level ecosystem services assessment and valuation.⁵⁷

Decision Context I: Forest Planning and the 2012 Planning Rule

The USFS adopted a new planning rule (USDA FS 2012) for the development of land management plans (plans) for National Forest System (NFS) lands that require plans to provide for ecosystem services and multiple uses:

Plans will guide management of NFS lands so that they are ecologically sustainable and contribute to social and economic sustainability; consist of ecosystems and watersheds with ecological integrity and diverse plant and animal communities; and have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future. These benefits include clean air and water; habitat for fish, wildlife, and plant communities; and opportunities for recreational, spiritual, educational, and cultural benefits.⁵⁸

Plans developed pursuant to the 2012 Planning Rule will provide direction for all management activities occurring in NFS forests following the plans' adoption. These activities must be consistent with the plans' components. Forest plans and management activities are subject to the provisions of the National Environment Policy Act (NEPA). See Ecosystem Services and Land Management Plan Revision for more detail.⁵⁹

Key Players

A handful of agency leaders championed an ecosystem services approach to planning as an opportunity for innovation, integration, and improved public engagement. Much of the work in the FRMES Guidebook reflects their contributions.

In 2012, seven national forests and national grasslands—early adopters—began revising land management plans in compliance with the 2012 Planning Rule:

⁵⁷ U.S. Department of Agriculture, U.S. Forest Service, "National Forest System Land Management Planning, 2012," *Federal Register* 77, No. 68 (April 9, 2012): 21162, http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362536.pdf.

⁵⁸ 36 CFR 219.1(c). In the planning rule ecosystem services are defined as "Ecosystem services. Benefits people obtain from ecosystems, including: (1) Provisioning services, such as clean air and fresh water, energy, fuel, forage, fiber, and minerals; (2) Regulating services, such as longterm storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood control; and disease regulation; (3) Supporting services, such as pollination, seed dispersal, soil formation, and nutrient cycling; and (4) Cultural services, such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences and tourism opportunities." 36 CFR 219.19

⁵⁹ C. Miller, K. Ng, and N. Smith, "Ecosystem Services and Land Management Plan Revision: Preliminary Observations of Three Ecosystem Services Evaluation Framework Workgroup Members," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

- Nez Pearce-Clearwater National Forest, Idaho
- Chugach National Forest, Alaska
- Cibola National Forest, New Mexico
- El Yunque National Forest, Puerto Rico
- Inyo, Sequoia, and Sierra national forests, California
- Francis Marion Forest, South Carolina
- Nantahala and Pisgah national forests, North Carolina

Ecosystem services can be considered at the forest-wide scale, the multiple-forest scale (as in California), and the project scale (see next section). The 2012 Planning Rule recognizes that ecosystem services provide benefits to people beyond national forest boundaries. Consequently, future planning efforts could consider ecosystem benefits at the broad landscape level—what the Forest Service calls the “all lands approach.”

The key players involved in ecosystem services assessments for forest planning have been Forest Service staff. Some early adopters have contracted with Forest Service enterprise teams for assistance. These enterprise teams bring together experts from across the Forest Service to provide capacity where it is needed, functioning as an internal agency “contracting group.” Stakeholders, including outside groups and partners, have been involved in a range of engagement activities, including public meetings and websites that allow Forest Service staff to crowd source information on the value that the public attaches to a forest. Staff at El Yunque and Francis Marion have reached out to local consultants and retired national and state Forest Service employees to help them develop a strategy for incorporating ecosystem services into their planning process. In Region 5 (Pacific Southwest), the regional office convened an ecosystem service assessment team and commissioned members from individual national forest planning specialist teams. In another case (El Yunque), a Forest Service unit collaborated with USFS Research and Development to assess ecosystem services. This work involved substantial engagement with state agencies and research organizations.

Methods, Tools, and Capacity

In accordance with the 2012 Planning Rule, the USFS has proposed directives that offer criteria for identifying and assessing key ecosystem services provided by the plan area.⁶⁰ To identify those services that “are most important to people in the broader landscape and those that would be most affected by the land management plan,” the proposed directives call for public participation and use of the best available scientific information. To assess these services, the proposed directives suggest consideration of the following information:

- Key ecosystem services contributions by the plan area,
- Geographic scale at which the plan area contributes to ecosystem services (e.g., watersheds, counties, regional markets, or eco-regions),
- Condition and trend of key ecosystem services,
- Drivers of demand for and availability of the services,
- Stability or resiliency of the ecosystems (or their key characteristics) that maintain the services, and
- Influence of non-NFS lands or conditions beyond the authority of the Forest Service on the plan area’s capacity to provide ecosystem services.

Each national forest and Forest Service region engaged in forest plan revision is using its own approach to identify and assess ecosystem services. In the Pacific Southwest region, Forest Service research station staff used GIS-based tools to characterize the geographic location and extent of ecosystem services, which will serve as indicators or proxies in a larger-scale bioregional assessment.⁶¹

The 2012 Planning Rule does not require the Forest Service to conduct a monetary valuation of ecosystem services.⁶² However, it does require that plan components guide contributions to economic sustainability,

⁶⁰ The Forest Service expects to finalize planning directives (both a manual and a handbook) in 2014.

⁶¹ M. Metcalfe, T. Kohler, A. Brough, and V. Emly, “Ecosystem Services in the Bioregion: A Summary for Forest Plan Revision,” U.S. Department of Agriculture, Forest Service, 2013.

where those contributions include ecosystem services. If market and non-market benefits are considered, they may be assessed qualitatively or quantitatively, and they may encompass monetary or non-monetary metrics. Consideration of non-market benefits and integration of public participation throughout the planning process (§ 219.4) are expected to improve the Forest Service's ability to account for the relative values of market and non-market goods and services.

As management alternatives are developed during the planning process, their effect on the quantity, the quality, or both of the key ecosystem services may be evaluated. Environmental impact statements will document how the provision of those services under each alternative affects social, economic, and cultural conditions, thereby highlighting services tradeoffs among the alternatives. No comparative evaluation of monetary values for the key ecosystem services is required.

Nor is use of a standard set of tools required. The purpose of selecting early-adopter forests is to determine if a standard set of tools would lead to efficiencies and consistent analyses. Field offices do receive national-level advice and support for evaluating ecosystem services. Within the Forest Service, members of the Ecosystem Services Evaluation Framework group and the Ecosystem Services Practitioners Network hold regular calls to connect people doing this work.⁶³

Decision Context II: Project-Level NEPA Decision Making

Attention to ecosystem services in the 2012 Planning Rule is likely to encourage consideration of these services at the project level. Prior to the rule's release, two national forests in Oregon (Deschutes and Willamette) began exploring project-level applications of ecosystem services approaches to planning and management. The Marsh Project in the Deschutes National Forest and the Cool Soda Project in the Willamette National Forest were motivated by interest in highlighting the goods and services provided by forests to people; encouraging integrated, outcomes-based resource management; and supporting collaborative project development and implementation.⁶⁴

Legal and Management Context

Compared to the 2012 Planning Rule, NEPA provides little explicit direction on and regulation of project-level incorporation of ecosystem services. However, NEPA is inherently aligned with an ecosystem services approach because of its requirement that the public participate in environmental analysis and decisionmaking regarding natural resource management to achieve a diverse set of objectives.

The ecosystem services concept supports public involvement by explicitly addressing public values and benefits in project proposals. Early engagement in project visioning can increase transparency and stakeholders' trust, thereby increasing the potential for successful project implementation. An ecosystem services approach also supports the use of interdisciplinary teams by addressing multiple objectives across resource disciplines.

Methods, Tools, Capacity

Project-level applications of the ecosystem services concept in Oregon have been highly collaborative. Non-governmental organizations, other federal, state and local agencies, academic institutions, and local citizens

⁶² The National Environmental Policy Act, National Forest Management Act, and Multiple Use Sustained Yield Act, also do not require monetary valuation.

⁶³ U.S. Department of Agriculture, U.S. Forest Service, *Ecosystem Services as a Framework for Forest Stewardship: Deschutes National Forest Overview*, by Nikola Smith, Robert Deal, Jeff Kline, Dale Blahna, Trista Patterson, Thomas A. Spies, and Karen Bennett, General Technical Report PNW-GTR-852, U.S. Forest Service (Portland, Oregon, 2011), http://www.fs.fed.us/pnw/pubs/pnw_gtr852.pdf.

⁶⁴ T. Foley, J. Bowles, N. Smith, and P. Caligiuri, "An Ecosystem Services Approach to Management of a Complex Landscape: The Marsh Project," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

have participated in exploratory methods for addressing nature's benefits in planning. On the Marsh and Cool Soda projects in the Deschutes and Willamette national forests, ranger districts, the Forest Supervisor's Office, and the Regional Office worked together to leverage expertise and existing data through workshops, consultations, and field data collection.⁶⁵ They used GIS and Microsoft Excel to synthesize information and analyze tradeoffs.

Decision Context III: State-Level Ecosystem Services Assessment and Valuation

Several states have expressed interest in state-wide ecosystem services assessments. Reports on the non-market ecosystem services values of their forests have been written for Texas, Georgia, and Virginia.⁶⁶ Interest in ecosystem services concepts at the state level extends beyond estimates of the economic and environmental contribution of forests. Southern forest stakeholders appear to have three main motivations for quantifying and valuing ecosystem services at the state level: reporting (measures needed by the state legislatures for appropriations), decisionmaking (understanding of the consequences of converting forests and other land uses and practices), and communication (a narrative to capture public interest).⁶⁷

The majority of state forestry agencies included discussion of ecosystem services benefits and values in their state forest action plans of 2010. An amendment to the Cooperative Forestry Assistance Act (CFAA), as enacted in the 2008 Farm Bill, requires such plans from all states receiving federal forestry funding. The plans determine priority landscapes and outline strategies following national themes and associated management objectives, one of which is to "enhance public benefits from trees and forests, including air and water quality, soil conservation, biological diversity, carbon storage, and forest products, forestry-related jobs, production of renewable energy, and wildlife." Although this objective does not specifically refer to *ecosystem services*, it clearly describes managing forests to provide them.

Because state forestry agencies have had considerable latitude in how they prepare forest action plans, the types of ecosystem services and benefits they have evaluated and the valuation methodologies they have used have varied widely, making cross-state comparisons and compilation of summary statistics difficult.

Key Players

To address the difficulty of making cross-state comparisons of the value of statewide forest-based ecosystem services, nine southern states (Alabama, Georgia, Florida, Kentucky, Mississippi, Oklahoma, South Carolina, Texas, and Virginia) were awarded a regional investment competitive grant from the USDA Forest Service in 2013. The grant has allowed researchers from the Forest Service Southern Research Station and North Carolina State University to partner on a forest ecosystem services valuation project. The project is bringing together stakeholders and experts on ecosystem services and valuation to develop a process and methodology for standardizing the quantification, valuation, and reporting of forest ecosystem services across the southern states (and perhaps the nation). This effort will help the Southern Group of State Foresters and other members of the forestry community to provide accurate estimates of the total economic and environmental contribution of forests as well as to understand the consequences of converting forests to other land uses.

The project objectives include developing guidelines that will improve states' ability to accurately quantify and value forest ecosystem services in a way that is comparable across states and that supports improved land use planning. Specifically, through stakeholder meetings, literature reviews, and meetings of expert panels, the researchers will

⁶⁵ N. Smith, "Sustaining Ecosystem Services across Public and Private Lands: The Cool Soda All Lands Restoration Proposal," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁶⁶ Simpson, H., E. Taylor, Y. Li, and B. Barber, "Texas Statewide Assessment of Forest Ecosystem Services: A Comprehensive Analysis of Regulating and Cultural Services Provided by Texas' Forests," Texas A&M Forest Service, College Station, TX, 2013; R. Moore, T. Williams, E. Rodriguez, and J. Hepinstall-Cymerman, "Quantifying the Value of Non-Timber Ecosystem Services from Georgia's Private Forests," Georgia Forestry Foundation, 2011.

⁶⁷ North Carolina State University and USDA Forest Service, Forest Ecosystem Services Stakeholder Meeting: Meeting Summary, 2014.

- Identify and prioritize the ecosystem services and benefits produced by southern forests (for valuation efforts),
- Identify methods employed to estimate the value of these services and benefits and assess the methods' accuracy and cost-effectiveness for state-level valuation of forest ecosystem services, and
- Develop guidelines and standardized methods to enable states to produce reliable, accurate, verifiable, and comparable estimates of the quantity and value of the priority ecosystem services and benefits produced by southern forests.⁶⁸

Methods, Tools, Capacity

At a meeting in Raleigh, North Carolina, in February 2014, approximately 40 southern forests stakeholders discussed standardizing methodologies for quantifying and valuing forest ecosystem services. They represented private industry, non-governmental organizations, academia, and federal and state agencies in 10 of 13 USFS Region 8 states. Some 90% of these stakeholders had more than 10 years' experience working in the natural resources field.

Panels of ecosystem services valuation experts are in the process of identifying accurate and cost-effective methods for state-level valuation and developing standardized guidelines and methods to produce reliable, accurate, verifiable and comparable estimates of the quantity and value of the priority ecosystem services and benefits from southern forests. Researchers from the Forest Service Southern Research Station and North Carolina State University are directing this work.

Institutional Structures

Research Community

USFS Research & Development (FS R&D) is a deputy area within the Forest Service. It provides science, tools, and data that are fundamental to much of the USFS work on ecosystem services. Research is undertaken by five research stations, the Forest Products Laboratory, and the International Institute of Tropical Forestry. Under FS R&D, the Forest Service's Forest Inventory & Analysis Program projects the condition of forests in 10 to 50 years, allowing the Forest Service to evaluate whether current forest management practices are sustainable and to assess the implications of current policies. FS R&D is actively engaged with other agencies in developing an interagency ecosystem services research strategy.

Cross-Agency Coordination

In June 2012, Forest Service staff working on ecosystem services policy, programming, and research held the Ecosystem Services Champions Forum to begin a dialogue on the agency's strategic direction. In January 2013, the National Ecosystem Services Strategy Team was chartered by the USFS Associate Deputy Chiefs "to collaboratively develop national strategy and policy around ecosystem services and integrate it into Forest Service programs and operations." This effort is the agency's first to look across deputy areas and to comprehensively assess opportunities to incorporate ecosystem services approaches into USFS programs and activities. Opportunities fall into three categories: (1) analysis and decisionmaking, (2) measurement and reporting, and (3) investment in ecosystem services.

Funding Mechanisms, Measures of Project Success

A significant organizational constraint to incorporation of ecosystem services approaches in USFS programs and activities is the agency's budgetary structure. This structure inadvertently creates "siloed" approaches to

⁶⁸ E. Mercer, E. Stills, F. Cubbage, and S. Moore, "Valuation of Forest Ecosystem Services," Research Proposal Summary, prepared for the USDA Forest Service Southern Research Station, 2013.

resource management and accomplishment reporting by establishing separate budgets and performance targets for individual resource programs (timber, recreation, aquatics, and so on). An ecosystem services approach can support and be supported by integrated, outcomes-based budgeting and performance measures by articulating the goods and services provided by ecological systems and coordinated management across resource program areas.

Agency Examples

The USFS prepared five agency examples for this guidebook:

- Application of Ecosystem Services Concepts to Planning and Implementation Processes for the Inyo, Sierra, and Sequoia National Forests describes a bioregional assessment of ecosystem services in California (USFS region 5) designed to inform forest-level planning.⁶⁹
- Sustaining Ecosystem Services across Public and Private Lands: The Cool Soda All Lands Restoration Proposal describes a project-level planning pilot in the Willamette National Forest.⁷⁰
- An Ecosystem Services Approach to Management of a Complex Landscape: the Marsh Project describes a project-level planning pilot in the Deschutes National Forest.⁷¹
- Ecosystem Services and Land Management Plan Revision: Preliminary Observations of Three Ecosystem Services Evaluation Framework Workgroup Members describes how the USFS is implementing the ecosystem services requirement in its 2012 Planning Rule.
- Integrating Ecosystem Services into U.S. Forest Service Programs and Operations describes efforts within the USFS to institutionalize and coordinate ecosystem services activities.

⁶⁹ D. Whittall, M. Metcalfe, J. Stringer, and D. Saah, "Application of Ecosystem Services Concepts to Planning and Implementation Processes in the Inyo, Sierra, and Sequoia National Forests," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁷⁰ N. Smith, "Sustaining Ecosystem Services across Public and Private Lands: The Cool Soda All Lands Restoration Proposal," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.

⁷¹ T. Foley, J. Bowles, N. Smith, and P. Caligiuri, "An Ecosystem Services Approach to Management of a Complex Landscape: The Marsh Project," in *Federal Resource Management and Ecosystem Services Guidebook* (Durham: National Ecosystem Services Partnership, Duke University, 2014), www.nespguidebook.com.



EXPLORATION OF LEGAL AUTHORITY

National Environmental Policy Act
Federal Land Policy Management Act

Integration of Ecosystem Services Valuation Analysis into National Environmental Policy Act Compliance:

Legal and Policy Perspectives

Author
Dina Bear

Introduction

Federal agencies do not commonly undertake analysis of the value of ecosystem services potentially affected by their proposed actions. Although such analysis is an appropriate component of and consistent with compliance with the National Environmental Policy Act (NEPA),¹ as that law's history and purpose, statutory language, and regulatory direction make clear, it is stymied by at least four barriers. Nevertheless, NEPA compliance is required for a broad variety of federal programs, plans, and policies. Such analysis enhances understanding of ecosystem services and helps to fulfill both the public policy purposes and the legal requirements of NEPA.

NEPA's History and Purpose

In the 1950s, a few members of Congress began to articulate a federal role in protecting the nation's environment.² Catalyzing the movement to legislate to address harm to the environment were some highly visible environmental disasters in the 1960s and Rachael Carson's book *Silent Spring*, which documented the effects of pesticides on birds and the 1968 oil spill off Santa Barbara, California. Tarred and dead birds, fouled waters, and heavy smog fanned the activism of the 1960s into a movement to save the environment that gained widespread and strong bipartisan support.

In the summer of 1968, Congress convened the joint, bipartisan Senate-House "Colloquium to Discuss a National Policy for the Environment." The colloquium included scientists, members of the academic community, business leaders, executive branch officials, and other participants outside of the legislative branch. It resulted in the *Congressional White Paper on a National Policy for the Environment*.³ The letter of submittal to Congress accompanying the paper stated that "The Congress is the only institution having the scope to deal with the broad range of man's interactions with his physical-biological surroundings. We therefore believe that leadership toward a national environmental policy is our responsibility."⁴

The white paper reflected colloquium participants' deep thought about the relationship between the physical environment and economics. For example, Secretary of the Interior Stewart Udall observed that "The real wealth of the country is the environment in the long run. We must reject any approach which inflates the values of today's satisfaction and heavily discounts tomorrow's resources."⁵ There was much discussion about "broadening the scope of cost accounting," and "narrow utilitarian views governing the use of environmental resources" were cited as the root of many conflicts as well as a major barrier to sound environmental management.⁶ The participants believed that finding "equitable ways of charging for environmental abuses within the traditional free-market economy" was vital.⁷ But there was also recognition that "The benefits of preventing quality and productivity deterioration of the environment are not always

¹ 42 U.S.C. §§ 4321-4321.

² The first NEPA-like legislation was introduced in 1959 by Senator James E. Murray from Montana. His bill, S. 2549, the Resources and Conservation Act, would have established a mechanism in the Executive Office of the President to coordinate resource conservation on the basis of identified national goals. For an authoritative discussion of the work preceding NEPA's development and passage, see, Caldwell, Lynton Keith, *The National Environmental Policy Act*, Indiana University Press, 1998.

³ Submitted to the U.S. Congress under the Auspices of the Committee on Interior and Insular Affairs and the Committee on Science and Astronautics, GPO, October 1968.

⁴ Letter of submittal, *White Paper*, *Id.*

⁵ *Id.* at 2.

⁶ *Id.* at 3.

⁷ *Id.* at 2.

measurable in the marketplace. Ways must be found to add to cost-benefit analyses nonquantifiable, subjective values for environmental amenities, which cannot be measured in conventional economic terms.”⁸

On October 8, 1968, the same day that the white paper was published in the *Congressional Record*, Senator Henry Jackson from the state of Washington called for the Senate to appoint conferees to deliberate on the Senate-passed National Environmental Policy Act and the House-passed bill, H.R. 12549.⁹ In discussing the bills, he relied heavily on a report that had been prepared for the House-Senate colloquium by Professor Lynton K. Caldwell, then chairman of the Department of Government at Indiana University, with the assistance of Bill Van Ness, Senator Jackson’s special counsel.¹⁰ The report emphasized the importance of recognizing the costs of environmental deterioration. The report noted that it has:

been poor business, indeed, to be faced with the billions of dollars in expense for salvaging our lakes and waterways when timely expenditures of millions or timely establishment of appropriate policies would have largely preserved the amenities that we have lost and would have made unnecessary the cost of attempted restoration. A national system of environmental cost accounting expressed not only in economic terms but also reflecting life-sustaining and amenity values in the form of environmental quality indicators could provide the Nation with a much clearer picture than it now has of its environmental condition. It would help all sectors of America to cooperate in avoiding the overdrafts on the environment and the threat of ecological insolvency that are impairing the national economy today.¹¹

Throughout the discussion of NEPA, Senator Henry Jackson made it clear that the philosophical and legal framework of NEPA was intended to embrace human beings and human needs of all kinds. NEPA’s most quoted provision, which requires preparation of environmental impact statements, contains the phrase “the human environment.”¹² That phrase signals that the impacts to be analyzed are not only humans’ impact on the physical environment but the impacts of the environment on people. As Senator Jackson explained, “When we speak of the environment, basically, we are talking about the relationship between man and these physical and biological and social forces that impact upon him. A public policy for the environment basically is not a public policy for those things out there. It is a policy for people.”¹³

The polluted Cuyahoga River burst into flames in the summer of 1969, adding further support for Congressional action. By the end of the year, Congress had passed NEPA, and President Nixon signed the act into law on January 1, 1970.¹⁴ In his remarks on signing NEPA, the president praised the Congress’s actions, committed to quick nominations for highly qualified persons for the Council positions, and said all levels of government and the public had to be involved in protecting the environment because “It is literally now or never.”¹⁵

⁸*Id.* at 16.

⁹ S.1075. October 8, 1969.

¹⁰ “A National Policy for the Environment,” prepared for the Committee on Interior and Insular Affairs, July 11, 1968.

¹¹ *Congressional Record*, vol. 115, no. 164, October 8, 1969, Senate, p. 5.

¹² Section 102(2) (C) of NEPA requires federal agencies to prepare “detailed statements” (now known as an EIS) for “every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment.”

¹³ Hearings on S.1075, S.237, and S. 1752, Senate Committee on Interior and Insular Affairs, 91st Cong., 1st Sess. 118 (1969).

¹⁴ Pub. L. 91-190.

¹⁵ President Richard M. Nixon, “Statement about the National Environmental Policy Act of 1969,” January 1, 1970, *Public Papers of the Presidents*, January 1, 1970.

Statutory Provisions

Unlike many other environmental statutes, NEPA focuses on no one activity, nor is it an anti-pollution law, as first reported by the *New York Times*.¹⁶ Although it is certainly within the scope and purpose of the law to foresee and prevent pollution, NEPA focuses on interactions between human beings and the physical environment. It speaks to

. . . the *interrelations of all components* of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.¹⁷

Further, the federal government is charged with using

all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may --

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
4. preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
5. achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.¹⁸

Congress specifically directed all federal agencies to

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment;¹⁹ and

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently

¹⁶ Caldwell, Lynton Keith, *The National Environmental Policy Act*, Indian University Press, 1998, pp. 37-38.

¹⁷ 42 U.S.C. §4331(a) (emphasis added).

¹⁸ 42 U.S.C. § 4331(b).

¹⁹ 42 U.S.C. 4332(A).

unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations.²⁰

Congress deliberately chose the term “human environment” to signal that the required analysis under NEPA should not focus on, as Dr. Caldwell once said, “those trees out there,” but rather on the interaction of trees and human beings—the impact of each on the other.²¹ It is equally clear that Congress did not intend for the analysis to be solely the domain of scientists focusing on the natural and physical world, but also that of social scientists, economists, physicians, and others focused on the human world. Congress understood the difficulty of precisely denominating the economic value of all aspects of the environment and allowed qualitative as well as quantitative analytical work to be considered in the course of agency decision making.

Importantly, Congress also made the policies and goals set forth in NEPA supplementary to federal agencies’ existing authorities.²² It directed that, *to the fullest extent possible*, the policies, regulations, and public laws of the United States “shall be interpreted and administered in accordance with the policies set forth in this Act.”²³

Regulatory Direction

NEPA established the Council on Environmental Quality (CEQ) to oversee the law’s implementation.²⁴ The CEQ issued guidelines and, later, regulations requiring all executive branch agencies to implement NEPA’s procedural provisions. Early in the evolution of guidance to executive branch agencies, the CEQ recognized that significant adverse effects of potential agency actions included those that “curtail the range of beneficial uses of the environment.”²⁵

CEQ regulations reiterate the statutory provisions that require the use of an inter-disciplinary approach to “insure the integrated use of the natural and social sciences,”²⁶ and to take into account any analyses of unquantified environmental impacts, values, and amenities, along with any quantification prepared by way of a cost-benefit analysis.²⁷ “Effects” to be analyzed in any level of analysis include direct, indirect, and cumulative effects on natural systems, including ecosystems, land use, population density or growth rate; effects on natural resources and on the components, structures, and functioning of affected ecosystems; and aesthetic, historic, cultural, economic, social, and health impacts.²⁸ Analysis of both beneficial and adverse impacts must be included.²⁹ Finally, the regulations require that the key term “human environment” “shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment.”³⁰

In short, the intent and requirements of both the statute and the regulations are completely consistent with, and indeed advanced by, integration of an analysis of ecosystem services

²⁰ 42 U.S.C. §4332(B).

²¹ Personal communication from Dr. Caldwell to author, June 2005.

²² 42 U.S.C. § 4335 (incorporated into CEQ’s regulations at 40 C.F.R. § 1500.6).

²³ 42 U.S.C. § 4332 (emphasis added).

²⁴ 42 U.S.C. §§ 4342 – 4347.

²⁵ “Guidelines, Statements on Proposed Federal Actions Affecting the Environment,” *Federal Register* vol. 36, no. 79, p. 7725, §5(c), April 23, 1971; see similar language in “Guidelines, Preparation of Environmental Impact Statements,” *Federal Register* vol. 38, no. 147, p. 20551, § 15006(b).

²⁶ 40 C.F.R. §§1502.6, 1507.2.

²⁷ 40 C.F.R. §1502.23.

²⁸ 40 C.F.R. § 1508.8.

²⁹ 40 C.F.R. § 1508.8(b).

³⁰ 40 C.F.R. § 1508.14.

valuation in the NEPA process. As one law review writer has stated, “Valuation of ecosystem services is exactly the kind of assessment NEPA envisions, providing a means to inform the public and decision-makers about what we stand to gain or lose in several alternative scenarios.”³¹ Similarly, a 2013 report from the U.S. Army Corps of Engineers’ Institute for Water Resources noted that

As a foundational environmental law that requires agencies to evaluate the consequences of a full range of alternative ways to pursue goals before acting, NEPA seems particularly supportive of considering EGS [ecosystem goods and services] information in water resources planning. NEPA requires the consideration of all direct, indirect and cumulative effects of each alternative on significant resources. The consideration of, if not the valuation or quantification of EGS, could contribute to informing the public and decision makers about potential gains and losses in EGS from alternative plans and scenarios. NEPA also includes provisions for considering activities at the programmatic level, allowing for analysis of regional or national effects. Information about EGS could inform those analyses.³²

In short, federal agencies would be hard pressed to articulate an argument against inclusion of analyses of ecosystem services likely to be affected by proposed actions, and yet they are not routinely conducting such analyses.

Barriers to Ecosystem Services Analyses

Analysis and valuation of ecosystem services appears to be both within the legal scope of NEPA and potentially quite useful in meeting NEPA’s goals and requirements, yet federal agencies are not undertaking these activities. Among the barriers to these activities are misunderstanding of NEPA, lack of familiarity with ecosystem services concepts, lack of demand for ecosystem services valuation by members of the public and public interest groups, and lack of capacity.

Misunderstanding of NEPA

In the wake of the dramatic disasters of the 1960s and early 1970s, NEPA’s enactment and early implementation were focused almost exclusively on how human beings adversely affected the environment. Legal and political actions, literature, and popular media all focused on what human beings were doing to the environment. This formulation often made it appear that human beings were not part of the environment but rather an outside (and deleterious) force on it.

Completely overlooking the phrase “human environment” and the rich legislative history behind that phrase, one early legal case suggested that NEPA did not define “environment” and speculated that it did not cover human beings.³³ A decision in another early NEPA-related case

³¹ Robert Fischman, *The EPA’s NEPA Duties and Ecosystem Services*, Stanford Environmental Law Journal, vol. 20: 497, 501. Professor Fischman’s articles analyze ecosystem services in the context of the review required under Section 309 of the Clean Air Act by the Environmental Protection Agency of EISs.

³² Denise Reed, Lynn Martin, and Janet Cushing, *Using Information on Ecosystem Goods and Services in Corps Planning: An Examination of Authorities, Policies, Guidance, and Practices*. Institute for Water Resources, U.S. Army Corps of Engineers, September 2013.
http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/EGS_Policy_Review_2013-R-07.pdf.

³³ *Clinton Community Hospital Corp. v. Southern Maryland Medical Center*, 374 F. Supp. 450 (D. Md. 1974). No other cases have followed this line of reasoning when plaintiffs have demonstrated that the proposed action would cause some impact on the physical environment.

contained the somewhat puzzling observation that, “environmental problems in the city are not as readily identifiable as clean air and clean water.”³⁴

The majority of early cases, however, clearly established that NEPA’s coverage included the urban environment and impacts on human beings. They also established that the impacts to be analyzed included not just air and water impacts. In *Hanley v. Mitchell*, the Court of Appeals for the Second Circuit ruled the law’s coverage

extends beyond sewage and garbage and even beyond water and air pollution The Act must be construed to include protection of the quality of life for city residents. Noise, traffic, over-burdened mass transportation systems, crime, congestion, and even availability of drugs all affect the urban ‘environment’ and are surely results of the ‘profound influences of high density urbanization [and] industrial expansion [citing Section 101(a) of NEPA].’³⁵

Another case specifically refuted the notion relied on in the *Clinton Community Hospital* decision that the “human environment” does not cover human beings.³⁶ In that case, involving the proposed use of federal funds for acquisition of a site for a correction facility, the court observed that

A review of NEPA’s language casts some doubt upon the contention that the environment does not include human beings. . . . The statute is replete with references to the interrelationship of man and his surroundings and concern for human welfare. An examination of judicial decision in the area demonstrates the term reaches just about everything important to people, including crime and overpopulation, race relations, employment and the availability of schools and housing.³⁷

Cases alleging inadequate economic analysis, when brought by a party that meets the prudential requirements for being in the “zone of interest” covered by NEPA (i.e., that there must be some tie to the physical environment), have been successful.³⁸ On the other hand, plaintiffs whose interest is identified as solely economic competition have generally not been considered to be within the appropriate zone of interest.³⁹

Contributing to the lingering perception that NEPA does not cover human beings or impacts on human beings are some cases from the 1970s brought on behalf of plaintiffs who stood to suffer economically in the event of proposed post–Vietnam War military installation closures and reductions-in-force actions. The pleadings were devoid of any allegations regarding environmental effects per se, and the courts ruled in favor of the government, holding that to be cognizable under NEPA, complaints had to allege some nexus between a proposed action and the physical environment.⁴⁰ This holding was codified in CEQ’s NEPA regulations requiring

³⁴ *Nucleus of Chicago Homeowners Ass’n. v. Lynn*, 524 F.2d 225, 229 (7th Cir. 1975).

³⁵ *Hanley v. Mitchell*, 460 F.2d 640 (2nd Cir. 1972).

³⁶ *Id.* at fn. 30.

³⁷ *Monarch Chemical Works, Inc. v. Exxon*, 452 F. Supp. 493 (D. Neb. 1978), judgment aff’d., 604 F. 2d 1083 (8th Cir. 1979).

³⁸ *Natural Resources Defense Council v. Duvall*, 777 F. Supp. 1553 (E. Calif. 1991).

³⁹ *Benton County Sav. and Loan Ass’n. v. Federal Home Loan Bank Bd.*, 450 F. Supp. 884 (W.D. Ark. 1978).

⁴⁰ *Image of Greater San Antonio v. Brown*, 570 F.2d 517 (5th Cir. 1978); *Breckinridge v. Rumsfeld*, 537 F.2d 864 (6th Cir. 1976); *National Ass’n of Government Emp. V. Rumsfeld*, 418 F. Supp. 1302 (1976).

environmental impact statements (EISs) to address any interrelated socioeconomic and natural or physical environmental effects.⁴¹

Further contributing to the perception that NEPA does not cover human beings or impacts on them is a Supreme Court decision dealing with the restart of one of the nuclear power plant units at Three Mile Island following the accident there in March 1979. The reactor proposed for restart was not operating at the time of the accident, but a group of local residents deeply feared and strongly opposed its restart. They asked the Nuclear Regulatory Commission to include in its EIS for the unit's restart an analysis of the psychological harm they would likely experience as a result of their fears (as opposed to the actual restart). In its decision in *Metropolitan Edison Co. v. People Against Nuclear Energy*, the Supreme Court unanimously held that, "All the parties agree that effects on human health can be cognizable under NEPA, and that human health may include psychological health."⁴² The court went on to find that under the facts alleged, the causation between possible harm to the plaintiffs as a result of their fears and the act of restarting the unit in question was too attenuated to pass muster under "proximate cause," a legal theory used in tort law. This opinion—the first to introduce proximate cause in the context of a NEPA case—has been misinterpreted to stand for a variety of inaccurate propositions: that NEPA does not cover human beings, that it does not include human health impacts, and that it does not include psychological health impacts despite the court's making it clear that human health, generally, and psychological health, in particular, are cognizable under NEPA.⁴³

Finally, there is a widespread assumption that EISs should focus solely on adverse impacts from projects when, in fact, neither the law nor regulations support that notion. CEQ's regulations explain that the effects to be analyzed under NEPA "include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial."⁴⁴ This stipulation is important for three reasons: (1) the characterization of an effect may vary with an individual's perspective; (2) even an action intended to improve the environment may benefit from an analysis of alternative ways of achieving that goal; and (3) ultimately, decision makers must make a judgment about the benefits versus the negative impacts of a proposal. The commonplace but faulty belief that NEPA applies only to adverse impacts undermines analysis of the value of ecosystem services and the impacts that a proposed action and alternative actions would have on them in the context of an EIS or environmental assessment.

Analysis of ecosystem services, of course, focuses not just on humans' impacts on the physical environment but also on the environment's contribution to human society. The combination of the political atmosphere surrounding NEPA's passage, early judicial decisions, and the tendency to think of NEPA in terms of adverse impacts may have reinforced a view that impacts on human beings (and thus, the issue of ecosystem services) have a "second class" status

⁴¹ 40 C.F.R. § 1508.14. Some have misinterpreted this regulation to mean that social and economic effects are not to be analyzed in environmental assessments. CEQ's definition of effects applies to EAs just as to EISs.

⁴² 460 U.S. 766, 771 (1983).

⁴³ The confusion about the role of human beings as being part of, not separate from, the "human environment" has had an impact in the context of issues beyond ecosystem services. For example, although the word "health" is referenced in NEPA and included in CEQ's regulatory definition of the type of impacts that must be analyzed, health impacts in NEPA documents have typically been ignored or addressed only in a very narrow sense. Ironically, many countries—including Australia, Canada, and Thailand—and international bodies, including the European Union, have developed a model of "health impact assessment" based on NEPA's model of environmental impact assessment. Much work also has been done to reintegrate health impacts into NEPA analyses. See, *Improving Health in the United States: The Role of Health Impact Assessment* generally and Appendix F, National Academies Press, 2011.

⁴⁴ 40 C.F.R. § 1508.8(b).

under NEPA despite Congress’s carefully chosen phrase—“the human environment”—to frame the statute. The result is that federal agencies hire scientists with expertise in the natural and physical environment—but not social scientists and economists—to work on NEPA-related analyses.

Lack of Familiarity with Ecosystem Service Concepts

Academic literature has addressed the concept of ecological services since the early 1970s, yet a survey by the Udall Center for Studies in Public Policy of project managers, interdisciplinary team members, and decision makers who had worked on NEPA documents in 2011 and 2013 showed that 41% of the 524 respondents were still totally unfamiliar with the concept. Another 42% were somewhere familiar with it.⁴⁵ Although there appears to be no similar study in the context of the public interest community that often engages in the NEPA process, awareness of the concept in that community may be no greater and might be lower. Moreover, awareness of the concept by the public at large is probably low.

Even interpretation of the term *ecosystem services* varies. A broad definition of these services would encompass all aspects of nature that contribute to society’s wealth and wellbeing. These aspects include ecological processes, like nutrient cycling and carbon sequestration, as well as tangible things that arise from these processes, like duck populations. They also include benefits like the commercial value of a fishery or human health improvements due to cleaner air as well as activities, like hunting, fishing, and birding, for which environmental amenities provide the context.

Lack of Demand

Lack of demand for ecosystem services valuation by members of the public and public interest groups is one reason for federal agencies’ lack of awareness or analysis of ecosystem services. Indeed, some respondents to the Udall Center for Studies in Public Policy survey of people who had worked on NEPA documents in 2011 and 2013 stated that a “requirement” stemming from court cases, for example, would be necessary to compel further attention to these services.⁴⁶

Overwhelmingly, agency personnel implementing NEPA or overseeing its implementation are driven to prioritize their work according to the reality or perception of demands on their time. Those demands may come from their agency’s management, the CEQ in its NEPA oversight role, the EPA in its EIS review and rating role, Congress, the public at large or a particular segment of the public, and the courts. None of those “drivers” have demanded or even requested integration of ecosystem services analyses into the NEPA process. Neither the CEQ nor the EPA has issued guidance or direction on this activity. With some notable exceptions, public interest groups have not focused on the subject. And to date, no litigation challenging an agency’s compliance with NEPA on the basis of no or inadequate analysis of ecosystem services has been identified.

Lack of Capacity

Even if awareness of and demand for ecosystem services exist, agency personnel must be given the education, training, and tools to analyze those services in the context of a specific proposed agency action, whether that proposed action is a management plan covering millions of acres or a single building complex in a particular type of ecosystem. The information transfer

⁴⁵ Carrie K. Presnall, Laura López-Hoffman, and Marc L. Miller, “Incorporating an Ecosystem Services Approach in Environmental Impact Statements,” Udall Center for Studies in Public Policy, Environmental Policy Working Papers, University of Arizona, February 2013.

⁴⁶ *Id.* at pp. 11–12.

necessary for executive branch agencies to widely implement ecosystem services analysis in appropriate situations has yet to occur.

Relationship of NEPA to Other Statutory Frameworks

NEPA compliance is required for a broad variety of federal programs, plans, and policies. For that purpose, agencies generally prepare a “programmatically EIS” from which analyses for individual program, plan, or policy components may then be “tiered.”⁴⁷ Programmatic EISs most frequently apply to plans prepared in compliance with an agency’s authorizing statute and regulations. Among the plans that generally trigger the requirement to prepare EISs are U.S. Forest Service forest plans, resource management plans, Department of Defense policy and military installation plans, and Department of the Army civil works plans.

U.S. Forest Service Forest Plans

The National Forest Management Act of 1976 (NFMA) requires preparation of land and resource management plans for units of the National Forest system.⁴⁸ It also requires revision of these plans when conditions change significantly but at least every 15 years.⁴⁹ In addition, the law requires the Forest Service to develop regulations for forest planning and to specify appropriate compliance with NEPA.⁵⁰

The Forest Service published its latest iteration of final planning regulations in 2012.⁵¹ The regulations define ecosystem services as “benefits people obtain from ecosystems,” including “provisioning services” such as clean air and fresh water, “regulating services,” such as long-term storage of carbon and disease regulation, “supporting services” such as pollination and seed dispersal, and “cultural services” such as aesthetic and spiritual.⁵² The regulations require that plans identify and evaluate “benefits people obtain from the National Forest Service planning area (ecosystem services).”⁵³ Plans must provide “for social, economic, and ecological sustainability within Forest Service authority and consistent with the inherent capability of the plan area. . . .”⁵⁴ They must include standards and guidelines to provide for ecosystem services and multiple uses in the plan area.⁵⁵ Their standards and guidelines to address social and economic sustainability must specifically address ecosystem services.⁵⁶

Various industry and user groups are litigating the regulations, alleging that they are contrary to laws authorizing management and administration of the National Forest system.⁵⁷ The as-yet unsettled lawsuit includes in its claims allegations regarding the requirement to include ecosystem services in forest plans.

An important framework for consideration of ecosystem services is contained in the Forest and Rangeland Renewable Resources Planning Act of 1974.⁵⁸ Specifically, the law directs the

⁴⁷ 40 C.F.R. § 1508.28.

⁴⁸ 16 U.S.C. §§ 1600 – 1687.

⁴⁹ *Id.* at § 1604.

⁵⁰ *Id.*

⁵¹ 36 C.F.R. § 219.

⁵² 36 C.F.R. § 219.19.

⁵³ 36 C.F.R. § 219.6(7).

⁵⁴ 36 C.F.R. § 219.8(a).

⁵⁵ 36 C.F.R. § 219.10(a).

⁵⁶ 36 C.F.R. § 219.8(b) (4).

⁵⁷ *Federal Forest Resource Coalition v. Vilsack*, Civil No. 12-1333 (D.D.C.).

⁵⁸ 16 U.S.C. § 1642 *et seq.*

Secretary of Agriculture to prepare every 10 years a renewable resource assessment that presents the demand for and supply of renewable resources, an inventory of present and potential renewable resources, and an analysis of the effects of global climate change. Ecosystem services are not referenced specifically in the law, but a cogent discussion of renewable resources might well include assessment of the demands and opportunities for ecosystem services associated with those resources. In fact, the Forest Service is now considering such an assessment, based in part on recommendations from a 2011 report to the president from his Council of Advisors on Science and Technology. That report recommended that the federal government establish a Quadrennial Ecosystem Services Trend Assessment to provide an comprehensive assessment of U.S. ecosystems, to predict trends in ecosystem change, to synthesize research findings on how ecosystem structure and condition are linked to ecosystem functions that contribute important ecosystem services, and to characterize challenges to the sustainability of ecosystem services along with recommended policy responses.⁵⁹

Bureau of Land Management Resource Management Plans

The Federal Land Policy and Management Act (FLPMA) governs planning by the Bureau of Land Management (BLM) in the Department of the Interior. The BLM is to manage public lands “in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use.”⁶⁰ The BLM must “be managed in a manner which recognizes the Nation’s need for domestic sources of minerals, food, timber, and fiber. . .”⁶¹

The FLPMA requires BLM to prepare and periodically revise land use plans. The plans must reflect the BLM’s multiple use mandate and, among other requirements, must be prepared with a systematic interdisciplinary approach to “achieve integrated consideration of physical, biological, economic and other sciences”; to “consider the relative scarcity of the values involved”; and to “weigh long-term benefits to the public against short-term benefits.”⁶² When credible analysis can be proffered, these provisions compel consideration of ecosystem services, even though the term *ecosystem services* is specifically referenced by neither the FLPMA nor the BLM’s implementing regulations. Like forest management plans, resource management plans are developed through the NEPA process.

In 2013, the BLM partnered with the U.S. Geological Survey to evaluate the feasibility and value of incorporating ecosystem services valuation tools into the agency’s decision-making process by initiating a pilot project on the San Pedro watershed in southeast Arizona and northern Sonora, Mexico. The project is analyzing four ecosystem services (water, carbon, biodiversity, and cultural values) in three resource management scenarios (urban growth, water augmentation of the San Pedro River, and mesquite management and grasslands restoration). The BLM is also evaluating use of ecosystem services valuation for other regions of the country and resource management issues.

⁵⁹ President’s Council of Advisors on Science and Technology, “Report to the President—Sustaining Environmental Capital: Protecting Society and the Economy,” July 2011.

⁶⁰ 42 U.S.C. § 1691(a) (8).

⁶¹ 42 U.S.C. § 1702(a) (12).

⁶² 43 U.S.C. § 1712.

The Secretary of the Interior has a mandate under FLPMA to prepare and maintain “an inventory of all public lands and their resources and other values,” including outdoor recreation and scenic values. The inventory is to be kept current to reflect changes in condition and “to identify new and emerging resource and other values.”⁶³ Like the Forest Service inventory, the BLM inventory might be used in some analysis of ecosystem services on a broad, national scale.

Department of Defense Policy and Military Installation Plans

Since the 1960s, the Department of Defense (DOD) has had programs focused on natural resources conservation and the environment, programs now administered principally through the Office of the Deputy Undersecretary for Installations and the Environment. In 2011, the Under Secretary of Defense for Acquisition, Technology and Logistics issued an instruction that made it Defense Department policy to “demonstrate stewardship of natural resources in its trust by protecting and enhancing those resources for mission support, biodiversity conservation, and maintenance of ecosystem services.”⁶⁴ Under the terms of the instruction, the Deputy Under Secretary of Defense for Installations and Environment is directed to integrate ecosystem services valuation into the DOD Natural Resources Conservation Program. The Department of Defense defines ecosystem services as benefits obtained from ecosystems, including “provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.”⁶⁵

The Sikes Act requires DOD installations and ranges that contain significant natural resources to prepare an integrated natural resources management plan (INRMP) and to review and revise it as needed every five years.⁶⁶ Thus, other agencies and the public can expect to see analysis of ecosystem services integrated into the INRMP and its revisions as well as into the accompanying required NEPA analysis.

Department of the Army Civil Works Plans

Principles and Requirements for Federal Investments in Water Resources

In the Water Resources Development Act of 2007, Congress directed that the 1983 Principles and Guidelines utilized by the U.S. Army Corps of Engineers, Bureau of Reclamation, Tennessee Valley Authority, and Natural Resources Conservation Service be updated to reflect national priorities, including not only economic development but protection of the environment by maximizing sustainable economic development, avoiding the unwise use of floodplains, minimizing adverse impacts when a floodplain or flood-prone area is used, and protection and restoration of natural system functions. In 2013, the CEQ issued proposed principles and requirements (P&R) and proposed interagency guidelines intended to carry out Congress’s mandate.⁶⁷ Both the draft P&R and interagency guidelines are intended to incorporate ecosystem services valuation into planning processes, including land management planning efforts and NEPA compliance.⁶⁸ The draft P&R state that

⁶³ 42 U.S.C. § 1711.

⁶⁴ *Id.* at § 4(a) (2).

⁶⁵ Department of Defense Instruction Number 4715.03, March 18, 2011, Glossary.

⁶⁶ 16 U.S.C. §§ 560a-670o.

⁶⁷ The drafts of both documents, along with public comments and other relevant material, can be accessed at <http://www.whitehouse.gov/administration/eop/ceq/initiatives/PandG>.

⁶⁸ The P&R add the departments of Agriculture, Interior, and Commerce as well as the EPA and FEMA to the covered agencies.

The NEPA process should be integrated with the processes developed to implement these Principles and Requirements to facilitate the production of a single decision document that fulfills the requirements of both processes: and the interagency guidance provides more specific direction on integration at both the project and programmatic level. The evaluation framework is to apply an ecosystem services approach ‘to appropriately capture all effects (economic, environmental and social) associated with a potential Federal water resources investment.’ It is characterized as ‘a way to organize all the potential effects of an action (economic, environmental and social) within a framework that explicitly recognizes their interconnected nature.’⁶⁹

This description aptly reflects part of what NEPA analyses are intended to do.⁷⁰

Institute for Water Resources Report

In September 2013, the Institute for Water Resources published “Using Information on Ecosystem Goods and Services in Corps Planning: An Examination of Authorities, Policies, Guidance and Practices.”⁷¹ The report discusses the Corps of Engineers’ existing authorities as they relate to ecosystem goods and services, analyzes implementation challenges, and suggests some specific steps that could be taken to efficiently analyze ecosystem services within Corps processes. It identifies the NEPA process as one such vehicle. It also provides a survey of the analysis of ecosystem goods and services by other federal agencies, several states, and the United Kingdom and Australia.

Conclusion

To the extent that economic valuation of environmental impacts of the proposed action and alternatives can be identified and credibly assessed, the ecosystem services valuation analysis is required for compliance with NEPA. The statute clearly anticipated that economic effects of actions affecting the environment would be integrated into NEPA compliance, and CEQ’s guidelines and regulations have always reflected that notion.

What seems “new” about “ecosystem services valuation” (other than the terminology, which is actually not new but has not been widely understood) is the type of economic attributes and evaluations that it tends to embrace. For example, no participant in or observer of NEPA compliance would suggest that an EIS concerning grazing on national grasslands would be complete without an assessment of the economic impact of the proposed alternatives on ranchers who utilize the ecosystem services provided by the grasslands to sustain their way of life. Nor would it be complete without assessment of how the use of grasslands may affect the economics of tourism, either positively or negatively, or how it might affect the value and services of riparian areas. Valuation of ecosystem services can broaden understanding of the synergistic impacts of a proposed action in a way that conforms to the original intent of NEPA.⁷²

⁶⁹ P&R, Chapter II, Section 1 A.

⁷⁰ The P&R and the interagency guidelines are still in draft. In the 2012 omnibus appropriations, Congress prohibited the Corps from spending appropriated funds to implement the provisions of the new P&R and directed it to continue relying on the 1983 guidance. In the Consolidated Appropriations Act for 2014, no funds were allocated for P&R implementation.

⁷¹ Reed, Martin, and Cushing, *supra* at fn. 32.

⁷² Letter from Professor Lynton K. Caldwell to Dinah Bear, December 27, 1994, “In my view, environmental impact analysis takes cognizance of social and economic impacts of *environmental* effects . . .” (emphasis in original; available on file at the Nicholas Institute for Environmental Policy Solutions).

Clearly, not every proposed federal action could or should lead to an analysis of ecosystem services valuation within the framework of NEPA compliance. Such analysis will not be relevant to all federal actions in all settings. In most cases, it would make little sense to focus such analysis on small site-specific actions, which often are categorically excluded from documentation in an EA or an EIS under NEPA. However, it may be useful to consider an analysis of the value of ecosystem services in the context of drafting and promulgating a particular categorical exclusion.⁷³ It would also likely be unnecessary to include such analysis in many EAs given their limited requirements, although in certain instances ecosystem services could be an issue that weighs in favor of preparation of an EIS.

The most promising context for a robust and useful analysis of ecosystem services valuation is likely to be in the context of programmatic EISs, whether for land management plans, energy development, or other plans, programs, or policies. Because particular ecosystem services often function meaningfully at a large scale—watersheds or air sheds or estuaries, for example—programmatic EISs can be “tiered” to analysis of ecosystem services valuation for related site-specific projects proposed in the future.

Another benefit of the analysis of ecosystem services valuation in the NEPA context is that it can aid assessment of cumulative effects, which under NEPA are defined as the environmental impact resulting from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of the actor undertaking the other actions.⁷⁴

In short, analysis of the effects of proposed actions on the value of ecosystem services is appropriate to include in documents prepared pursuant to the National Environmental Policy Act. Such analysis enhances understanding of the services and helps to fulfill both the public policy purposes and the legal requirements of NEPA.

⁷³ Categorical exclusions are defined as classes of actions that neither individually nor cumulatively have a significant on the human environment. An ecosystem analysis in this context could be, in certain instances, a valuable part of the administrative record helping to shape the parameters of a particular categorical exclusion.

⁷⁴ 40 C.F.R. § 1508.7.

About the Author

Dinah Bear is an attorney and consultant who served as deputy general counsel and general counsel at the Council on Environmental Quality for 25 years. In that capacity she oversaw and interpreted the National Environmental Policy Act.

Acknowledgments

The author thanks the following reviewers: Joe Carbone, Tim Profeta, J.B. Ruhl, Lynn Scarlett, and Lois Schiffer.

How to Cite

Dinah Bear. 2014. "Integration of Ecosystem Services Valuation Analysis into National Environmental Policy Act Compliance: Legal and Policy Perspectives." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

Application of an Ecosystems Services Framework for BLM Land Use Planning:

Consistency with the Federal Land Policy and Management Act and Other Applicable Law

Authors

Paul B. Smyth, Senior Counsel Perkins Coie, LLP

Introduction

What is the statutory and regulatory authority of the Bureau of Land Management (BLM) to determine whether and how it can apply an ecosystem services framework to land use planning? The answer to this question is of great national importance because among the federal land managing agencies, the BLM administers the largest share of federal land. Its adoption of an ecosystem services framework could promote use of the framework by other federal land managing agencies and as a model for state and tribal land managing agencies.

Analysis of the BLM's land use planning authority—Section 202 of the Federal Land Policy and Management Act of 1976 (FLPMA)—and its components in relation to ecosystem services as well as analysis of similarities in BLM and U.S. Forest Service planning requirements suggest that the BLM does have the legal authority to manage public lands for both the preservation and use of ecosystem services. The agency's resource management plans can be amended to integrate ecosystem services concepts into agency decision making. Consideration of ecosystem services could be incorporated into that process immediately through national or state director guidance, and over the longer term, through inclusion of either the rental value or the loss value of those services in determinations of fair market value, an FLPMA requirement for use of public lands and their resources.

The Bureau of Land Management

The BLM is a federal agency within the U.S. Department of the Interior that currently manages more than 245 million acres of surface land and 700 million acres of subsurface mineral estate in the United States.¹ The lands managed by the BLM are commonly known as public lands.² Sister federal land managing agencies include the National Park Service and the U.S. Fish & Wildlife Service within the Department of the Interior and the U.S. Forest Service within the Department of Agriculture. The BLM primarily manages land that entered the public domain in the 19th century through treaty or conquest and that Congress has not withdrawn for management by other federal agencies or purposes, such as parks, refuges, forests, and Indian and military reservations or that has not passed into non-federal ownership through homesteading, mineral entries, grants to states and railroads, or other means.

The Federal Land Policy and Management Act of 1976 (FLPMA), as amended, is the BLM's "organic act."³ FLPMA "established a policy in favor of retaining public lands for multiple use management."⁴ Such management describes the complex task of balancing the many competing land uses, "including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and [uses serving] natural scenic, scientific and historical values."⁵ An equally important management goal, sustained yield, requires the BLM to achieve and maintain in perpetuity a high level of output of the various renewable resources of public lands.⁶ To accomplish these goals, FLPMA establishes the process of inventory and planning.

¹ <http://www.blm.gov/wo/st/en/prog/planning.html>.

² 43 U.S.C. § 1702(e).

³ Pub. L. No. 94-579, 90 Stat. 2743 (codified as amended at 43 U.S.C. §§ 1701-87).

⁴ *Lujan v. National Wildlife Federation*, 497 U.S. 871, 877 (1990).

⁵ 43 U.S.C. § 1702(c).

⁶ *Id.* § 1702(h).

Ecosystems Services

Ecosystem services are the benefits people obtain from ecosystems.⁷ They include “provisioning services” such as food, water, timber, and fiber; “regulating services” that affect climate, floods, disease, wastes, and water quality; “cultural services” that provide recreational, aesthetic, and spiritual benefits; and “supporting services” such as soil formation, photosynthesis, and nutrient cycling. Although buffered against environmental changes by culture and technology, humans are fundamentally dependent on the flow of ecosystem services.⁸ “[T]he services and countless benefits to the human economy that come from Nature have an estimated value every year of around double the global Gross Domestic Product.”⁹

Healthy public land ecosystems provide goods and services that are vital to human health and livelihoods. Many of these goods and services, such as watershed protection, wildlife habitat and diversity, carbon storage, and scenery and solitude, are commonly viewed as free benefits to society. Without a defined marketplace for these goods and services, they are often absent from governmental and corporate balance sheets. The result is that ecosystem services become subject to short-term development pressures and permanent loss. Understanding that public land ecosystems are natural assets with economic and social value can promote conservation and responsible decision making. Recognition and determination of the market value for carbon sequestration, watershed management, ecotourism, and a host of other services can change how public lands are used and can promote good stewardship, especially when used in conjunction with other conservation tools.

BLM Land Use Planning Authority

The BLM’s resource management plans (RMPs) form the basis for every action and approved use on the public lands.¹⁰ The BLM prepares RMPs for areas of public lands, called planning areas, which tend to have similar resource characteristics. Planning emphasizes a collaborative environment in which local, state, and tribal governments, the public, user groups, and industry work with the BLM to identify appropriate multiple uses of the public lands. Plans are periodically revised as changing conditions and resource demands require.¹¹

RMPs are used by managers and the public to

- Allocate resources and determine appropriate multiple uses for the public lands,
- Develop strategies to manage and protect resources, and
- Establish systems to monitor and evaluate the status of resources and the effectiveness of management practices over time.¹²

⁷ The terms *ecosystem services* and *environmental services* are often used interchangeably, but they are not the same. *Ecosystem services* are services provided by nature; *environmental services* are services provided by humans. See <http://www.sciencedirect.com/science/journal/22120416>.

⁸ Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis* at v. Island Press, Washington, DC. Available at

<http://www.millenniumassessment.org/documents/document.356.aspx.pdf>.

⁹ Forward by HRH, the Prince of Wales, at vi, to T. Juniper, *What Has Nature Done for Us?*, Profile Books 2013.

¹⁰ 43 U.S.C. § 1732(a)

¹¹ http://www.blm.gov/wo/st/en/prog/planning/planning_overview.html.

¹² *Id.*

Land use planning essentially begins with an inventory of public lands, as formulated in Section 201(a) of the FLPMA:

The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resource and other values (including, but not limited to, outdoor recreation and scenic values), giving priority to areas of critical environmental concern. This inventory shall be kept current so as to reflect changes in conditions and *to identify new and emerging resource and other values*. The preparation and maintenance of such inventory or the identification of such areas shall not, of itself, change or prevent change of the management or use of public lands.¹³

The emphasized language “to identify new and emerging resource and other values” directly supports incorporation of ecosystem services into inventories.

Section 202(c) of the FLPMA sets out the principles for BLM land use planning:

In the development and revision of land use plans, the Secretary shall–

- (1) use and observe the principles of *multiple use and sustained yield* set forth in this and other applicable law;
- (2) *use a systematic interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences*;
- (3) give priority to the designation and *protection of areas of critical environmental concern*;
- (4) *rely, to the extent it is available, on the inventory of the public lands, their resources, and other values*;
- (5) consider present and *potential uses* of the public lands;
- (6) consider the *relative scarcity of the values involved* and the availability of alternative means (including recycling) and sites for realization of those values;
- (7) *weigh long-term benefits* to the public against short-term benefits;
- (8) provide for compliance with applicable pollution control laws, including State and Federal air, water, noise, or other pollution standards or implementation plans; and
- (9) to the extent consistent with the laws governing the administration of the public lands, coordinate the land use inventory, planning, and management activities of or for such lands with the land use planning and management programs of *other Federal departments and agencies* and of the States and local governments¹⁴

This authority contains language that invites consideration of ecosystem services in BLM land use planning.

¹³ 43 U.S.C. §1711(a) (emphasis added).

¹⁴ 43 U.S.C. §1712(c) (emphases added).

Section 202(c) Factors in Relation to Ecosystem Services

Subsection 202(c)(1) - Multiple Use and Sustained Yield

FLPMA defines *multiple use* and *sustained yield* as follows:

The term “multiple use” means the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; the use of some land for less than all of the resources; a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and non-renewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific and historical values; and harmonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output.¹⁵

The term “sustained yield” means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the public lands consistent with multiple use.¹⁶

The Supreme Court has described these two terms and recognized how they relate to the inventory of the public lands, as follows:

“Multiple use management” is a deceptively simple term that describes the enormously complicated task of striking a balance among the many competing uses to which land can be put, “including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and [uses serving] natural scenic, scientific and historical values.” A second management goal, “sustained yield,” requires BLM to control depleting uses over time, so as to ensure a high level of valuable uses in the future. § 1702(h). To these ends, FLPMA establishes a dual regime of inventory and planning. Sections 1711 and 1712, respectively, provide for a comprehensive, ongoing inventory of federal lands, and for a land use planning process that “project[s]” “present and future use,” § 1701(a)(2), given the lands' inventoried characteristics.¹⁷

The FLPMA's definition of *multiple use* could hardly be more accommodating to BLM's consideration of ecosystem services: “the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people.” Paraphrased, FLPMA's definition could easily support the following statement: “Multiple use management means managing public lands and their ecosystems for the benefit of the American people.”

¹⁵ 43 U.S.C. §1702(c).

¹⁶ 43 U.S.C. §1702(h).

¹⁷ *Norton v. Southern Utah Wilderness Alliance*, 542 U.S. 55 at 58 (2004).

The definition of *sustained yield* is similarly accommodating, emphasizing “achievement and maintenance in perpetuity” of the output of renewable resources. This language strongly supports protection of ecosystems for the ongoing benefit of people.

Subsection 202(c)(2) - Systematic Interdisciplinary Approach to Achieve Integrated Consideration of Physical, Biological, Economic, and Other Sciences

Subsection 202(c)(2) directly supports consideration of ecosystem services in BLM land use planning. Determining, evaluating, and preserving ecosystem services requires an interdisciplinary approach integrating the very sciences identified in 202(c)(2). The use of the term “economic . . . sciences” strongly invites valuation of the physical and biological benefits provided by public lands.

Subsection 202(c)(3) - Protection of Areas of Critical Environmental Concern

Congress has defined *area of critical environmental concern* (ACEC) and provided criteria for the designation of land as an ACEC.¹⁸ BLM planning regulations require public lands to be evaluated under the ACEC criteria during the planning process.¹⁹ According to these regulations

Areas having potential for Areas of Critical Environmental Concern (ACEC) designation and protection management shall be identified and considered throughout the resource management planning process (see §§1610.4-1 through 1610.4-9).

(a) The inventory data shall be analyzed to determine whether there are areas containing resources, values, *systems or processes* or hazards eligible for further consideration for designation as an ACEC. In order to be a potential ACEC, both of the following criteria shall be met:

(1) *Relevance*. There shall be present a significant historic, cultural, or scenic value; a fish or wildlife resource or *other natural system or process*; or natural hazard.

(2) *Importance*. The above described value, resource, *system, process*, or hazard shall have substantial significance and values. This generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern. A natural hazard can be important if it is a significant threat to human life or property.

(b) *** The approved plan shall include the general management practices and uses, including mitigating measures, identified to protect designated ACEC.²⁰

The criteria for ACECs include natural systems or processes and could include consideration of ecosystem services. The BLM could designate ACECs to protect ecosystem services and to target specific kinds of ecological resources for special management, if the relevance and importance criteria are met. For example, the BLM could identify particular watersheds for their unique contributions to downstream water quality and protect them from incompatible forms of leasing and permitting through ACEC designation.

¹⁸ 43 U.S.C. §1702(a). See also 43 CFR 1610.5-6(a)(1) and (2).

¹⁹ 43 CFR 1610.5-6.

²⁰ *Id.* (emphases added).

Subsection 202(c)(4) - Reliance on the Inventory of the Public Lands, Their Resources, and Other Values

Land use planning essentially begins with an inventory of public lands. Section 201(a) of FLPMA states that

The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resource and other values (including, but not limited to, outdoor recreation and scenic values), giving priority to areas of critical environmental concern. This inventory shall be kept current so as to reflect changes in conditions and to identify new and emerging resource and other values. The preparation and maintenance of such inventory or the identification of such areas shall not, of itself, change or prevent change of the management or use of public lands.

The emphasized language “to identify new and emerging resource and other values” directly supports incorporation of ecosystem services into inventories.

Subsection 202(c)(5) - Consider Present and Potential Uses of the Public Lands

Subsection 202(c)(5) addresses both current and future land uses. It gives the BLM the opportunity to anticipate future land uses and values and to fold them into its planning. It directly supports the agency’s consideration of emerging concepts of land use, such as treating land to enhance ecosystem services or even leaving land alone because its economic benefit is greatest if left alone.

Subsection 202(c)(6) - Consider the Relative Scarcity of the Values Involved

Subsection 202(c)(6) directly supports BLM planning efforts to identify and consider the preservation of unique land values, including those providing ecosystem services. When essential ecosystem services are scarce in a planning area or region, this subsection supports BLM planning efforts to preserve them.

Subsection 202(c)(7) - Weigh Long-Term Benefits to the Public Against Short-Term Benefits

The benefits of ecosystem services are often more enduring than economic benefits derived from exploitation of the land. Subsection 202(c)(7) supports consideration of the long view appropriate to an evaluation of ecosystem services.

Subsection 202(c)(8) - Provide for Compliance with Applicable Pollution Control Laws

Although subsection 202(c)(8) does not directly implicate consideration of ecosystem services, it is not inconsistent with that consideration under any of the other 202(c) subsections.

Subsection 202(c)(9) - Coordinate the land Use Inventory, Planning, and Management Activities of or for Such Lands with the Land Use Planning and Management Programs of Other Federal Departments and Agencies and of the States and Local Governments

The extent to which subsection 202(c)(9) supports consideration of ecosystem services depends on the management regimes of other neighboring federal, state, and local land management agencies. Public lands managed by the BLM are often adjacent to or intermingled with lands within the National Forest system.

Similarities of BLM and Forest Service Planning Requirements

The BLM and the U.S. Forest Service have similar, but not identical, land management missions. Many of the BLM authorities have parallels in the National Forest Management Act of

1976, as amended.²¹ For example, the Forest Service must “maintain on a continuing basis a comprehensive and appropriately detailed inventory of all National Forest System lands and renewable resources. . . [and keep it] current so as to reflect changes in conditions and identify new and emerging resources and values.”²² The Forest Service must also “develop, maintain, and, as appropriate, revise land and resource management plans for units of the National Forest System, coordinated with the land and resource management planning processes of State and local governments and other Federal agencies.”²³ Forest plans must use “a systematic interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences. . . .”²⁴ and “provide for multiple use and sustained yield of the products and services obtained therefrom. . . .”²⁵ In essence, it appears that if the Forest Service can consider ecosystem services in forest planning, the BLM can also consider ecosystem services for public lands planning.

In fact, in 2012 the Forest Service issued regulations that identify the protection of ecosystem services as an important element of forest planning.²⁶ In addition, the Forest Service is exploring national opportunities to advance markets and payments for ecosystem services and encourages broader thinking and collaboration that stimulates market-based conservation and stewardship. The U.S. Department of Agriculture, of which the U.S. Forest is a part, created the Office of Environmental Markets (OEM) to foster the development of markets for ecosystem services, as required by Section 2709 of the 2008 Farm Bill.²⁷ The BLM could consider partnering with the Forest Service and OEM in this effort.

Legal Basis for Including Consideration of Ecosystem Services in BLM Decision Making

Amending RMPs to include consideration of ecosystem services would provide the legal basis for integrating ecosystem services concepts into BLM decision-making. Section 301(a) of FLPMA requires that “[t]he Secretary shall manage the public lands . . . in accordance with the land use plans . . . when they are available.”²⁸ According to the Supreme Court’s finding in a 2004 case, “The statutory directive that BLM manage ‘in accordance with’ land use plans, and the regulatory requirement that authorizations and actions ‘conform to’ those plans, prevent BLM from taking actions inconsistent with the provisions of a land use plan.”²⁹ In fact, BLM actions contrary to a plan can be set aside as contrary to law under the Administrative Procedures Act.³⁰

Once ecosystem services concepts are adopted in BLM’s RMPs, the agency will be required to take these concepts into account in its actual decisions regarding leasing, permitting, and other public land determinations, such as whether to retain a tract of land or offer it for sale. The

²¹ Pub. L. No. 94-588, 90 Stat. 2949 (codified as amended at 16 U.S.C. § 1601 *et seq.*).

²² 16 U.S.C. § 1603.

²³ 16 U.S.C. § 1604(a).

²⁴ 16 U.S.C. § 1604(b).

²⁵ 16 U.S.C. § 1604(e)(1).

²⁶ 36 C.F.R. Part 219.

²⁷ See <http://www.fs.fed.us/ecosystemservices/OEM/index.shtml>.

²⁸ 43 U.S.C. § 1732(a); see also 43 CFR § 1610.5-3(a) (2003) (“All future resource management authorizations and actions . . . and subsequent more detailed or specific planning, shall conform to the approved plan”).

²⁹ *Norton v. Southern Utah Wilderness Alliance*, 542 U.S. 55 at 69 (2004). See also 43 CFR 1610.5-3(a) (“All future resource management authorizations . . . shall conform to the approved plan.”)

³⁰ 5 U.S.C. § 706(2).

requirement that BLM actions be consistent with RMPs is enforceable by affected outside parties.

Practical Basis for Including Consideration of Ecosystem Services in the BLM Planning Process

Consideration of ecosystem services could be incorporated into the BLM planning process immediately through national or state director guidance, and over the longer term, through determinations of fair market value, receipt of which is provided for in the FLPMA for use of public lands and their resources.

National or State Director Guidance

Consideration of ecosystem services in the BLM planning process could be immediately implemented through national or state director guidance. As each plan, plan revision, or plan amendment is developed, BLM regulations require the following:

The Field Manager, in collaboration with any cooperating agencies, will analyze the inventory data and other information available to determine the ability of the resource area to respond to identified issues and opportunities. The analysis of the management situation shall provide, consistent with multiple use principles, the basis for formulating reasonable alternatives, including the types of resources for development or protection. Factors to be considered may include, but are not limited to:

- (a) The types of resource use and protection authorized by the Federal Land Policy and Management Act and other relevant legislation;
- (b) Opportunities to meet goals and objectives defined in *national and State Director guidance*;
- (c) Resource demand forecasts and analyses relevant to the resource area;
- (d) The estimated sustained levels of the various goods, services and uses that may be attained under existing biological and physical conditions and under differing management practices and degrees of management intensity which are economically viable under benefit cost or cost effectiveness standards *prescribed in national or State Director guidance*;
- (e) Specific requirements and constraints to achieve consistency with policies, plans and programs of other Federal agencies, State and local government agencies and Indian tribes

....³¹

By virtue of the foregoing planning regulation, national director or state director guidance on the consideration of ecosystem services would have to be taken into account in the development of any future BLM land use plan or plan amendment.

Fair Market Value for Use of Public Lands

Beyond land use planning, there is another mechanism for the BLM to integrate consideration of ecosystem services into its decision making. Section 102(a)(9) of FLPMA requires that “the United States receive fair market value of the use of the public lands and their resources unless

³¹ 43 CFR 1610.4-4 (emphases added).

otherwise provided for by statute. . . .”³² The BLM determines fair market value in a variety of ways. In the contexts of mineral leasing and public land sales, it determines fair market value primarily through competitive bidding.³³ In other contexts, such as land exchanges and the establishment of rentals for use of public lands, it uses appraisals.³⁴ To date, the BLM has included neither the rental value of ecosystem services nor the loss of these services in its fair market value determinations.³⁵ Grazing fees are determined by a statutory formula.³⁶

There is no legal reason, absent specific legislation such as for grazing fees, that the BLM could not take into account the value of the ecosystem services lost or gained in determining fair market value for exchanges or rentals. The constraint on doing so is practical, not legal. Methodology to assist in determining the value of ecosystem services is still being developed.³⁷ The BLM would have administrative discretion to adopt any rational methodology.

Conclusion

The BLM has substantial legal authority to adopt preservation and use of ecosystem services into its planning regime for public lands. Among the many aspects of its planning authority that permit the integration of ecosystems services concepts into BLM land use plans, the designation of ACECs to protect natural processes and systems appears particularly well suited. Moreover, the BLM has the authority to integrate its own use of ecosystem services concepts with those of neighboring federal land managers, such as the U.S. Forest Service, that are similarly integrating consideration of ecosystem services into their own land management planning processes. Once ecosystem services concepts were included in BLM land use planning, BLM decisions would be guided by consideration of these concepts. The agency could immediately implement consideration of ecosystem services into land use planning through national director or state director guidance. Over the longer term—and to the extent that appropriate methodology is developed and adopted—the BLM could also use the requirement that it obtain fair market value for use of public lands to ensure consideration of ecosystem services in determining land values and rentals.

³² 43 U.S.C. § 1701(a)(9).

³³ See 43 CFR 3120.1-1 and 2711.3-1.

³⁴ See 43 CFR 2201.3-2 and 2920.5-4.

³⁵ BLM Manual MS-9310 *Appraisal of Real Property* (issued October 27, 1999).

³⁶ 43 U.S.C. § 1905 and Executive Order No. 12548 (Feb. 14, 1986).

³⁷ <http://www.sciencedirect.com/science/journal/22120416>.

About the Author

Paul B. Smyth is senior counsel at Perkins Coie LLP in Washington, D.C., where he specializes in environmental, energy, and natural resources law. He was previously associate solicitor for the Division of Mineral Resources in the Department of the Interior's (DOI) Office of the Solicitor in Washington, D.C. At DOI, he has also served as counselor to the solicitor and director of the Indian Trust Litigation Office, deputy associate solicitor of the Division of Land and Water Resources, acting director of the Office of Hearings and Appeals, and deputy associate solicitor of the Division of Energy and Resources. Smyth received the DOI's Distinguished Service Award in 2008 and Presidential Meritorious Executive Award in 2002 and 2007. In 2010, the American Bar Association's Section of Environment, Energy and Resources selected him as its Government Attorney of the Year.

Acknowledgments

The author thanks the insightful reviewers of this paper: J.B. Ruhl, Brian Amme, and Fariba Hamedani.

How to Cite

Paul B. Smyth. 2014. "Application of an Ecosystem Services Framework for BLM Land Use Planning: Consistency with the Federal Land Policy and Management Act and Other Applicable Law." In *Federal Resource Management and Ecosystem Services Guidebook*." Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.



AGENCY EXAMPLES

Bureau of Land Management

Upper Green River Conservation Exchange Program
Bureau of Land Management Solar Energy Program

Environmental Protection Agency

Review of NO_x and SO_x Secondary Air Quality Standards

Fish and Wildlife

Great Dismal Swamp National Wildlife Refuge
San Diego National Wildlife Refuge
Silvio O. Conte National Fish and Wildlife Refuge, Connecticut River Watershed

Forest Service

Inyo, Sierra, and Sequoia National Forests
Cool Soda All Lands Restoration Proposal
The Marsh Project in Deschutes National Forest
Ecosystem Services and Land Management Plan Revision
U.S. Forest Service Programs and Operations

National Oceanic and Atmospheric Administration

Coastal Blue Carbon Projects
Marine InVEST in Galveston Bay, Puget Sound, and Chesapeake Bay

National Park Service

Great Smoky Mountains Ozone Damange Study
Air Quality and Ecosystem Services Workshop

Bureau of Land Management

An Ecosystem Services Approach to Sage-Grouse Conservation: Upper Green River Conservation Exchange Program

Authors

Lynn Scarlett, The Nature Conservancy

Amanda Reed, The Nature Conservancy

Created 2014



Photo Courtesy of Holly Copeland, The Nature Conservancy

Introduction

In 2011, the Sublette County Conservation District of Wyoming, the University of Wyoming, and The Nature Conservancy came together, using Natural Resources Conservation Service (NRCS) Conservation Innovation Grant funding, to explore the idea of an ecosystem services exchange in the Upper Green River Basin. This group teamed up with the Environmental Defense Fund, which was also exploring an exchange in the region, and together they created the Upper Green River Conservation Exchange Program (UGRCE).

The UGRCE Program is driven largely by landowners' desire to be compensated for conservation actions. Its goal is to develop a trading framework and a set of associated quantification tools that can be adapted to protect multiple ecosystem services, while providing economic incentives for landowners. In particular, the program aims to protect water quality and riparian function as well as mule-deer and sage-grouse habitat for a number of economic and social benefits.

Due to pending regulations regarding the potential listing of the Greater sage-grouse as a threatened or endangered species and the need to develop coordinated conservation efforts across landownership, the UGRCE Program has focused the first phase of the exchange on protecting sage-grouse habitat in Sublette County, Wyoming, which provides a nexus of landowners, core sage-grouse habitat, and oil and gas development, much of which is managed by the Bureau of Land Management (BLM). The BLM must ensure that energy companies provide appropriate mitigation for impacts to the land and resources, including mitigation on federal and non-federal lands outside of the area of impact, referred to here as "off-site" mitigation. The UGRCE Program could provide an important mechanism for this off-site mitigation.

Although the UGRCE Program provides a framework for assessing and offsetting impacts to multiple ecosystems services, the focus here is on its application to sage-grouse habitat given the pending listing decision and the BLM's responsibility to advance sage-grouse conservation on the lands it manages.

Location

The Upper Green River Basin lies at the headwaters of the Colorado River in southwestern Wyoming. It is located in the upper watershed of the Green River drainage in Sublette County, Wyoming, and in a small portion of Lincoln County, Wyoming.

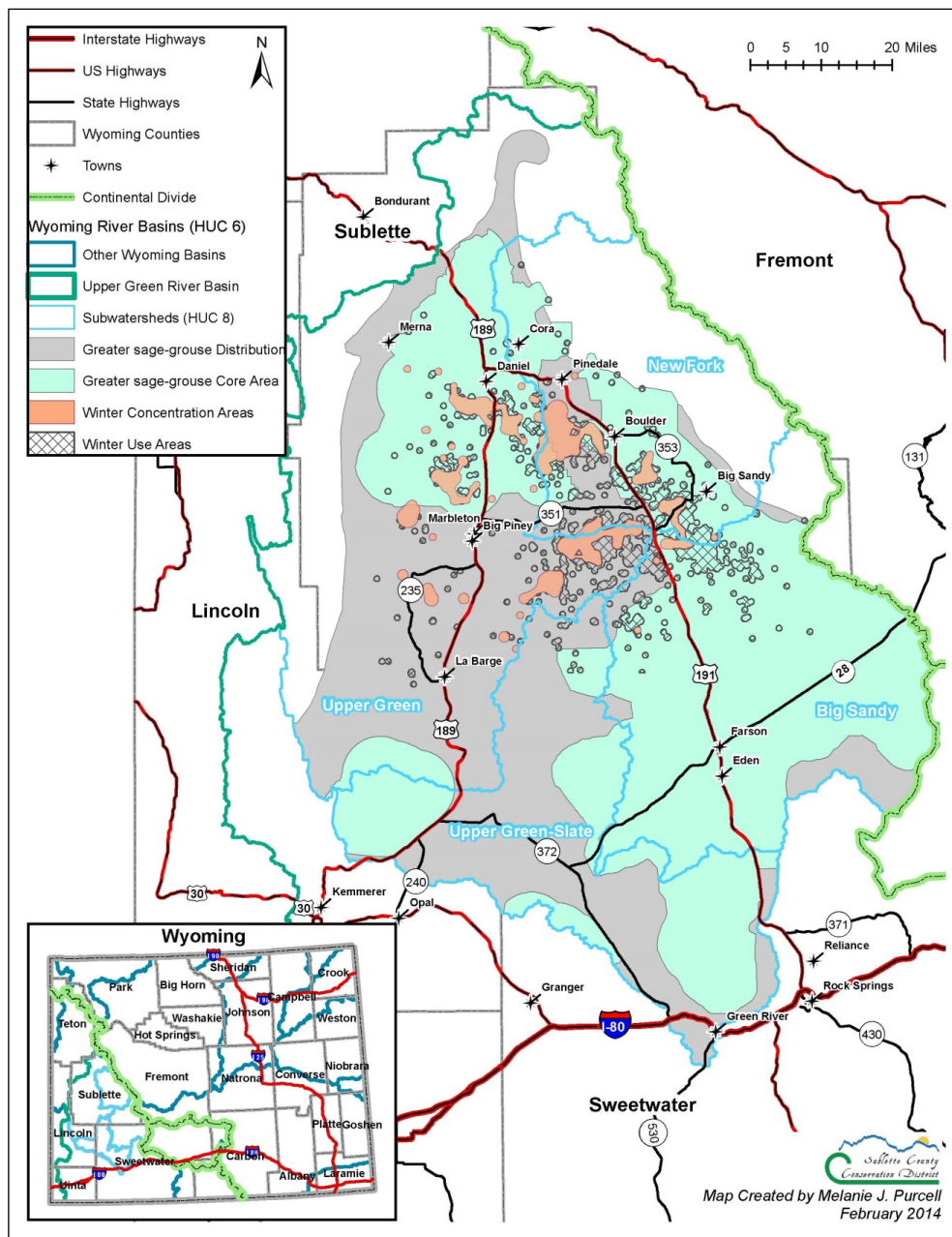
Figure 1. Upper Green River Basin.



Source: K. Musser, U.S. Geological Survey.

The Basin includes more than 2.6 million acres, 39% of which is managed by the Bureau of Land Management; 34%, by the U.S. Forest Service; 22%, by private landowners; and 5%, by miscellaneous other owners. The area includes high mountain wilderness, forested areas, and open space that provides important wildlife habitat and migration corridors for species such as mule-deer, pronghorn, elk, pygmy rabbits, and sage-grouse. As Figure 2 shows, nearly all of Sublette County is within Greater sage-grouse habitat; core areas cover more than half of the county. The basin is also home to the headwaters of the Colorado River and, therefore, it is critical to providing millions of ranchers, farmers, industry, and citizens with ample, clean water. Additionally, the area provides significant outdoor recreation opportunities.

Figure 2. Sage-Grouse Habitat in Sublette County.



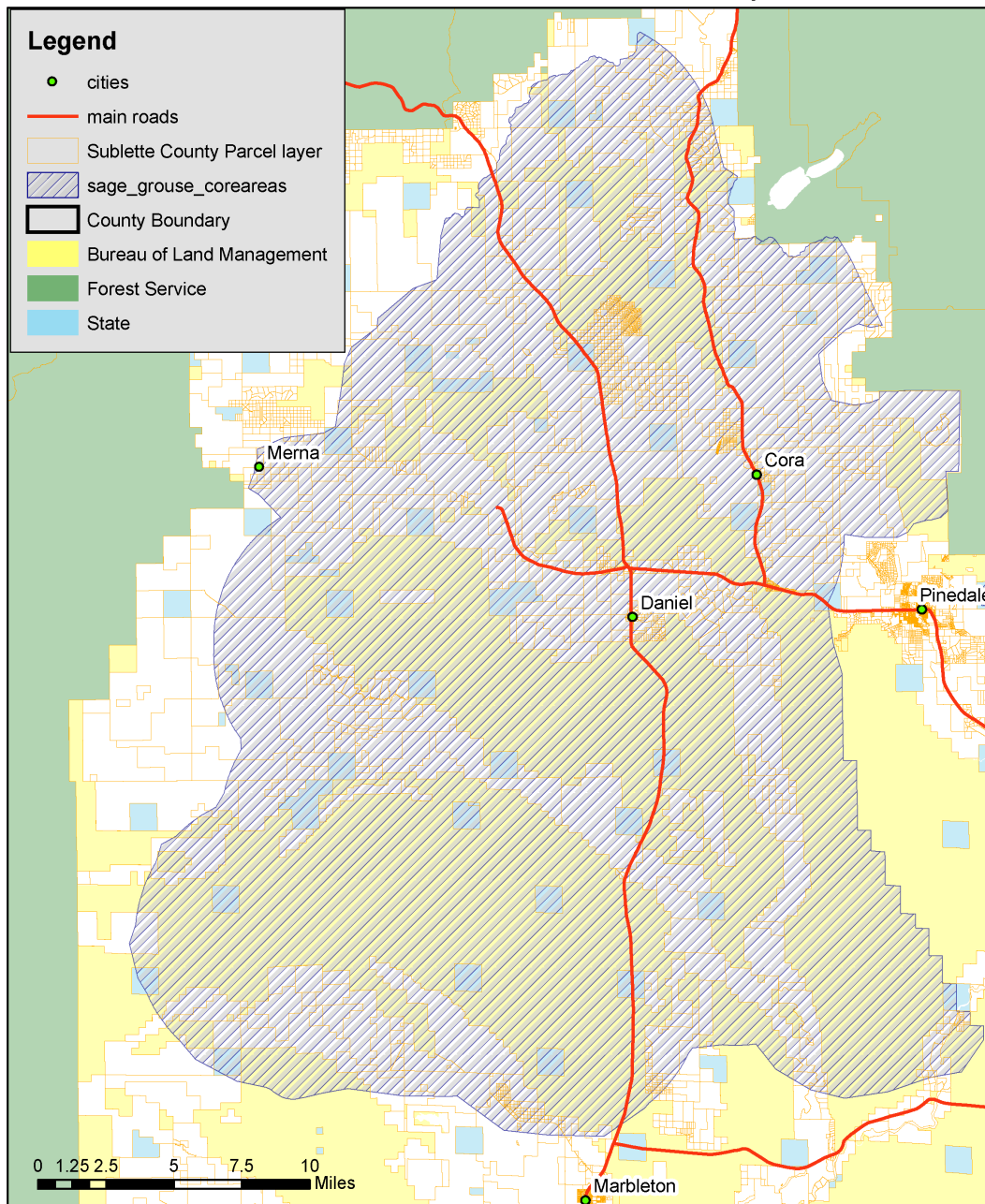
Source: Melanie J. Purcell, Sublette County Conservation District.

Figure 3 shows the landownership in northwest Sublette County and the overlay with Greater sage-grouse core habitat. The checkered-board pattern of landownership also reflects varying uses of the land and resources and the challenges of developing a comprehensive conservation strategy for the sage-grouse.

Figure 3. Landownership and Sage-Grouse Core Areas in Northern Sublette County.

Map created November 2012
1:283,779

Core Sage-grouse area North/northwest Sublette County



Source: Sublette County Conservation District, <http://www.sublettecd.com/pid/73/sage-grouse-initiative.aspx>.

Though ranching dominated the economy through much of the 20th century, tourism, recreation, and energy production increasingly drive the local economy. A 2007 county report notes that one of every two workers in the county work for the natural gas industry, and one of every two

dollars spent in the county derive from that industry.¹ Much of this development is occurring on public lands, but because revenues from oil, gas, and mineral development on federal lands are shared with the state and county, they important to local communities.

Since the early 2000s, the area has experienced significant growth in oil and gas activity. One of the largest natural gas fields in the United States—the Jonah Field—is within the Green River Basin. Located some 35 miles south of the town of Pinedale, this field is estimated to have 10.5 trillion cubic feet of natural gas in an area the size of a single survey township (approximately 13,000 acres).

The area continues to experience residential development pressures, with population growth between 2000 and 2010 accelerating at four times the national rate. The area ranks as one of the top 25 in the Rocky Mountain region for potential conversion of rangeland for development. Nonetheless, a significant portion of lands (nearly 600,000 acres of private lands) remains in use as agricultural land, largely as rangelands.

Motivation

A central motivation for applying an ecosystem services approach to sage-grouse conservation through the UGCRE Program is the potential listing of the Greater sage-grouse as threatened or endangered under the Endangered Species Act (ESA). Such a listing would have a significant impact on economic activities in the region, especially on oil and gas development. However, the UGCRE Program offers significant potential to protect and enhance sage-grouse habitat on private lands.

Background

In recent decades, sage-grouse populations have declined throughout their range, which includes portions of 11 western states. Currently, Wyoming holds more than one-third of the total sage-grouse population. Between 1999 and 2003, the U.S. Fish and Wildlife Service (FWS) received eight petitions to list the Greater sage-grouse throughout all or parts of its range. Concern about a potential listing of the species and its impacts on land uses prompted the state of Wyoming and other entities to initiate significant, coordinated planning efforts to create a statewide strategy for sage-grouse conservation. The complexity associated with sage-grouse and sage-grouse habitat conservation in Wyoming stems, in part, from the involvement of multiple entities, including the FWS as the deciding official with regard to sage-grouse listing, the state of Wyoming as the agency with trust responsibilities for managing the sage-grouse, the BLM and U.S. Forest Service (FS) as agencies with management responsibilities for federal surface land ownership and mineral rights, and private landowners that currently or could conserve sage-grouse habitats on their lands.

In a March 2010, the FWS concluded that listing the Greater sage-grouse was “warranted, but precluded.”² In other words, it found that the Greater sage-grouse met criteria for being listed under the ESA but deferred a final decision. As a “candidate” for listing, the Greater sage-

¹ Sublette County, *Social and Economic Impacts to Sublette County, Wyoming from Natural Gas Development*, <http://www.sublettewyo.com/DocumentCenter/Home/View/274>.

² U.S. Fish and Wildlife Service, “12-Month Finding for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered” (75 *Federal Register* 13910, March 23, 2010).

grouse was among 251 species for which the FWS agreed in a multi-district litigation settlement to provide final listing determinations by 2015.³

In its 2010 decision assessing the status of the species against the five “listing factors” under Section 4(a)(1) of the ESA, the FWS concluded that Factor A, “the present or threatened destruction, modification, or curtailment of the habitat or range of the Greater Sage-Grouse,” and Factor D, “the inadequacy of existing regulatory mechanisms,” posed “a significant threat to the Greater Sage-Grouse now and in the foreseeable future.”⁴ In this same document, the FWS indicated that the principal regulatory mechanisms for the BLM were conservation measures in its land use plans.

State of Wyoming Response

Concern about a potential listing of the species and its impacts on land uses prompted the state of Wyoming and others entities—local working groups—to initiate significant, coordinated planning efforts to create a statewide strategy for sage-grouse conservation. These efforts resulted in adoption of a conservation plan by the Wyoming Fish and Game Commission in June 2003. Within this context, the local working groups, including the Upper Green River Basin Local Sage-grouse Working Group, were established in 2004 to “develop and facilitate implementation of a local conservation plan for the benefit of sage-grouse and, whenever feasible, other species that use sagebrush habitats.”⁵

In 2007, the Upper Green River Basin Local Sage-Grouse Conservation Working Group, of which the BLM is a participant, developed a conservation plan that, among many other provisions, identifies research and development of “incentives that would reward landowners who provide the type of habitat that maintains and enhances sage-grouse populations.”⁶ The plan also proposes consideration of “off-site mitigation as an alternative mitigation for mineral development impacts on known sage-grouse habitat” and calls for development and implementation of “acceptable off-site mitigative measures for enhancing sage-grouse or habitat, as needed, to offset impacts of surface disturbing activities.”⁷

The state of Wyoming has also worked with the FWS to develop an “umbrella” Greater sage-grouse Candidate Conservation Agreement with Assurances (CCAAs) “for ranch management activities that could offer private landowners assurances their livestock operations could continue in the event the species was listed under the ESA.”⁸ CCAAs are voluntary conservation agreements between the FWS and non-federal landowners to implement conservation measures that remove threats to or improve the status of unlisted species. In return, landowners receive assurance that their conservation efforts will not result in future regulatory obligations in excess of those established in a CCAA if the species is later listed.⁹

³ See http://www.fws.gov/endangered/improving_ESA/listing_workplan.html.

⁴ See <https://www.fws.gov/endangered/laws-policies/section-4.html>.

⁵ Upper Green River Basin Sage-Grouse Working Group, “Upper Green River Basin Sage-Grouse Conservation Plan,” May 24, 2007.

⁶ Upper Green River Basin Sage-Grouse Working Group, Conservation Plan, May 24, 2007, p. 42.

⁷ *Ibid.*, p. 56.

⁸ Greater Sage-Grouse Umbrella CCAA for Wyoming Ranch Management: A Candidate Conservation Agreement with Assurances for Greater Sage-Grouse, Draft Document, December 19, 2012, <http://www.fws.gov/mountain-prairie/species/birds/sagegrouse/20130207DraftCCAA.pdf>.

⁹ FWS, Candidate Conservation Agreements with Assurances Handbook, June 2003.

BLM Response

Most of the occupied sage-grouse habitat in the Upper Green River Basin is public land, where as many as 90% of known sage-grouse leks (strutting grounds used in breeding season) are found on. Because this land is primarily managed by the BLM, its actions are critical to sage-grouse protection.¹⁰ In response to the 2010 finding on petitions to list the sage-grouse, the BLM issued Instruction Memorandum No. 2012-043 to provide interim management policies and procedures to field offices for protecting the sage-grouse and managing their habitat.¹¹ The guidance focuses on protection of un-fragmented habitats; minimization of habitat loss and fragmentation; and management of habitats to maintain, enhance, or restore conditions that meet sage-grouse needs.¹² Following this guidance, the BLM Wyoming state director issued Instruction Memorandum IM WY2012-019.¹³ This memorandum is used in place of Instruction Memorandum No. 2012-043 to allow for other established sage-grouse management prescriptions such as those established by the Wyoming Governor's Executive Order 2011-5.¹⁴

The BLM is also the lead, in coordinated effort with the FS, in preparing land-use plan amendments and accompanying environmental impact statements (EISs) and related National Environmental Policy Act (NEPA) analyses "to incorporate specific conservation measures across the range of the Greater sage-grouse."¹⁵ The BLM plan amendments will apply to six resource management plans (RMPs) across Wyoming (as well as three Forest Service plans), with conservation actions designed to "attempt to prevent the bird from being listed as a [threatened or endangered] species."¹⁶ The Wyoming Greater Sage-Grouse Draft Land-Use Plan (LUP) Amendments and draft EIS for the BLM covering the nine RMPs and three Forest Service plans were released in December 2013. Publication of a Record of Decision is expected in fall 2014.¹⁷

Eight key issues were identified in the scoping process for the land-use plan amendments. These issues include questions about how to (1) maintain energy and mineral development, given valid existing rights while protecting sage-grouse and their habitat, (2) maintain and put in place measures to protect and improve sage-grouse habitat while maintaining grazing privileges, and (3) "promote or maintain activities that provide social and economic benefit to local communities while providing protection for Greater sage-grouse habitat."¹⁸

In 2013, the BLM issued an interim policy and draft regional mitigation manual for developing regional mitigation plans and implementing offsite mitigation.¹⁹ The purpose of this guidance is to move the BLM from planning for compensatory mitigation on a project-by-project basis to

¹⁰ See <http://www.blm.gov/wo/st/en/prog/more/sagegrouse.html>.

¹¹ http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2012/IM_2012-043.html.

¹² Bureau of Land Management, "Greater Sage-Grouse Interim Management Policies and Procedures," IM 2012-043, December 22, 2012.

¹³ <http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2012.Par.56874.File.dat/wy2012-019.pdf>.

¹⁴ <http://governor.wy.gov/Documents/Sage%20Grouse%20Executive%20Order.pdf>.

¹⁵ Greater Sage-Grouse Land Use Plan Amendments/EISs: Scoping Summary Report, ES-1, May 2012.

¹⁶ BLM, NEPA Hotsheet, July 31, 2013.

¹⁷ See <http://www.blm.gov/wy/st/en/programs/Planning/amendments/sage-grouse.html>.

¹⁸ Greater Sage-Grouse Land Use Plan Amendments/EISs: Scoping Summary Report, ES-3, May 2012.

¹⁹ Bureau of Land Management, "Interim Policy, Draft- Regional Mitigation Manual Section- 1794," IM 2013-142, June 13, 2013,

http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-142.html.

planning for compensatory mitigation on a landscape scale so that offset mitigation actions have greater value for species conservation and other resource values. The manual also clearly affirms the BLM's authority to require compensatory mitigation as a stipulation for granting permits and other land use authorizations. Although this guidance pertains to mitigating all impacts to resource values on BLM lands, its immediate application is in guiding mitigation strategies in the land-use amendment process for advancing sage-grouse conservation. To this end, the draft sage-grouse land-use plan amendments issued in December 2013 have a placeholder for developing and implementing a regional mitigation plan for sage-grouse on the basis of the Western Association of Fish and Wildlife Agencies (WAFWA) sage-grouse management zones.²⁰ These regional mitigation plans will identify potential compensatory mitigation actions, which may include contributions to mitigation banks or other credit trading mechanisms.

Key Players

The UGRCE Program is intended to be a “performance-based conservation mechanism for mitigating impacts on riparian function, Greater sage-grouse, and mule deer habitat from energy and other resource use pressures.”²¹ The working group notes that

Protecting upland sagebrush habitat for Greater sage-grouse and other sagebrush obligate species..., such as Mule Deer, will also potentially benefit a number of other ecosystem services. Game species such as Mule Deer provide important revenues to the state of Wyoming. Additionally, riparian areas play a critical role in the life cycles of all species in the area, including Greater sage-grouse. Water and riparian areas are scarce, and therefore all the more precious. Maintaining or improving the function of riparian areas, and the ability of local water bodies to provide optimal seasonal water quality and quantity, is therefore key to supporting fish, wildlife, livestock and human uses of both range and riparian resources.

The central set of decision challenges for the working group include how to select, characterize, measure, and evaluate a set of ecosystem services that can be incorporated into a “conservation exchange.” The exchange is conceived as

- “Creating a viable source of revenue—from development companies, and groups concerned with environmental conservation—for farmers and ranchers who create quality habitat for species and improve riparian function.”
- “Enabling mitigation actions that result in a net increase in functional habitat while enabling resource use projects to proceed with greater certainty and lower administrative costs.”
- “Significantly improving the effectiveness and efficiency of conservation investments, resulting in more meaningful and longer-lasting benefits for the species.”²²

The UGRCE working group, in which the BLM participates, includes representatives of the Sublette County Conservation District, the University of Wyoming, the Wyoming Department of

²⁰ The Wyoming Greater Sage-Grouse Draft Land Use Plan Amendment and Draft Environmental Impact Statement, December 2013. See <http://www.blm.gov/wy/st/en/programs/Planning/amendments/sage-grouse.html>, Chapter 2, p. 9.

²¹ Upper Green River Conservation Exchange: Local Context and Scope, February 2013, p. 2.

²² Ibid.

Agriculture, the Wyoming Game & Fish Department, the Environmental Defense Fund, and The Nature Conservancy as well as a number of consultants and landowners. Participants in the prospective exchange include “primary participants,” who generate on-the-ground environmental benefits and facilitate transactions; “supporting participants,” who provide technical and administrative support; and “oversight participants,” who ensure that everyone is adhering to the operational protocol and meeting regulatory requirements.²³

Given the motivations of the BLM, local and state agencies, and other public and private actors to protect the sage-grouse, the UGRCE will focus the first phase of the exchange on protecting and improving sage-grouse habitat. The exchange will develop a framework for trading credits/debits and a quantification tool for measuring impacts and conservation actions for protecting and restoring sage-grouse habitat. Once tested and validated, the exchange will adapt these tools for other ecosystem services. It is expected that initial credit buyers will be energy and agriculture producers but that the exchange may appeal to other buyers such as conservation groups once it begins operating.

Decision Context

In the context of sage-grouse conservation, the UGRCE must fit into local, state, and federal decision-making processes. At the local level, the exchange must provide benefits to incentivize private landowners’ participation. At the state level, trust responsibilities for managing the Greater sage-grouse—until listed as threatened or endangered under the ESA—reside with the state of Wyoming. Thus, the state is a primary decision maker in approving the UGRCE as consistent with its sage-grouse conservation plan, including support for off-site mitigation as an appropriate conservation tool.

At the federal level, several procedural challenges complicate development and implementation of a conservation exchange involving BLM lands, as in Sublette County. One pertains to NEPA and timing considerations. The BLM is under an extremely tight timeframe to prepare its sage-grouse proposed land-use plan amendments and accompanying draft EIS; a Record of Decision is scheduled for release by 2014. The timeframe is driven by the need to have conservation measures identified prior to the deadline by which the FWS makes its final sage-grouse listing determination, expected in 2015. Regional mitigation plans will be developed in a parallel effort outside of the NEPA process; however, given their implication for conservation of the sage-grouse, these plans are driven by the same FWS deadline.

Ideally, the UGRCE could be used as one of multiple tools to implement off-site mitigation that would be required for BLM land-use authorizations. In this way, the UGRCE would be contributing to the last step in the mitigation hierarchy, which is to offset unavoidable impacts through compensatory mitigation actions, which can include off-site mitigation.²⁴ The UGRCE does not set out to implement avoidance or minimization measures, which would be identified through the BLM land-use plan and regional mitigation plan. The decision to employ the exchange for off-site mitigation would likely come during the project-level EIS and NEPA analysis. During this process, the applicant and BLM will examine site-specific mitigation needs and potential actions. If off-site mitigation is implemented through the UGRCE, these actions

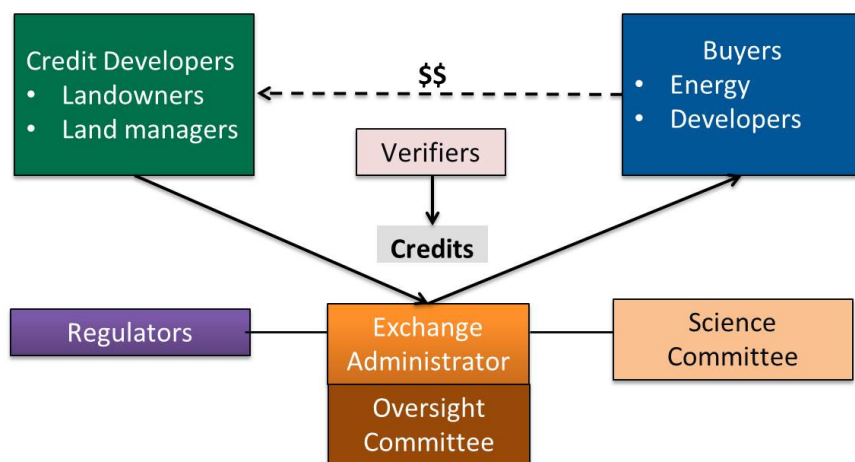
²³ Ibid., pp. 12–13.

²⁴ The Council on Environmental Quality’s definition of the mitigation hierarchy is to avoid, minimize, rectify, and then to compensate for unavoidable impacts. See 40 CFR 1508.20.

may be included in one or more NEPA alternatives or as part of the mitigation plan for that project.

For the UGRCE to fit into this decision context, quantification measures or credits must be developed and deemed acceptable by the state and the BLM, and participating agencies need to approve use of the UGRCE as a mechanism for off-site mitigation. However, many details are still being worked out, and there are significant questions about supply and demand of credits, contract terms that would be amenable to buyers and sellers, and binding agreements with private parties to monitor mitigation actions on private lands. Energy companies need a supply of offset mitigation credits for their impacts on lands, and these credits must extend for the life of the impacts. Ranchers and other landowners are the potential suppliers of the credits. Yet their willingness to participate in the UGRCE depends on the design and quantification of credits and the financial benefits they receive by undertaking the activities that generate credits. To work through these challenges, the UGRCE will use “paper” pilot tests to test certain design options and then will implement one or more actual exchange pilot tests to work out technical and implementation details.

Figure 4. Proposed Structure of the Upper Green River Conservation Exchange.



Source: Anne MacKinnon.

Tradeoffs Considered and Analysis

The UGCRE aims to develop a conservation exchange program that may be adapted for multiple ecosystem services, but it will first test the exchange on sage-grouse habitat due to concerns about the species, its potential listing as threatened or endangered under the ESA, and potential avoidance of such a listing through improved protection of the species and its habitat. However, the following sections on tradeoffs and analysis apply to the larger ecosystems framework being developed by the UGRCE; therefore, they are not specific to the sage-grouse context.

Management and Policy Options

The UGCRE is considering a variety of actions as potential generators of mitigation credits. These actions include practices to control invasive weeds, create or improve game corridors, remove or minimize infrastructure, and undertake certain defined best practices in grazing

management, stream bank stabilization, irrigation management, agriculture flooding for wetland development, sediment and erosion control, and meadow restoration.

For the BLM, key policy considerations include whether and how to include off-site mitigation of energy and other projects on BLM lands in its decision making. For the BLM and the UGRCE, the following determinations are significant:

- Processes for landowner engagement in setting up the exchange;
- Mitigation ratios and reserve requirements based on multiple factors, including habitat quality, location within the landscape, risk of failure to reach conservation goals, and the nature of conservation actions and impacts;
- Verification and monitoring processes;
- Duration of credits—permanent, time-limited, or both, depending on circumstances; and
- Timing of credit “releases”—that is, when credits from a conservation project can be applied to an investor’s “account.”

These design determinations can affect incentives, transaction costs, and on-the-ground results. For example, high mitigation ratios may provide buffers against failures of actions to produce desired outcome,s but they can also raise delivery costs and reduce program participation. Requiring permanent credits may be necessary to ensure mitigations that apply to long-term impacts, but it may raise costs and reduce landowner participation.

Ecosystem Goods and Services Considered

In 2011, The Nature Conservancy, the University of Wyoming, and the Sublette County Conservation District completed a feasibility analysis of a payment for ecosystem services program for the Upper Green River Basin.²⁵ The study looked at a wide range of potential ecosystem services and found that the primary interests for ecological protection were sagebrush-grasslands, desert shrub, and riparian and coldwater aquatic systems. It further found that potential credit buyers might include the extractive industry, tourists, the hospitality industry, second-home owners, municipalities, sportsmen, downstream water users, and irrigation districts that derive benefits from these habits and their functions. The Sublette County Conservation District, which represents agricultural interests, was very interested in protecting riparian functions for irrigation; conservationists and sportsmen were interested in wetlands for migratory birds and wildlife; and many stakeholders were interested in protecting sage-grouse habitat not only for habitat connectivity and avoiding an ESA listing of the Greater sage-grouse, but also for recreation and tourism.

Building on this analysis, the UGRCE decided to focus on protecting and enhancing sage-grouse and mule deer habitat and on restoring or improving riparian function. The ecosystem services provided by protecting, enhancing, and restoring this habitat and riparian function include, primarily, maintaining biodiversity, supporting outdoor recreation (hunting), sustaining adequate water supplies and water quality, and regulating weeds to improve grazing forage. However, at this point, the focus of the project and its metrics is primarily on the ecological benefits of conservation actions. These benefits are evaluated at the project-level scale and in

²⁵ Esther A. Duke, Amy Pocewicz, and Steve Jester, *Upper Green River Basin Ecosystem Services: Feasibility Analysis Project Report* (Washington, DC: The Nature Conservancy, 2011).

the landscape context (e.g., how do actions at the project site affect connectivity and population levels?).

At this point, the exchange is not looking at other ecosystem services functions, such as air quality or carbon capture. This decision is based, in part, on the potential credit buyer market (i.e., the extractive and agriculture industries will create demand for sage-grouse habitat credits). The decision also takes into account the complexity of measuring and quantifying certain ecosystem services. In limiting the scope of these services to sage-grouse and mule-deer habitat and riparian function, the working group will be able to develop a robust set of quantification tools for measuring impacts (buyers) and credits (sellers) and will be able to test the overall exchange format.

Analysis

One analysis of ecosystem services opportunities in the Upper Green River Basin was undertaken in 2011. Researchers conducted interviews and focus group discussions with landowners, government agency and NGO scientists, conservation funders, and industry and other experts to assess ecological priorities, program design preferences, desired outcomes, and the demand for conservation credits.

The UGRCE is now building off that research as well as similar exchange efforts led by the EDF in other states to develop two products to implement the exchange: (1) science-based quantification tools for sage grouse and mule deer (a similar tool for riparian function is led by the University of Wyoming) and (2) an operations manual for the overall structure of the exchange and implementing transactions. A multi-stakeholder science team is developing the interactive geospatial quantification tools, which take into account local site-specific factors, as well as the larger landscape context. Ultimately, there will be separate quantification tools for mule deer habitat, sage-grouse habitat, and riparian functions.

Table 1. Credit Types and Tradable Units.

Credit Category	Credit Type	Tradable Unit	Examples of Eligible Conservation Actions
Sagebrush habitat	Habitat for Greater sage-grouse	▪ Functional acres	<ul style="list-style-type: none"> ▪ Cheatgrass and invasive weed control ▪ Creation or maintenance of game corridors ▪ Grazing management ▪ Removal or minimization of new infrastructure
Muledeer habitat (sagebrush, bottom lands, irrigated hay meadows)	Habitat for mule deer	▪ Functional acres	<ul style="list-style-type: none"> ▪ Cheatgrass and invasive weed control ▪ Creation or maintenance of game corridors ▪ Grazing management ▪ Removal or minimization of new infrastructure
Water quality and supply	Riparian function	▪ Functional acres or stream length	<ul style="list-style-type: none"> ▪ Streambank stabilization ▪ Irrigation management ▪ Meadow restoration

The quantification tool either calculates the value of a conservation action at a specific location (credit) or measures the level of impact from development actions at a specific site (debit). This analysis is based on the regional context of the site and local site conditions (see “Specific Data and Information” below). Mitigation ratios are developed to ensure consistency among credits throughout the landscape and an overall net benefit to the species and habitat.

Existing Resources and Funding

General Data

Because of the decade-long focus in the state of Wyoming on enhancing protection for sage-grouse and their habitat, extensive amounts and variety of data are available on wildlife, vegetation, water, and other natural resources. In addition, for their planning processes and analyses, the Forest Service and the BLM have national data sets with census, labor, economic, and other data. They have developed and piloted use of the Economic Profile System—Human Dimensions Toolkit to help assess demographic and economic issues and to standardize the collection of social and economic data for land use planning, environmental analyses, and others purposes. The toolkit, which is available to the public, draws from public domain data sources such as the U.S. Census, the Bureau of Economic Analysis, and the Bureau of Labor Statistics.²⁶

In addition to having access to significant data and analytic tools, the UGRCE involves partners with knowledge and experience in designing payment-for-ecosystem services programs. These partners include the Environmental Defense Fund, The Nature Conservancy, the Willamette Partnership, Environmental Incentives, the University of Wyoming, and a variety of consultants with specialized expertise.

Currently, the UGRCE is using, with permission of the affected landowners, existing conservation plans and their ecological information to prioritize ecosystem services and locations in the Upper Green River Basin. This information will be used to explore opportunities for individual landowners to participate in pilot programs.

Specific Data and Information

Ecosystem services credit systems and exchanges require site-specific and regional- or coarse-scale information; therefore, the quantification tools under development include geospatial information about habitats at the local and regional scale. For example, the sage-grouse quantification tool is based on a framework of four spatial scales for sage-grouse habitat in an unpublished BLM report.²⁷ These scales are (1) occupied species range, (2) subpopulations associated with different habitats conditions (i.e., BLM core habitat), (3) habitat immediately surrounding the project site, and (4) habitat at the project site. First- and third-order data can be collected from existing data models, such as BLM core habitat or state core area maps, but third- and fourth-order data must be collected and verified at the site. For example, site-level habitat data such as cover and foraging vegetation will be collected through a site visit and survey.

²⁶ See <http://www.ntc.blm.gov/krc/viewresource.php?courseID=504>.

²⁷ S.J. Stiver, E.T. Rinkes, and D.E. Naugle, eds., *Sage-Grouse Habitat Assessment Framework: Multi-scale Habitat Assessment Tool*, unpublished report (Boise, Idaho: U.S. Bureau of Land Management, Idaho State Office, 2010).

Funding

Much of the work leading up to development of the UGRCE has been provided by in-kind contributions from the various organizations involved in the work. Additionally, funding from a USDA NRCS Conservation Innovation Grant has supported its development.

The exchange will need to seek seed money to implement its first transactions; ultimately, administration of the exchange will be funded through a transaction fee structure. The goal is for the exchange to be self-sustaining in approximately three years. The first mock “paper” transaction took place in March 2014 in Sublette County, allowing parties, including the BLM, to get a feel for how the exchange will work. Participants included a diverse group of potential sellers and credit developers (i.e., landowners) and credit buyers (in this case, energy companies). One pilot transaction, cheat-grass treatment on private lands, has already occurred. Additional pilot transactions, including the real exchange of credits/debits, are anticipated for fall of 2014 and spring and summer of 2015.

Implications

The UGCRE efforts are designed to link into overall conservation planning, resource management, and species protection in the region. The goal is to create an exchange program that can attract landowner participation in conservation; provide cost-effective ways for energy companies and others to offset the impacts of their activities on wildlife habitat, water, and other natural resources; and generate both environmental and economic benefits in the region. Ultimately, the exchange could become a model for agencies, in particular for the BLM, to implement off-site mitigation. If combined with adequate resource management planning, the exchange could help avoid the need to list the Greater sage-grouse as threatened or endangered. Additionally, because the exchange is built on a science-based analysis of the value of conservation measures, it provides a level of assurance for investors, communities, and policy makers in making choices and tradeoffs among conservation options.

In particular, the USGCRE could provide multiple benefits to the BLM’s planning and permitting processes and ongoing management of resource values:

- The UGCRE provides an easy avenue for implementing off-site mitigation that may be identified through a regional mitigation plan or through a project-level NEPA analysis. Local, state, and public entities are likely to accept that the mitigation actions are adequate to protect the resource values, because the quantification of credits is driven by a multi-stakeholder, science-based process.
- Management responsibilities for generated credits resides with the landowner or third-party entity per the exchange agreements. Therefore, the BLM is relieved of long-term management activities for off-site mitigation actions. However, it remains responsible for ensuring their implementation and success through “enforceable, binding agreements between private parties and the BLM.”²⁸
- Adaptive management is built into the exchange framework so that conservation actions are monitored for their effectiveness. This knowledge will benefit the BLM’s land-use planning process and mitigation recommendations for land-use authorizations.

²⁸ Bureau of Land Management, “Interim Policy, Draft- Regional Mitigation Manual Section- 1794,” IM 2013-142, June 13, 2013.

http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-142.html.

The Upper Green River Conservation Exchange Local Context and Scope document includes additional program outcomes clustered into three categories, by type of participant. It states that

Landowners are able to quantify the amount of environmental benefit (credits) from implementing conservation practices. These credits can attract funding from public and private investors seeking to improve habitat for sage-grouse and mule deer, and increase riparian function in the Upper Green River Basin. By participating in the Conservation Exchange, landowners can:

- Efficiently identify the areas and opportunities with the greatest potential to create environmental benefit through the use of interactive geospatial credit/debit quantification tools.
- Identify investors and create new funding opportunities for conservation.
- Create a tangible product from conservation efforts with financial, social and environmental value.
- Have consistency to be able to confidently include restoration and conservation projects into their annual planning.

Investors can efficiently invest with confidence, knowing that credits are consistently defined and useful in comparing the relative improvements across projects to find opportunities for achieving the greatest environmental benefit. This increases accountability with taxpayers, regulators and local constituents, and allows for greater coordination with other investors to fund large-scale projects. By participating in the Conservation Exchange, investors can:

- Increase the effectiveness of environmental investments, maximizing the environmental return on investments.
- Increase efficiency by relying on the market structure to identify quality projects with willing landowners to guide project design and to verify that the completed project delivers the expected amount of benefit.
- Consistently report results that are verified and periodically checked to ensure that they are appropriately maintained.
- Choose from a variety of high-impact investment approaches.
- Be confident that their investments are producing environmental benefits without having to maintain the staff to monitor every project and develop complex arrangements that define success for each unique project.

Local Constituents and Environmentalists can identify habitat priorities and show how individual actions help address these priorities. Regional reports of accomplishment can rally the community around making progress toward common goals. By participating in the Conservation Exchange, local constituents and environmentalists can:

- Shift focus to project outcomes, not just practices.
- Enable the possibility of larger projects through aggregation.
- Create incentives for implementing projects with the greatest environmental benefits.
- See net increases in the amount of overall conservation benefits generated in the Upper Green River Basin.
- Attract investment to support a sustainable, conservation economy.

- Assess development impacts and restoration improvements using consistent methods to ensure mitigation results in net environmental benefits.²⁹

²⁹ Ibid., pp. 3–4.

Acknowledgments:

Thanks go to the following reviewers: Kristi Hansen, University of Wyoming; Anne Mackinnon, Consultant; Ted Toombs, Environmental Defense Fund; Jennifer Lamb and Graham McGaffin, The Nature Conservancy; and Rebecca Moore and Rob Winthrop, Bureau of Land Management.

How to cite:

Reed, A., and L. Scarlett. 2014. "An Ecosystem Services Approach to Sage-Grouse Conservation: Upper Green River Conservation Exchange Program." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

Bureau of Land Management

**Protecting Ecosystem Services
While Developing Renewable Energy:
Bureau of Land Management Solar Energy Program**

Authors

Amanda Reed, The Nature Conservancy
Laura Crane, The Nature Conservancy

Created 2014



Photo courtesy of Laura Crane, The Nature Conservancy

Introduction and Location

In 2012, the Department of Interior (DOI) established the Solar Energy Program, as approved through the Record of Decision (ROD) for the Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS).

Geographically, the program covers approximately 100 million acres and 89 Bureau of Land Management (BLM) land-use planning units in Arizona, California, Colorado, Nevada, New Mexico, and Utah (see Figure 5.) As described in the Solar PEIS, the program defined how utility-scale solar energy would be considered and developed on public lands administered by the BLM.

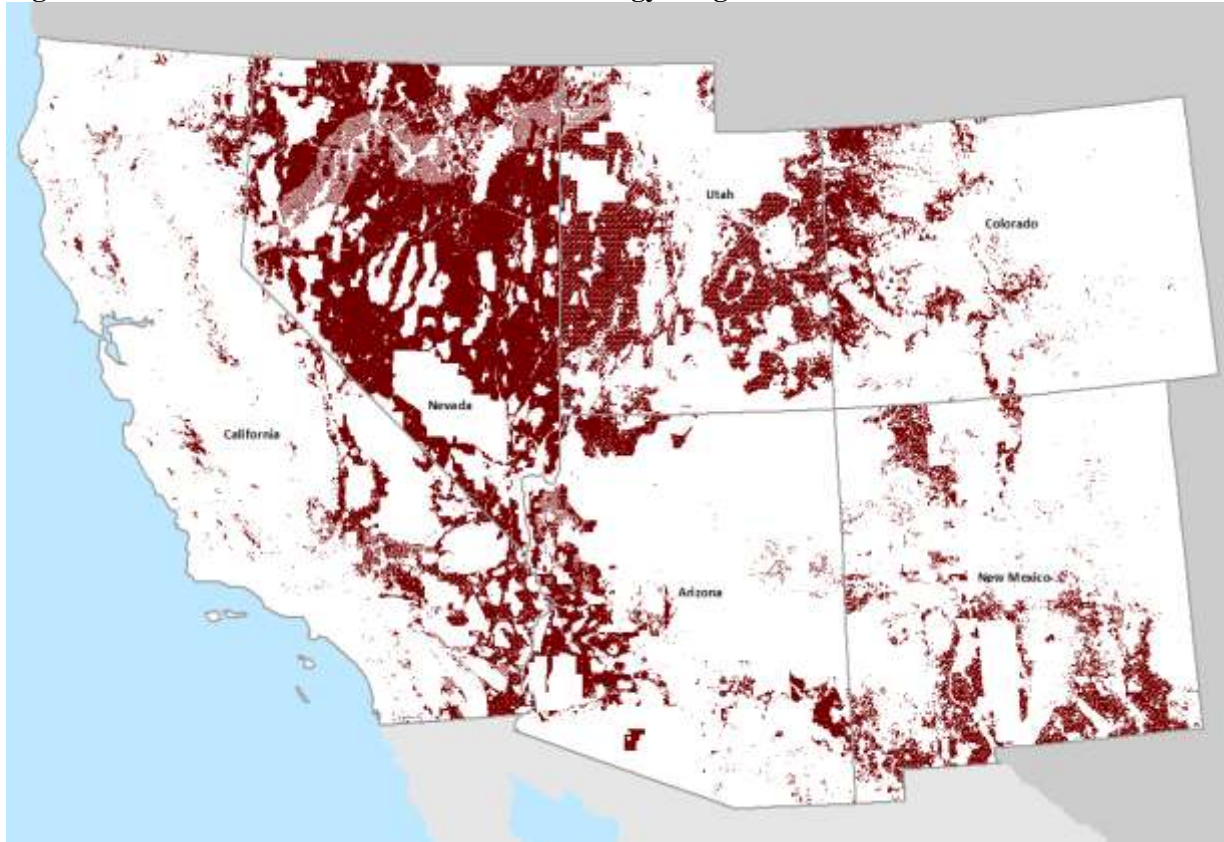
Further, the program established solar energy right-of-way authorization policies and required environmental impact minimization measures, or “design features,” for industry use on public lands. In terms of public lands allocation, the program also defined three types of land use zones in relation to utility-scale solar energy: (1) *exclusion areas* or BLM lands where utility-scale solar energy is not allowed (79 million acres); (2) *variance areas* as well as a variance process defining where and how solar energy might be considered case by case on the basis of environmental concerns and a more localized, regional analysis (19 million acres); and (3) initial *solar energy zones* (SEZs), where solar energy development is the priority land use allocation (285,000 acres). At the time of the ROD, the initial SEZs would provide enough land, if developed, to power 7 million homes with clean energy.¹

Utility-scale solar energy development often requires new infrastructure, including the solar installation plus associated infrastructure such as power lines and substations, to be built on large acreages (1–9 acres/MW). If not sited carefully, this infrastructure can pose serious threats to wildlife, habitats, and water resources. However, with smart planning, including intelligent siting and design features, it is possible to develop clean, renewable energy while also protecting ecosystem function and ecosystem services. In the locations covered by the Solar Energy Program, key ecosystem services and functions include protection of clean air, carbon sequestration from plants and microbiotic soils, and other regulating services; protection of clean water and recharge of groundwater aquifers through maintenance of soil stability and hydrologic function and other critical provisioning services; and sustained protection of wildlife, habitats and corridors to maintain biodiversity, and other supporting services. Additionally, the program considers recreation, open space, views, and tribal sacred space—all a fundamental component of cultural identity in the U.S. west.

The Solar Energy Program offers a framework for integrating these ecosystem services at both a larger, regional scale and at a more local or project-level scale. For example, decisions about where to prioritize the siting of utility-scale solar energy development as well as key areas that should be avoided due to ecosystem services-related conflicts (i.e., sustained biodiversity, recreational settings, or tribal sacred areas) occur at a regional level. Decisions about where to invest in nature to offset the unavoidable impacts of development also happen at a regional level, as do decisions about whether solar energy is appropriate in the variance lands. Finally, decisions about further minimizing impacts from development activities and ongoing operations occur at a local level.

¹ Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern State, Bureau of Land Management, October 2012 (ROD, October 2012).

Figure 5. Public Lands Included in the Solar Energy Program.



Source: The Nature Conservancy.

Motivation

The BLM and the U.S. Department of Energy (DOE), through its Energy Efficiency and Renewable Energy Program, initiated the Solar Energy Program in 2008. At the time, the BLM was overwhelmed with a large number of permit applications for utility-scale solar energy project proposals, particularly in Arizona, California, and Nevada. The Solar PEIS document notes that the BLM was answering the “need to respond in a more efficient and effective manner to the high interest in siting utility-scale solar energy development on public lands and to ensure consistent application of mitigation measures; avoidance, minimization, and compensation for the unavoidable impacts of such development.”²

The BLM was also responding to multiple congressional and administrative mandates to increase renewable energy production on its lands, while meeting its Federal Land Policy and Management Act of 1976 (FLPMA) mandate: “the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people without permanent impairment of the productivity of the land and the quality of the environment.”³

² ROD, October 2012

³ The Federal Land Policy and Management Act of 1976 Public Law 94-579; <http://www.blm.gov/flpma/FLPMA.pdf>.

Related renewable energy mandates include the following:

- In Executive Order 13212, Actions to Expedite Energy-Related Projects, the President ordered that executive departments and agencies “...take appropriate actions to expedite projects that will increase the production, transmission, or conservation of energy.” Moreover, “For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections.”⁴
- In Secretarial Order No. 3285A1, the Secretary of the Interior announced a policy goal of identifying and prioritizing specific locations on public lands that are best suited for large-scale production of solar energy.⁵
- In Section 211 of the Energy Policy Act of 2005, Congress instructed the Secretary of the Interior, within 10 years of enactment of the act, to “...seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity.”⁶
- The Energy Independence and Security Act of 2007 requires the DOE to facilitate integration of utility-scale solar energy into regional electricity transmission systems, and Executive Order 13514 requires federal agencies to help advance local efforts for renewable energy development.⁷

Finally, the BLM was responding to demands of state-level renewable energy portfolio standards, including the identification of development focus areas with high solar resource potential. Given these mandates and other market forces, the reasonably foreseeable development scenario (RFDS) developed for the Solar Energy Program estimated that the amount of solar energy generation on BLM lands in the study area over the 20-year study period would be about 24,000 MW; that generation necessitates the corresponding dedicated use of about 214,000 acres of BLM-administered lands.⁸ Prior to the program, BLM solar policies guided resource managers to address environmental concerns for solar projects on a case-by-case basis; the program established policies and guidance that take a programmatic approach to assessing impacts and siting solar development to avoid, minimize, and offset impacts on a regional scale.

At the same time, multiple environmental NGOs, including Defenders of Wildlife, The Wilderness Society, and The Nature Conservancy, were also interested in developing a regional approach to siting solar energy development in the desert southwest given the expected demand. They viewed such an approach as part of their larger efforts to reduce the impacts of energy development, while promoting renewable energy sources.

Decision Context

The BLM’s stated objectives for managing utility-scale solar development are as follows:

⁴ Executive Order 13212, Actions to Expedite Energy-Related Projects, May 2001; <http://www.gpo.gov/fdsys/pkg/FR-2001-05-22/pdf/01-13117.pdf>.

⁵ Secretarial Order No. 3285A1, Issued in March 2009 and amended February 2010; http://www.drecp.org/whatisdrecp/docs/DOI_Secretarial_Order_3285_A1.pdf.

⁶ Section 211, of the Energy Policy Act of 2005 (P.L. 109-58); <http://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf>.

⁷ <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>; http://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf.

⁸ Final Solar PEIS, July 2012. See <http://solareis.anl.gov/documents/fpeis/index.cfm>.

- Facilitate near-term utility-scale solar energy development on public lands,
- Minimize potential negative environmental impacts,
- Minimize potential negative social and economic impacts,
- Provide flexibility to the solar industry to consider a variety of solar energy projects (e.g., location, facility size, and technology),
- Optimize existing transmission infrastructure and corridors,
- Standardize and streamline the authorization process for utility-scale solar energy development on BLM-administered lands, and
- Meet projected demand for solar energy development (as estimated by the RFDS developed for the PEIS).⁹

The BLM can achieve these goals through landscape-scale planning and the application of the mitigation hierarchy, which is to avoid impacts associated with development of solar energy, to minimize those impacts, and, only then, to compensate for unavoidable impacts. The BLM applies the mitigation hierarchy through planning processes at (1) the programmatic level, which established Solar Energy Program and defined land use allocations; (2) a regional scale to determine whether additional avoidance areas are needed, where additional development is appropriate, and where the investment to compensate for the impacts of renewable energy development should occur; and (3) the local or project level, where additional decisions are made for minimizing impacts and measuring unavoidable impacts.

Avoidance is the least costly and most effective step in the mitigation hierarchy to meet goals related to the long-term viability of wildlife and ecosystem function, to achieve a balance of development and conservation, and to protect ecosystem services. Specifically, the avoidance step refers to identification of places that are too important for species, habitats, ecological function, and other ecosystem services values to allow development. Avoidance (or exclusion) areas are avoided entirely with respect to development activities. Through Solar Energy Program, the BLM proactively identified, at the programmatic level, exclusion areas. Some of these areas include lands designated by the BLM as areas of critical environmental concern (ACECs), habitat designated critical by the U.S. Fish and Wildlife Service for fauna and flora, and federally designated national conservation areas, national monuments, national trails, wilderness areas, and wilderness study areas.

The BLM also implemented an innovative approach to incorporating the avoidance principle: proactively identifying and promoting solar energy development in areas with the least conflict with environmental and other values. At the time of the ROD, the Solar Energy Program identified 17 solar energy zones (SEZs). By identifying where solar energy development is preferred, the BLM intends to help drive solar energy development in ways that avoid important ecological areas and concentrate development in areas of relatively low impact.

The Solar Energy Program also provided guidelines for a variance process to identify additional solar energy zones. The process involves landscape-scale analyses to evaluate the regional importance of locations and to select areas for solar energy development that protect ecological, cultural, and recreational values, while also meeting the needs of solar energy developers. The BLM retains the authority to determine if additional exclusion areas are necessary when a solar energy developer proposes a project in a variance area.

⁹ ROD, October 2012.

Minimization of solar energy development impacts, either for an entire solar energy zone or for a project, is achieved, in part, through required design features (e.g., identification of parcels that should not be released for lease due to local environmental values, reconfiguring of a project to avoid a desert wash, or requirements to use technologies that minimize water use). Avoidance of ecological features at the local or project level constitutes minimization of impacts. It is not characterized as the avoidance step in the mitigation hierarchy, because the larger ecosystem function is compromised in development areas, and indirect impacts from development generally affect adjoining lands.

Compensation measures are actions taken to offset residual impacts of development after applying appropriate avoidance and minimization measures. Through the Solar Energy Program and with the support of its Interim Policy on Regional Mitigation, the BLM is again taking a proactive, regional approach to identifying the most strategic places to invest in protection of wildlife and ecosystem services and the best actions to take at these places.¹⁰ For each solar energy zone, the BLM is developing regional mitigation strategies and a regional mitigation plan. The latter allows for prioritization of mitigation investments on the basis of multiple conservation goals. As envisioned, regional mitigation plans will simplify and improve the mitigation process for future SEZ projects to promote coordination of mitigation actions to yield the greatest benefit. The plans include detailed data analysis about impacts, using finer-scale information than the analysis that established exclusion areas and solar energy zones. Additionally, when a solar developer requests a permit, a site-level environmental assessment will be undertaken to quantify impacts to resource values and connect those impacts to mitigation actions laid out in regional mitigation plans. The first pilot project to develop a regional mitigation strategy was undertaken for the Dry Lake solar energy zone in Nevada. It was released in March 2014.¹¹

Near-term utility-scale solar energy development is facilitated through proactive identification of solar energy zones, allowing the BLM to minimize potential negative environmental, social, and economic impacts as well as to optimize existing transmission infrastructure and corridors to known locations for concentrated development. By focusing development in solar energy zones, the BLM can direct its limited capacity to processing those applications that have the highest probability of approval, given the analysis underlying SEZ identification. Solar PEIS standardizes and streamlines the authorization process for solar energy development within solar energy zones, and the variance process provides flexibility to the solar industry to develop a range of projects.

¹⁰ Bureau of Land Management, Interim Policy on Regional Mitigation, IM 2013-142 (June 2013); http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-142.html.

¹¹ Bureau of Land Management, Solar Regional Mitigation Strategy for the Dry Lake Solar Energy Zone, Tech Note 444 (2014). Bureau of Land Management, Southern Nevada District Office, Las Vegas, NV.

Table 2. BLM Decision Context.

	Programmatic	Land use planning	Permit decision
Scale	West-wide	Regional or landscape level	Site specific
Process	Public process for programmatic Solar PEIS	Public process through resource management plan (RMP) development/ amendment or regional mitigation strategy development	Public process initiated externally through permit application or competitive bid
Evaluation	Programmatic environmental impact statement (EIS) to assess demand, resources, environment, alternatives	Regional environmental impact statement to assess demand, resources, environment, alternatives	Guided by RMP; solar energy development requires a site-specific environmental impact assessment
Function	Identifies avoidance areas and solar energy zones	Identifies variety of land uses and where they may or may not occur	Evaluates alternatives, including siting, construction, operations, and decommissioning
Requirements	Programmatic EIS	EIS	EIS of environmental assessment or EIS of project
Decisions	Exclusion areas, solar energy zones, variance process, design features, best management practices (BMPs)	Resource allocations	Decisions to deny or grant the permit or to grant it with stipulations such as BMPs and compensatory mitigation
Monitoring	Guidelines	Monitoring plan	Compliance monitoring

Source: Adapted from G. Toevs and M. Dwyer, “Integrating Ecosystem Services and Adaptive Management” (2013).

In the interest of increasing effectiveness in the management of the nation’s public lands, the BLM has identified several opportunities to improve the process described above by more explicitly integrating ecosystem services into land use planning and land-use allocation decisions:

- Integrate the assessment of impacts to ecological systems and the services they provide into the assessment of impacts in both the allocation of resources and the authorization of specific projects.
- Include guidance for decision-makers for considering tradeoffs between demands for products (i.e. water, energy) and impacts to ecological systems and the services they provide (e.g., water dynamics, nutrient cycling).
- Use information gained from implementation of the BLM Assessment, Inventory, and Monitoring System to
 - Validate or revise the assumptions made to estimate potential environmental, social, and economic impacts, including addressing the identification, production, and valuation (monetary and non-monetary) of ecosystem services;
 - Assess the relative effectiveness of resource allocation strategies, project siting criteria, and stipulations to achieve sustainable yield; and

- Use analysis of monitoring information to help guide future siting decisions and best management practices for operation.¹²

Key Players

The Energy Efficiency and Renewable Energy Program was initiated by the BLM and the DOE, and its development involved multiple stakeholders as well as specialists in solar energy, wildlife and special status species, vegetation, air quality, outdoor recreation, landscape architecture, archaeology, paleontology, hydrology, soils, sociology, and economics.¹³

The Solar PEIS was completed by the BLM Renewable Energy Coordination Office in conjunction with BLM renewable energy programs in Arizona, California, Colorado, New Mexico, Nevada, and Utah under an interagency assistance agreement with the DOE Argonne National Laboratories Environmental Services Division. In compliance with NEPA, the program's development included significant public involvement. The solar industry, utilities, and the environmental NGO community also played a significant role.

In addition to the BLM and DOE, 19 federal, state, and local cooperating agencies are involved in the Solar PEIS: U.S. Department of Defense; U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service (FWS); U.S. National Park Service (NPS); U.S. Environmental Protection Agency, Region 9; U.S. Army Corps of Engineers, South Pacific Division; Arizona Game and Fish Department; California Energy Commission; California Public Utilities Commission; Nevada Department of Wildlife; N-4 Grazing Board, Nevada; Utah Public Lands Policy Coordinating Office; Clark County, Nevada, including Clark County Department of Aviation; Dona Ana County, New Mexico; Esmeralda County, Nevada; Eureka County, Nevada; Lincoln County, Nevada; Nye County, Nevada; and Saguache County, Colorado.

Funding

To develop all SEZ regional mitigation strategies and adaptive management pilot projects, the BLM is leveraging existing renewable energy program funds allocated by Congress.

Existing Resources

BLM Rapid Ecoregional Assessments

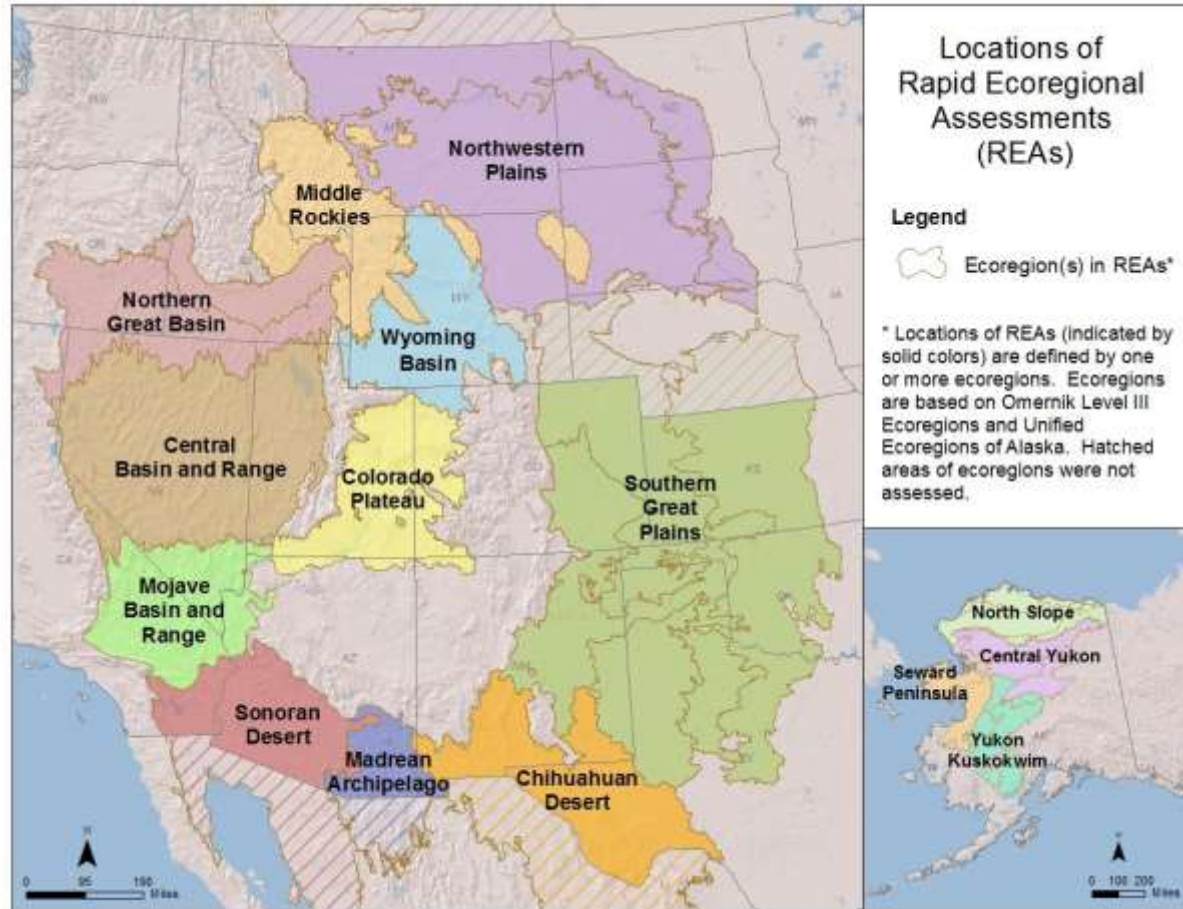
The Solar Energy Program uses analysis completed through BLM's rapid ecoregional assessments (REA) process. REAs provide regional baseline information regarding ecological values, conditions, and trends within ecoregions. REAs identify regionally important habitats for fish, wildlife, and species of concern and "the potential of these habitats to be affected by four overarching environmental *change agents*: climate change, wildfires, invasive species, and development (both energy development and urban growth)."¹⁴ The Solar Energy Program draws from numerous REAs completed in the six-state region (see Figure 6).

¹² G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).

¹³ See <http://energy.gov/eere/office-energy-efficiency-renewable-energy>.

¹⁴ See http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html.

Figure 6. Locations of BLM Rapid Ecoregional Assessments



Source: http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas/ecomap.html.

BLM Assessment, Inventory, and Monitoring (AIM) Strategy

The long-term solar monitoring and adaptive management plan identified in the Solar Energy Program will be based on BLM's AIM Strategy developed in 2011.¹⁵ It will also incorporate the national landscape monitoring framework, Greater sage-grouse habitat analysis, and other local management-driven monitoring efforts.

Transmission Planning Efforts

The Solar Energy Program incorporates multiple transmission planning efforts, including the Western Governors' Association Renewable Energy Zone Project, the California Renewable Energy Transmission Initiative, and the *Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE/EIS-0386) PEIS in evaluating electricity transmission access issues associated with solar energy development in the six-state area.¹⁶

¹⁵

http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/ib_attachments/2012.Pa.r.53766.File.dat/IB2012-080_att1.pdf.

¹⁶ See <http://solareis.anl.gov/eis/how/index.cfm>.

FWS and NPS Data

The FWS provided data for desert tortoise habitat and identified priority desert connectivity areas within the variance zones. The NPS provided data for natural, cultural, and visual resources and identified areas where there would be a high potential for resource conflicts. These data will be used during pre-application meetings to assess the impacts of potential solar energy development projects in the variance zones.

Desert Renewable Energy Conservation Plan

In 2011, the state of California called for development of the Desert Renewable Energy Conservation Plan (DRECP). Like the Solar Energy Program, the plan aims to facilitate renewable energy development while protecting desert ecosystems and species.¹⁷ Unlike Solar Energy Program, which is limited to BLM-managed lands, DRECP includes both private and public lands, and it must develop a reserve design that will lead to the recovery of covered species in addition to identifying zones for renewable energy development. The participating parties include the California Energy Commission, the California Department of Fish and Wildlife, the California Public Utilities Commission, California Independent System Operator, the BLM, the U.S. FWS, the NPS, the U.S. EPA, and the DOD. DRECP will be informed by and might refine the decisions in Solar PEIS for public lands in California deserts.

NGO Expertise

Multiple environmental NGOs, including Defenders of Wildlife, The Wilderness Society, and The Nature Conservancy, supported development of Solar PEIS through technical assistance as part of their larger efforts to reduce the impacts of energy development while promoting renewable energy development.

Options and Tradeoffs Considered

In addition to making regional land use decisions about where solar energy development may or may not occur, the Solar Energy Program provides a framework for evaluating options and tradeoffs at the local level to mitigate (avoid, minimize, offset) direct, indirect, and cumulative impacts.

The relevant ecosystem services at the larger scale might focus on habitat fragmentation, potential impacts on endangered species, water contamination and soil erosion, potential disruption of ecosystem functions and processes regulating biological communities, and climate change impacts. Ecosystem services at the local scale might focus on conflicting demands for products (e.g., water, energy) and on the impacts of disturbance of flora and fauna or of disruption of ecosystem processes (e.g., water dynamics, nutrient cycling).¹⁸

Tradeoffs at the programmatic scale were evaluated through identification of exclusion areas, where utility-scale solar development would not be allowed because of the high level of conflict with ecosystem services and cultural values, and solar economic zones, where solar energy development was prioritized in areas with the least conflict.

¹⁷ See <http://www.drecp.org/>.

¹⁸ G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).

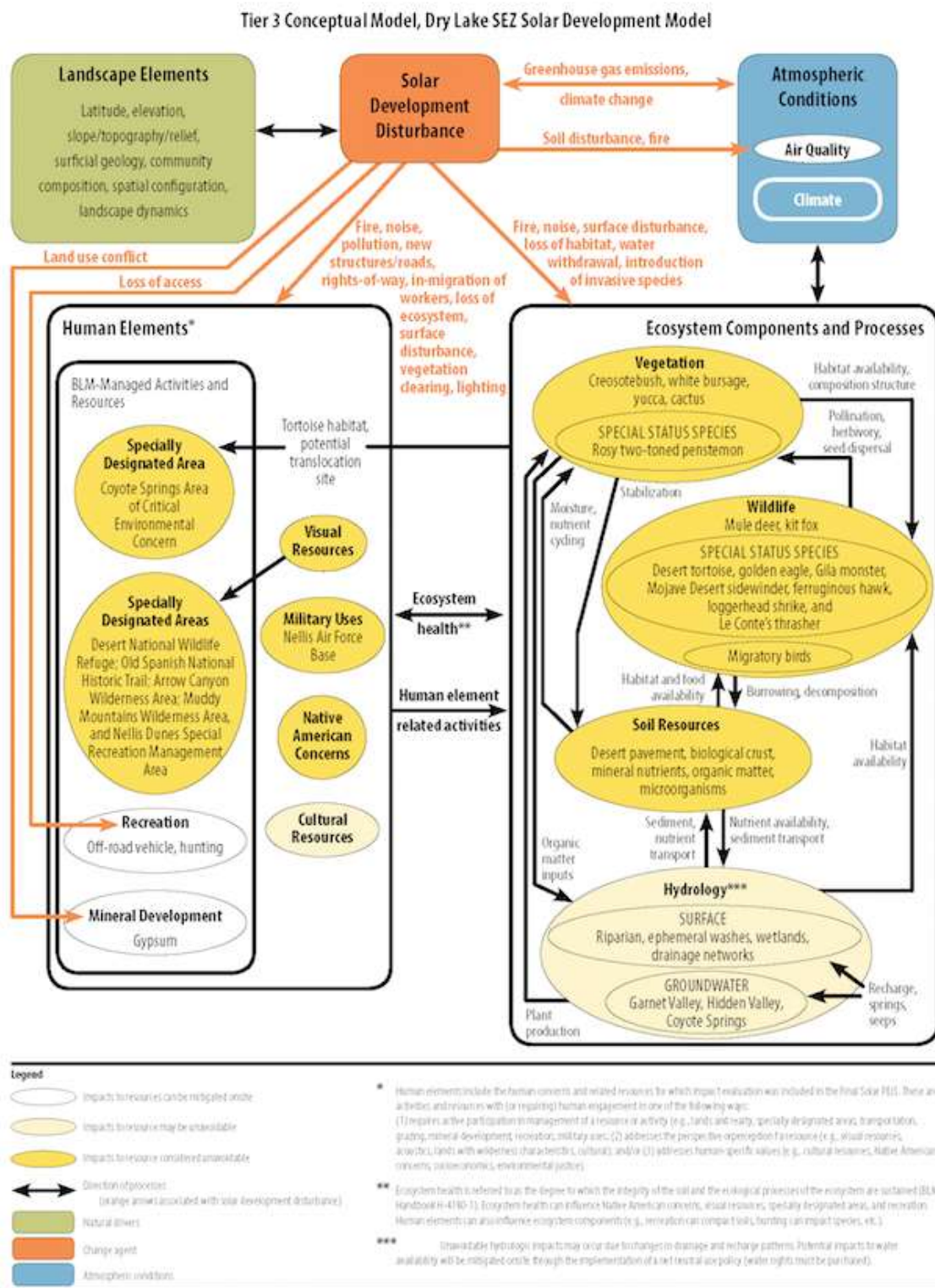
Exclusion areas were identified on the basis of the following criteria:

- Areas of critical environmental concern;
- Desert wildlife management areas;
- Critical habitat areas for species protected under the Endangered Species Act;
- Protection for lands with wilderness characteristics;
- Special recreation management areas;
- Sensitive species habitat: (Sage-grouse core areas, nesting habitat, and winter habitat; Mohave ground squirrel habitat; flat-tailed horned lizard habitat; fringe-toed lizard habitat);
- California desert conservation area;
- Desert Tortoise connectivity corridors;
- Big game migratory corridors;
- Visual resource management;
- National recreation, water, or side and connecting trails and national back country byways;
- BLM National Landscape Conservation System and national scenic and historic trails;
- National historic and natural landmarks;
- Traditional cultural properties and Native American sacred sites;
- Wild, scenic, and recreational rivers;
- Old growth forest; and
- ROW exclusion and avoidance areas.¹⁹

Tradeoffs at the regional level will be analyzed through the development of regional mitigation strategies as established by the Solar Energy Program (see Figure 7). Tradeoffs at the local level will be analyzed through the project-level NEPA process. This process includes analysis of unavoidable direct, indirect, and cumulative impacts that contribute to loss of ecosystem services as well as strategies for off-site mitigation, monitoring, and adaptive management. Regional mitigation plans will establish a crediting methodology for assessing impacts and determining mitigation actions. Individual permits will be granted with stipulations reflecting these requirements.

¹⁹ ROD, Table A-2 Exclusions under BLM's Solar Energy Program (October 2012).

Figure 7. Dry Lake Regional Mitigation Strategy Conceptual Model.



Source: Bureau of Land Management.

Analysis at the project level may incorporate impacts on

- Soils and nutrient cycles (erosion and carbon sequestration)
- Wildlife
- Special status species
- Vegetation
- Invasive/noxious weeds
- Hydrology
- Riparian function
- Visual resources
- Specially designated areas
- Military uses
- Cultural resources
- Native American concerns

Analysis

Solar PEIS provides a summary-level assessment of potential ecosystem service impacts, including impacts on rangeland resources, recreation lands, military and civilian aviation, soil resources, mineral resources, water resources, vegetation, wildlife and aquatic biota, special status species, air quality and climate, visual resources, acoustic environment, paleontological resources, cultural resources, native American concerns, and transportation.²⁰

In addition, the BLM has developed action plans for each of the solar economic zones as part of the supplement to the draft Solar PEIS. These action plans described additional data that could be collected for individual zones and proposed data sources. These data will inform development of the regional mitigation strategies.

However, the BLM faces a number of challenges in evaluating impacts to ecosystem services. First, ecosystem functions vary significantly across the area covered by the program. Second, the long-term impacts of solar energy installations on certain functions such as soils are not yet well understood. Third, there is little qualitative research on the assessment of “tradeoffs” for ecosystem services—that is, whether greenhouse gas savings from solar electricity outweigh the lost carbon sequestration from disturbing soils. Fourth, there are questions about the appropriate scale at which ecosystem services and impacts to them should be evaluated.

An ecosystems services impact assessment can help value impacts that are hard to monetize (e.g., viewsheds, access to public lands, water and air quality), but it requires a high level of in-house expertise that the BLM and even many conservation NGOs do not have, and some of the valuation methods are immature. Therefore, the BLM contracted with outside scientists to evaluate cumulative impacts to ecosystems services, including a small contract to Colorado State University. BLM also drew from an ecosystems services analysis done for the San Pedro River Watershed in Arizona.²¹

Implications

The Solar Energy Program could significantly reduce the impacts to ecosystem services functions from solar energy development over a 20-year timeframe. It reduces landscape-scale impacts by centering development in solar economic zones where environmental, social, and cultural conflict is relatively low. At the same time, the program provides a framework for assessing and mitigating individual project-level impacts. The program reflects a significant

²⁰ Final Solar PEIS (July 2012). See <http://solareis.anl.gov/documents/fpeis/index.cfm>.

²¹ K.J. Bagstad, D. Semmens, R. Winthrop, D. Jaworski, and J. Larson, *Ecosystem Services Valuation to Support Decisionmaking on Public Lands: A Case Study of the San Pedro River Watershed, Arizona*, USGS Scientific Investigations Report 2012-5251 (2012).

change in the BLM's land-use planning and permitting decision processes (e.g., from a case-by-case analysis to a programmatic analysis of ecosystem functions).

The ecosystem services framework facilitates impact assessments that could help avoid unintended consequences (e.g., cumulative impacts to water quantity or soil quality) and valuation of nonmarket benefits (e.g., access to public lands), which can help the BLM achieve its multiple use mandate.

How to cite:

Reed, A., and L. Crane. 2014. "Protecting Ecosystem Services While Developing Renewable Energy: Bureau of Land Management Solar Energy Program." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

Acknowledgments:

Thanks go to the following reviewers: Rebecca Moore, Rob Winthrop, Gordon Toevs, Mike Dwyer, and Joe Vieira at the Bureau of Land Management and Lynn Scarlett at The Nature Conservancy.

U.S. Environmental Protection Agency

Making Ecosystem Services the Focus of Determining Adversity to Public Welfare in Review of NO_x and SO_x Secondary Air Quality Standards

Author

Christine Davis, U.S. Environmental Protection Agency

Created 2014



Photo courtesy of Grand Canyon National Park Service

Background (Motivation and Decision Context)

The U.S. Environmental Protection Agency (EPA) conducted a joint review of the secondary National Ambient Air Quality Standards (NAAQS) for nitrogen oxides (NO_x) and sulfur oxides (SO_x) beginning in 2007 and concluding in 2012 with a final rulemaking for a NO_x/SO_x secondary standard.¹ Secondary standards are set to protect the public welfare from adverse effects due to air pollution in much the same way that primary standards protect human health. The review process includes an integrated science assessment (ISA), a risk and exposure assessment (REA), and a policy assessment (PA) that form the basis for the Administrator's decisions. As part of the NAAQS review process, the EPA is required to assess whether adversity to public welfare occurs with air quality that just meets the existing standard. The Clean Air Act describes public welfare as including:

Effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effect on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants (Section 302(h)).²

The EPA has been moving toward using an ecosystem services framework for describing and, in some cases, quantifying the public welfare effects of air pollutants. This framework allows the agency to discuss ecological effects on the environment in terms of their effects on the public in a context more familiar to decision makers than ecological effects divorced from public welfare impacts.

Review of the NO_x and SO_x secondary standards represents the EPA's first effort to make ecosystem services the primary focus of the determination of adversity to public welfare. In both the risk and exposure assessment and the policy assessment, the review ecosystem services was highlighted to better define (1) the ecological effects of nitrogen and sulfur deposition as risks to public welfare and (2) the potential change in services that might result from meeting potential alternative standards.³

Key Contributors

The Office of Air Quality Planning and Standards (OAQPS) was the lead office for the cross-agency review of the NO_x and SO_x secondary standards. Staff from ORD's National Center for Environmental Assessment completed an integrated science assessment reflecting the full body of scientific research on the ecological effects of nitrogen and sulfur and including a chapter on ecosystem services, with an emphasis on policy-relevant research. The ecosystem services analyses conducted as part of the risk and exposure assessment and the policy assessment were supported by air quality modeling by the OAQPS's Air Quality Analysis Division and water quality modeling by the Office of Atmospheric Programs (OAP). The analysis and descriptions of potential effects on ecosystem services were the result of collaborations between the OAQPS Health and Environmental Impacts Division, the Office of Policy's National Center for Environmental Economics (NCEE), and RTI International staff working under contract to the EPA.

¹ See <http://epa.gov/air/criteria.html>.

² See <http://www.epw.senate.gov/envlaws/cleanair.pdf>.

³ These documents are available at <http://www.epa.gov/ttn/naaqs/standards/no2so2sec/cr.html>.

Existing Resources and Organizational Capacity

OAQPS was able to leverage resources across the EPA. Each of the key players provided valuable inputs to the integrated science assessment, the risk exposure assessment, and the policy assessment. The EPA used its expertise in air and water quality modeling to simulate air and water quality under current conditions and under a scenario of pristine preindustrial conditions. Those estimates of air and water quality, the result of internal and external agency collaborations, underlie the analyses of changes in ecosystem services. Social scientists in the NCEE and at RTI helped relate the modeled scenarios to ecosystem services and, in a few cases, to estimation of monetary valuation of those services. Since this first-ever multi-pollutant review by OAQPS and the first to highlight ecosystem services, the EPA has devoted additional research resources to the development of ecosystem services methods, including ecosystem service mapping and classification.

Methodology (Location, Analysis, and Options Considered)

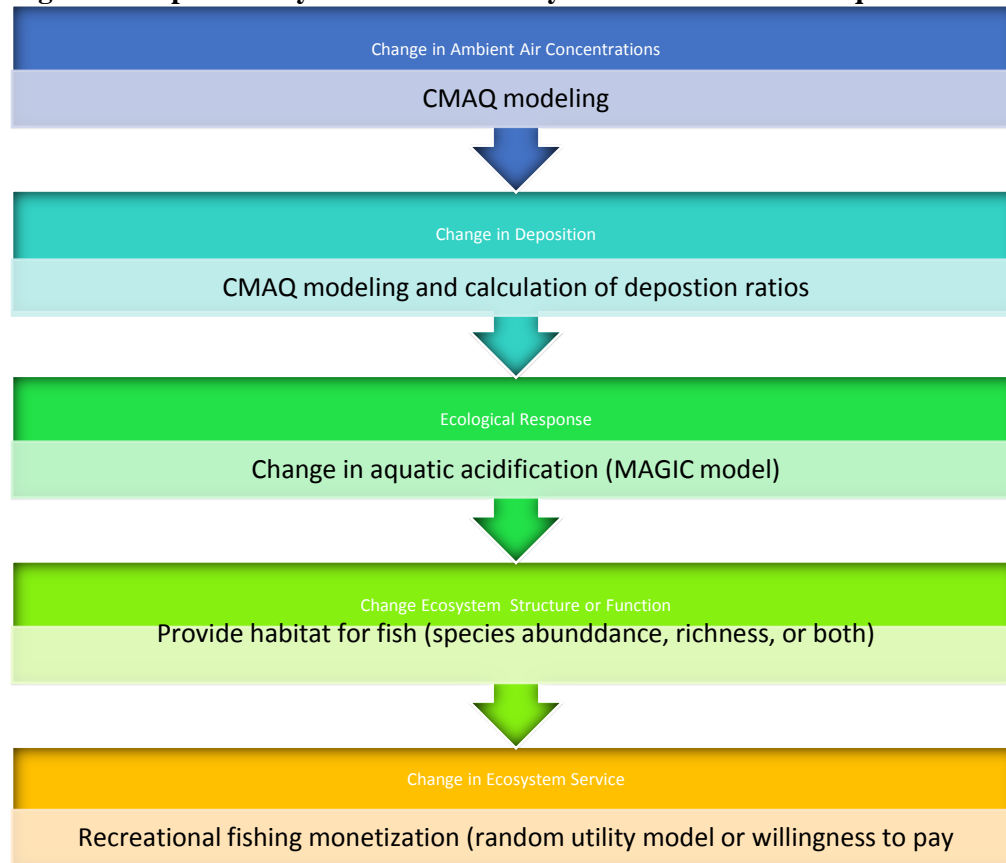
Analysis of ecosystem services impacts was complicated by the inclusion of two pollutants that alone affect multiple types of ecosystems and that together produce additive effects for certain types of ecosystem services.

Ideally, the analyses conducted for the review of ecosystem services would be national in scope, because ambient air quality standards are national in scope. However, because the environmental impacts of excess nitrogen and sulfur deposition vary across the country, the assessments were subdivided into effects categories, and case study areas were selected to represent each effect:

- Acidification due to nitrogen and sulfur deposition
 - Aquatic (Adirondack State Park in New York)
 - Terrestrial (northeast forests and southern Appalachian forests)
- Nutrient enrichment due to nitrogen deposition
 - Aquatic (Potomac River Basin-Chesapeake Bay and Neuse River Basin)
 - Terrestrial (San Bernardino County and Sierra Nevada Mountains—coastal sage scrub and mixed conifer forest)

Connecting air pollutant emissions to ecosystem service effects requires several steps, each with its own analysis leading. Figure 8 illustrates the steps involved in using aquatic acidification and recreational fishing as an example. This diagram can be modified for any of the other ecosystem service endpoints that correspond to the ecological effects caused by nitrogen and sulfur deposition.

Figure 8. Steps in Ecosystem Services Analysis for Air Pollution: Aquatic Acidification.



The ecosystem services associated with the ecological effects of nitrogen and sulfur were identified for each case study area as described. These services were then divided into quantified and un-quantified categories. For some services, the analysis included monetization. For many others, the analysis stopped at qualitative descriptions of anticipated effects on services and at description of the current magnitude of the potentially affected services. Table 3 illustrates the substantial difference between the number of quantified and un-quantified services.

Table 3. Quantified and Un-quantified Ecosystem Services Related to Nitrogen and Sulfur Deposition.

Ecological Effect	Quantified	Qualitative Discussion
Aquatic acidification	Recreational fishing Total ecosystem services*	
Terrestrial acidification	Timber market effects for sugarmaple and red spruce	Recreation (hiking, wildlife viewing, hunting) Fall color viewing Maple syrup production Non-use (existence, bequest)
Aquatic eutrophication		Commercial fishing Loss to seafood industry due to fish kills Recreational saltwater fishing Motor boating Bird watching Beach use Non-beach coastal visits
Terrestrial nutrient enrichment		Habitat for T&E species Existence Recreation (hiking, fishing, hunting, wildlife viewing) Alteration of fire cycle

*Total services are included in the willingness-to-pay survey used to quantify services related to Adirondack lakes acidification. The survey authors found that respondents were including near-shore effects on forests and bird populations as part of the total recreational experience when fishing.

Analysis and Tradeoffs

In the NO_x/SO_x review, assessment of the ecological production of ecosystem services used models when available and appropriate. The EPA's state-of-the-art air quality model, CMAQ, was used to generate deposition surfaces that in turn were incorporated into a water quality model, specifically the Model of Acidification of Groundwater Catchments (MAGIC) model. MAGIC model results were used to inform a random utility model for recreational fishing effects. The air quality surfaces were also incorporated into the greenhouse gas version of the Forest and Agriculture Sectors Optimization Model for forestry market effects.

In the absence of available models for various ecosystem services assessments, the EPA relied on published literature to provide ecosystem response functions that were useful to describe potential effects on services. It also used publicly available reports from the U.S. Forest Service (Cordell et al. n.d.) on recreation participation and published data on willingness to pay (WTP) for recreation activities (Kaval and Loomis 2003) to describe the current magnitude of the recreation services anticipated to be at risk from nitrogen and sulfur deposition. As a complement to the recreational fishing model, the EPA related water quality changes to the WTP survey of New York residents for fishing in the Adirondacks (Banzhof et al. 2006). Under the Clean Air Act, the EPA is prohibited from considering the cost of regulation when setting a national ambient air quality standard, which is to protect public welfare from known or anticipated adverse effects without regard to implementation cost. This prohibition does not prevent the EPA from considering the adverse economic effect of damage to the environment—

indeed, that adverse effect was a component of the ecosystem services analysis for the NOx/SOx review.

Implications and Next Steps

The review of the NOx/SOx secondary standards set a precedent for use of ecosystem services in risk assessments and provides examples of the methodologies for doing so.

Because of this precedent, the risk exposure assessment for the ongoing review of the ozone secondary standard was carried out with a focus on ecosystem services as the metric of adversity to public welfare. Moreover, ecosystem services analysis is likely to be part of any regulatory impact analysis that accompanies the standard.

The EPA is continuing to refine its methods to make analyses increasingly robust. In the next review cycle for the NOx/SOx secondary standard, the agency is again focusing on ecosystem services to assess the risks to public welfare. It is transitioning from the Millennium Ecosystem Assessment ecosystem services classification system to its own system: the National Ecosystem Services Classification (NESCO).⁴ NESCO is based on the concepts applied in development of national economic accounts, specifically the North American Industry Classification System and the North American Product Classification System. NESCO is being designed to aid in analyses of the impacts on human welfare of policy-induced marginal changes in ecosystems. It will support risk assessments, policy assessments, and cost-benefit analysis while minimizing the double counting and categorization issues present in the MEA framework.⁵ A draft report on the classification system is in preparation.

⁴ <http://water.epa.gov/learn/confworkshop/upload/FINAL-Summ-WS2-NESCO.pdf>.

⁵ For details, see water.epa.gov/learn/confworkshop/NESCO.cfm.

References

Banzhaf, S., D. Burtraw, D. Evans, and A. Krupnick. 2006. "Valuation of Natural Resource Improvements in the Adirondacks." *Land Economics* 82:445–464.

Cordell, K., B. Leeworthy, G.T. Green, C. Betz, and B. Stephens. n.d. "The National Survey on Recreation and the Environment." Research Work Unit 4953. Athens, GA: Pioneering Research on Changing Forest Values in the South and Nation USDA Forest Service Southern Research Station. www.srs.fs.fed.us/trendswww.srs.fs.fed.us/trends.

Kaval, P., and J. Loomis. 2003. "Updated Outdoor Recreation Use Values with Emphasis on National Park Recreation." Final report under Cooperative Agreement CA 1200-99-009, Project number IMDE-02-0070.

How to cite:

Davis, C. 2014. "Making Ecosystem Services the Focus of Determining Adversity to Public Welfare in Review of NO_x and SO_x Secondary Air Quality Standards." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

U.S. FISH AND WILDLIFE SERVICE

**Incorporating Consideration of Ecosystem Services
into Plans for the
Great Dismal Swamp National Wildlife Refuge**

Authors

Lynn Scarlett, The Nature Conservancy
Edward Maillett, U.S. Fish and Wildlife Service

Created 2014

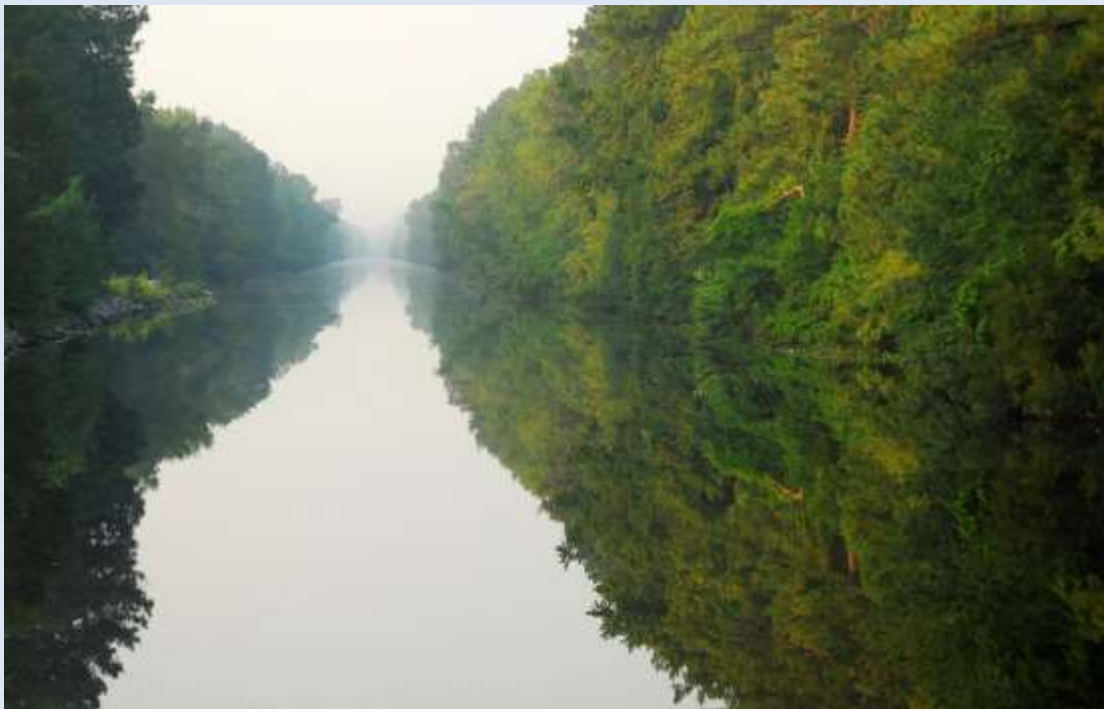


Photo courtesy of the Great Dismal Swamp National Wildlife Refuge

The Great Dismal Swamp National Wildlife Refuge (NWR) is located on the border of northeastern North Carolina and southeastern Virginia, where it provides ecosystem services to a population of more than 1.6 million in the adjacent Virginia Tidewater metropolitan area.¹ These services include recreation opportunities, carbon sequestration, moderation of the release of mercury and other soil-bound pollutants into regional waterways, and natural cooling.

The refuge was established in 1974 to conserve peat lands and more than 112,000 acres of seasonally flooded wetland forest—the largest intact wetland forest on the East Coast. Comprising 20% of the Fish and Wildlife Service (FWS) Region 5 land base, the refuge includes the 3,100-acre Lake Drummond, one of only two naturally occurring lakes in the state of Virginia (Figure 9), and it has a significant hydrological connections to the Albemarle Sound and Chesapeake Bay.

Figure 9. Great Dismal Swamp National Wildlife Refuge.



The Great Dismal Swamp has experienced perturbations from human activities over several hundred years. George Washington once helped form a group of shareholders to form the Dismal Swamp Company in order to drain, farm, and log portions of the swamp. Since that time, an estimated 150-plus miles of roads have been constructed to provide access for timbering,

¹ http://www.fws.gov/refuge/great_dismal_swamp/.

and associated ditches have been dug to facilitate timber harvesting by drying out swamplands. These activities have significantly altered the natural water regime of the Great Dismal Swamp, making it drier in some locations and prone to flooding in others. As a result, cypress and cedar trees, which had difficulty surviving, were slowly replaced by red maples and other forest species.

The Great Dismal Swamp NWR is working to restore and maintain the natural biological diversity and associated natural swamp ecosystem that existed prior to human alterations.

Management Challenges

Under the Dismal Swamp Study Act of 1972, a 210,000-acre area of the swamp was identified for study. At that time, it was decided to protect only 123,000 acres of the ecosystem. Since then, much of the unprotected land has been developed and converted to other uses. The corresponding loss of natural habitat has created several challenges:

- Increased frequency of droughts and tropical storm events associated with climate change,
- Altered hydrology due to ditches,
- Restrictions on the use of prescribed fire and hydrologic management due to the proximity of urban centers, and
- Lack of wildlife corridors.

The refuge area has experienced increasingly frequent drought events and, consequently, more severe fire events; 15 fires occurred in one particularly dry month. Since the early 2000s, the average size of fires has increased by an order of magnitude, from less than 100 to hundreds of acres. One of these fires burned more than 5,000 acres. In 2008 and 2011, the Great Dismal Swamp experienced wildfires lasting 121 and 111 days, respectively—the longest-duration fires in Virginia’s history.

Due to altered hydrological conditions, the refuge is even more susceptible to intensified wildfire conditions under drought conditions as well as to microbial decay of peat soils, resulting in loss of its carbon reserves and land subsidence. Land subsidence in turn destabilizes growing conditions for Atlantic white cedar, one of the refuge’s highest-priority conservation targets.

The proximity of urban area affects use of natural means such as prescribed fires and hydrologic management to minimize the frequency and intensity of wildfires. Limits on fire use can result in undesirable habitat changes and increased accumulation of downed wood, which can fuel intense wildfires.

Construction and widening of highways and encroaching human development will bring more residential and commercial development, along with potential conflicts between people and wildlife. Groundwater withdrawals on the western edge of the swamp (along the Suffolk escarpment) can reduce important groundwater inflows that drive the swamp’s hydrologic regime. Development of flood-prone areas to the north and east of the refuge may constrain hydrologic management opportunities on the refuge. It also may ecologically isolate the refuge, threatening the survival of unique species such as the black bear.

Management Efforts

In 2006, the Comprehensive Conservation Plan (CCP) for the refuge, required by statute under provisions of the 1997 National Wildlife Refuge System Improvement Act, was completed.² The CCP does not specifically address restoration of the Great Dismal Swamp NWR's hydrology and white cedar forest stands. To achieve CCP goals, the refuge is working on a habitat management plan that will protect and restore those areas within the Great Dismal Swamp ecosystem that are remnants of the Great Dismal Swamp or that can be restored to Great Dismal Swamp habitat while supporting protection and restoration of adjacent habitats that directly affect the ecosystem's vitality and viability.

The cities of Chesapeake and Suffolk—arguably the refuge's two most important municipal partners—are revising their comprehensive plans, and the Great Dismal Swamp NWR, The Nature Conservancy, and others are working with them to examine which natural resources they should aim to protect and how they can reap the development opportunities associated with rural, outdoor recreation and protection of natural landmarks. Portsmouth, Camden County, and Gates County are also slated to update their comprehensive plans. Ecosystem services concepts may help them understand the benefits of open lands and swamp protection as they consider their land and water management options.

Although there is no statutory or regulatory mandate for the Great Dismal Swamp NWR to incorporate ecosystem services into its planning, the FWS has signaled a general interest in better understanding and evaluating these services, an interest that has resulted in production of two studies. One study examined the effects on housing values of proximity to a national wildlife refuge (Taylor, Liu, and Hamilton 2012). The other study examined the ecosystem services and valuation associated with the wetland characteristics of four refuges (Patton, Bergstrom, Covich, and Moore 2012). These two studies prepared for the FWS Division of Economics could serve as a basis for conducting a quantitative assessment of some of the ecosystem services provided by the Great Dismal Swamp NWF.

Incorporating consideration of ecosystem services into plans for the Great Dismal Swamp NWR means, in part, evaluating the contribution of the refuge to air quality, water quality, and carbon sequestration and calculating the economic benefits associated with managing habitat for trust resources. This knowledge could help refuge managers and the larger community better assess resource management trade-offs.

Weighing Tradeoffs

Restoring the swamp's hydrological functioning could reduce peat exposure, which could reduce the severity and duration of wildland fires, in turn reducing surrounding communities' exposure to smoke (particulates), which can adversely affect public health. An Environmental Protection Agency linked peat bog wildfire smoke exposure in northeastern North Carolina with significant increases in relative risks for asthma, pneumonia, and acute bronchitis as well as increases in emergency department visits associated with cardiopulmonary symptoms and heart failure (Rappold et al. 2011). If its hydrological functioning is restored, the refuge could lessen not only flood risk but also the duration and adverse impacts of fire, thereby yielding public health benefits.

2

http://www.fws.gov/uploadedFiles/Region_5/NWRS/South_Zone/Great_Dismal_Swamp_Complex/Great_Dismal_Swamp/FinalCCP_GDS.pdf; <http://www.fws.gov/northeast/planning/downloads/NWRSImprovementact.pdf>. CCPs are 15-year plans, developed with public input, identifying management issues, goals, objectives, and strategies for each national wildlife refuge. For more information, see <http://www.fws.gov/mountain-prairie/planning/overview/index.html#ccp>.

But restoring the refuge's hydrology to reduce peat exposure will affect the adjacent Dismal Swamp Canal, which is part of the Intracoastal Waterway managed by the U.S. Army Corp of Engineers. Originally built for transportation purposes, the canal now largely serves recreational interests. The North Carolina Department of Transportation's Visitor Center reports some 600,000 annual visitors, more than 200,000 of them boaters. Lake Drummond is a primary source of water for the canal, which the Army Corp of Engineers manages through the Feeder Ditch that connects the two water bodies. The Dismal Swamp Study Act stipulated that the primary use of water from Lake Drummond and other waters is to be used to maintain and enhance the ecology of the Great Dismal Swamp. In accordance with an agreement with the refuge, the corp is authorized to draw water from the lake to supplement low flows on the canal, as long as the lake is not drawn down beyond a specified level.

Using an ecosystem services framework could assist in evaluating trade-offs between off-refuge recreation benefits associated with canal flows and broad public health, carbon sequestration, and other benefits associated with different levels of restoration of hydrological function in the refuge.

Options

Past drainage and flows of refuge waters into a canal system that supports high levels of recreation preclude restoration of historic water levels and patterns in the Great Dismal Swamp. However, the refuge is striving to restore enough hydrological function to prevent peat loss, to reduce the severity and duration of wildland fires and associated air quality impacts, and to provide biodiversity benefits. Restoring some of the natural hydrology of the swamp may even help the Norfolk metropolitan area, which is experiencing accelerated erosion, increased vulnerability to storm events, and unstable soils with a drawing down of the water table.

Key Players

The Fish and Wildlife Service is not the only agency making decisions regarding hydrological function, fire management, recreation, and public health associated with the Great Dismal Swamp NWR. Other federal, state, and local agencies involved in these decisions include the U.S. Army Corps of Engineers, the U.S. Department of Transportation, the Virginia Department of Environmental Quality, the North Carolina Department of State Parks, wildlife management agencies in Virginia and North Carolina; two cities, three counties, the Hampton Roads Planning District Commissioner, and the Dismal Swamp State Park.

A longtime nongovernmental partner of the refuge is The Nature Conservancy (TNC), which has helped acquire and transfer lands to the refuge as well as assist with restoration, management, and resilience enhancement efforts. TNC is interested in better characterizing and managing the ecosystem services associated with the refuge.

Other non-governmental partners include the Conservation Fund, the Trust for Public Land, and the Isaac Walton League. In addition, the refuge interacts with business organizations through the Hampton Roads Partnership and the Community Foundation. These partners have not been actively engaged in exploring how to consider ecosystem services concepts in planning and managing the area's natural resources.

FWS is moving toward adopting a landscape conservation design process to ensure that future refuge management plans consider the refuge's broad connected ecological landscape and the inter-dependence of trust resources when making management decisions on a refuge-wide

scale. The plans will reflect an adaptive management philosophy and the collaboration of managers, scientists, and other stakeholders.

Funding and Resources

The United States Geological Survey (USGS) has recently initiated a study to better understand a subset of ecological services associated with the refuge. The study will look at ecosystem services such as carbon sequestration, biodiversity, wildlife viewing, and education that were all identified as providing potentially highly valued services to visitors and surrounding communities.

Needs

As noted above, the FWS Division of Economics has conducted several preliminary studies measuring the ecological services associated with refuge amenities. In general, natural wildlife refuges across the country desire this information to convey the benefits associated with the refuges and conservation-related management, particularly benefits that may not be immediately recognized and that may be difficult to convey without scientific study. This information is particularly important for refuges located in more urban areas, where communities are much more likely to be focused on active use benefits rather than on passive or non-use benefits.

In California and elsewhere, some studies have attempted to account for carbon sequestration in peat and carbon emissions associated with peat losses. As part of its study, the USGS will investigate the feasibility of doing something similar for the Great Dismal Swamp.

Conclusion

Assessing and evaluating ecosystem services associated with the Great Dismal Swamp National Wildlife Refuge—especially, services from restored hydrological function—would help refuge managers communicate the benefits of these services to surrounding communities, (2) work with the Army Corps of Engineers to evaluate trade-offs between the canal's recreational uses and the refuge's water needs, and (3) assess within-refuge trade-offs among carbon sequestration, biodiversity, and public health.

If the economic benefits associated with fewer days of high smoke exposure, including fewer adverse impacts on tourism, could be demonstrated, they might translate into surrounding communities' willingness to support and assist in paying for hydrological restoration.

References

Patton, Douglas, John Bergstrom, Alan Covich, and Rebecca Moore. 2012. *National Wildlife Refuge Wetland Ecosystem Service Valuation Model, Phase 1 Report: An Assessment of Ecosystem Services associated with National Wildlife Refuges*. Prepared for the Division of Refuges and Division of Economics, U.S. Fish and Wildlife Service. University of Georgia. http://www.fws.gov/economics/Discussion%20Papers/USFWS_Ecosystem%20Services_Phase%20I%20Report_04-25-2012.pdf

Rappold, A.G., S.L. Stone, W.E. Cascio, L.M. Neas, V.J. Kilaru, M.S. Carraway, J.J. Szykman, A. Ising, W.E. Cleve, J.T. Meredith, H. Vaughn-Batten, L. Deyneka, and R.B. Devlin. 2011. "Peat Bog Wildfire Smoke Exposure in Rural North Carolina Is Associated with Cardio-Pulmonary Emergency Department Visits Assessed through Syndromic Surveillance." *Environmental Health Perspectives* 119(10):14151420. <http://doi.org/10.1289/ehp.1003206>.

Taylor, Laura O., Xiangping Liu, and Timothy Hamilton. 2012. *Amenity Values of Proximity to National Wildlife Refuges*. Center for Environmental and Resource Economic Policy, North Carolina State University. <http://www.fws.gov/economics/Discussion%20Papers/2012.4.NWRSAMenityReportApril2012withCovers8.pdf>.

Acknowledgments:

The authors thank Great Dismal Swamp National Wildlife Refuge manager Chris Lowie for expertise that made this report possible. Any errors or omissions are solely attributable to the authors.

How to cite:

Scarlett, L., and E. Maillett. 2014. "Incorporating Consideration of Ecosystem Services into Plans for the Great Dismal Swamp National Wildlife Refuge." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

U.S. FISH AND WILDLIFE SERVICE

**Incorporating Consideration of Ecosystem Services
into Plans for the
San Diego National Wildlife Refuge**

Authors

Lynn Scarlett, The Nature Conservancy
Edward Maillett, U.S. Fish and Wildlife Service

Created 2014



Photo courtesy of Lisa Cox, U.S. Fish and Wildlife Service

Developed in 1996, the MSCP is a regional agreement among federal, state, county, and local governments, through which federal Section 10 permits under the Endangered Species Act and California Natural Community Conservation Plan (NCCP) permits accommodate economic development and associated land uses while ensuring the protection of species. The MSCP is intended to preserve habitat, water supplies and water quality, and other features of intact coastal lowland Southern California habitats. The MSCP covers a 900-square-mile area of San Diego County and creates a regional habitat preserve network of some 198,000 acres (of which 175,000 have been established by federal, state, local, and other partners).

Figure 10. San Diego Refuge Complex.



¹ http://www.fws.gov/refuge/san_diego/.

NESPGuidebook.com

Figure 11. San Diego NWR Otoy-Sweetwater Unit.

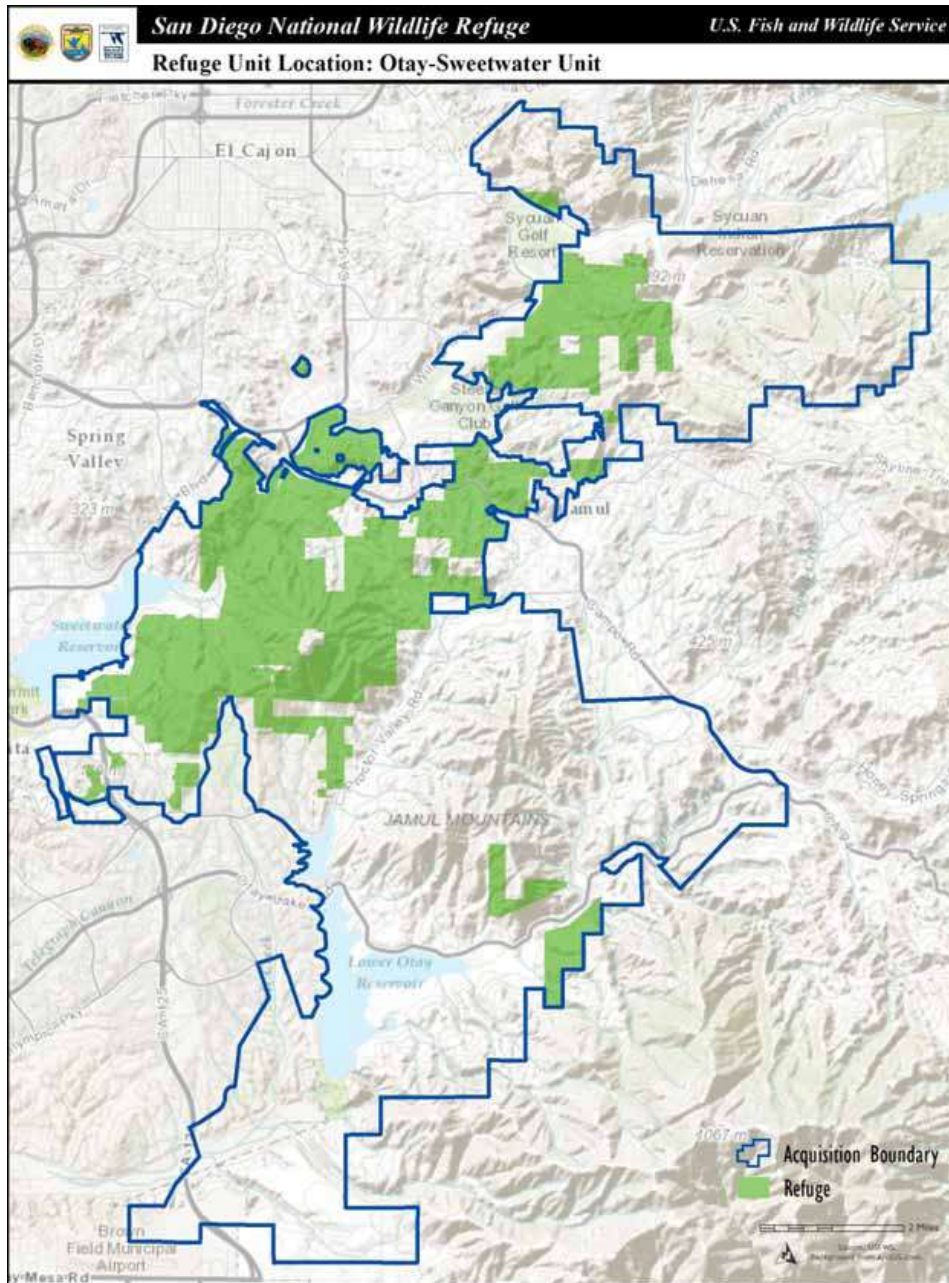


Figure 12. San Diego NWR Del Mar Mesa Vernal Pool Unit.



Two of the three distinctive geographic regions of San Diego County are represented within the San Diego NWR: the low-lying coastal plain and the mountainous Peninsular Range. The flat mesa and steep canyon formations common along the coastal plain characterize the Del Mar Mesa Vernal Pool Unit; the Otay-Sweetwater Unit is characterized by the broad floodplain created by the Sweetwater River and by the steep and rocky foothills of the Peninsular Range. Elevations on Del Mar Mesa range from approximately 320 feet above mean seal level (MSL) in the canyon bottoms to approximately 400 feet about MSL on the mesa. Within the more

topographically diverse Otay-Sweetwater Unit, which includes the McGinty Mountain, Las Montanas, Sweetwater River, San Miguel Mountain, and the Otay Mesa and Lakes management areas, the elevations range from 300 feet MSL to more than 2,300 feet above MSL.

Acquisition of lands for the San Diego NWR began in 1996 to support implementation of the MSCP. The San Diego NWR lies within and adjacent to the second largest city in California and the tenth largest metropolitan area in the United States, with a 2010 population of 1.3 million. Nearly 30% of the population is Hispanic and 16% Asian. Between 2010 and 2014, these populations grew at a faster rate—21% and 24%, respectively—than any other demographic.³ The San Diego Association of Governments, the area’s regional planning agency, projects the total population of the region to increase to more than 1.9 million by 2050.

Management Efforts

Refuge managers and partners perceive potential value in applying an ecosystem services framework to refuge-wide planning and evaluation of management alternatives as well as region-wide priority setting, land acquisition decision making, and communications. Such a framework could inform several management efforts.

At the regional level, the Department of the Interior and the U.S. Forest Service have established the California Desert Southwest Conservation Collaborative to coordinate and focus land acquisitions at the landscape level. Key goals include improved linkages among conserved lands, habitat connectivity, and siting of energy projects to minimize impacts. An ecosystem services framework could enhance consideration and evaluation of how various lands contribute to air and water quality, carbon sequestration, or other benefits to inform priorities and better understand tradeoffs.

Within the southern California region, San Diego, Orange, Riverside, and Imperial counties have multi-species habitat conservation plans, but they are not knitted together into regional efforts. As these urban areas broaden their efforts and seek better coordination, an ecosystem services framework may provide a strategic way to assess multiple goals such as habitat protection, maintenance of water supplies and water quality, stormwater management, and climate mitigation and adaptation.

Under discussion within the San Diego community is a quality-of-life initiative that would add 0.25% to the existing sales tax for open space and related investments. Identifying priority ecosystem services, characterizing them, evaluating them (in narrative terms, monetary terms, or both), and linking them to community needs and uses would help generate support for the initiative, which must be approved by a two-thirds majority vote in a general referendum by the end of 2016. Even if this initiative fails to pass, refuge managers note that state, regional, and local governments will continue to invest in open space land acquisitions as a way to mitigate the impacts of transportation, energy, housing, and other projects. Ecosystem services analyses could be useful in (1) identifying which lands provide the most “value” for “quality-of-life” investments (for example, combining scenic, recreational, air quality, water protection, and habitat protections) and (2) help the various stakeholders complement one another’s initiatives so that the total social return on natural capital investments is maximized.

³ http://www.sandag.org/resources/demographics_and_other_data/demographics/fastfacts/sand.htm.

Within the broader community context, the San Diego NWR is updating its comprehensive conservation plan (CCP). The draft plan provides extensive information on the natural, cultural, and other characteristics of the refuge lands. It also describes impacts or potential threats to the health of these lands and the wildlife associated with them. The CCP does not use an ecosystem services framework to describe and evaluate the benefits the refuge provides to local communities, but it does discuss wildlife conservation, recreation opportunities, viewsheds, and watershed protection as well as the economic benefits of outdoor recreation. Refuge managers believe ecosystem services characterization, prioritization, and valuation could be useful both in communicating refuge benefits and in assessing resource management options and tradeoffs.

Decision Context

The decision context for the San Diego NWR is complex and, as noted above, plays out at multiple decision-making levels, all of which are dealing with the following resource management issues.

Climate Mitigation and Adaptation

In 2006, the state of California passed legislation (A.B. 32) requiring, among other goals, that overall greenhouse gas emissions in the state be reduced to 1990 levels by 2020.⁴ In 2011, the California Air Resources Board adopted cap-and-trade regulatory provisions, which establish market-based decreasing annual aggregate emissions limits for regulated sources or categories of sources that emit greenhouse gas emissions. Protocols for using natural system “offsets,” particularly for the carbon sequestration capacity of forests, have been developed. Less understood is the carbon sequestration potential of grasslands, sage scrub and chaparral, and wetlands of the sort that characterize regions of coastal and inland southern California, including the region covered by the MSCP.

By applying an ecosystem services framework, refuge managers and partners could develop a better understanding of how refuge lands and management contribute to carbon sequestration, which in turn could enhance support for the refuge among partners seeking cost-effective offsets for carbon-emitting activities. These activities are of interest to the city of San Diego, which can make its 2020 carbon reduction goals but which faces an estimated 3.5 million ton shortfall toward meeting its 2035 goals. This shortfall is one part of the county of San Diego’s shortfall in its 2035 goals. The county is looking at a 13.7% reduction over 2005 levels, not the target 49% reduction. Improved understanding of the carbon sequestration role that non-forest natural systems might play and these systems’ relative economic values have increasing policy relevance in future development scenarios.

Transportation Projects and Mitigation

The San Diego Association of Governments (SANDAG), a regional planning entity, established the Environmental Mitigation Program (EMP) for transportation projects to protect, preserve, and restore native habitats as offsets to disturbances caused by regional and local transportation projects.⁵ SANDAG administers TransNet, a regional half-cent sales tax for transportation. Originally approved in 1987 as a 20-year transportation funding initiative, it was extended in 2008 for another 40 years to 2048 and is expected to generate \$14 billion for highway, transit, local road projects, and other transportation improvements. The EMP was created as part of the 2008 TransNet extension, and it budgeted \$650 million for mitigation.

⁴ http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf.

⁵ <http://www.keepsandiegomoving.com/EMP/EMP-intro.aspx>.

The EMP allows SANDAG to purchase land upfront (at relatively low cost and in relatively large parcels) and to bank it for future mitigation needs, rather than purchasing land in small parcels on a project-by-project basis. SANDAG estimates that a traditional project-by-project approach could cost as much as \$850 million over the next 40 years—\$200 million more than the early purchase approach. The latter approach is expected to accelerate project delivery while meeting the mitigation needs of major transportation projects in the Regional Transportation Plan. By September 2012, SANDAG had used EMP funding to purchase more than 3,300 acres of habitat in the San Diego region for approximately \$100 million. EMP funding was also used for research, regional collaboration on land management, post-wildland fire restoration, and other activities.

Neither SANDAG nor the current Regional Transportation Plan use an ecosystem services approach in their analysis of potential mitigation projects. Such an approach could improve the assessment of land parcels and the comparative suite of values they contribute to the community to supplement the more traditional focus on biodiversity and related metrics.

Water Supply, Water Quality, and Stormwater Management

One of the San Diego NWR's key accomplishments is sustaining water quality. Most water for the San Diego region is imported; just 10% comes from local supplies. Nonetheless, these local supplies provide an important contribution to the area's water needs. Refuge lands lie within watersheds that include two local reservoirs, the Sweetwater Reservoir and Lower Otay Reservoir. A key concern of the Sweetwater Authority, prior to purchase of refuge lands, was the potential for reservoir contamination from surface runoff from future development. The Sweetwater Authority is responsible for ensuring safe, reliable sources of drinking water for more than 186,000 residents and had already needed to build one diversion facility to protect the reservoir from contaminated runoff associated with nearby development. It was in the midst of planning a second diversion facility when establishment of the refuge and subsequent protection of lands made that facility unnecessary, saving the Sweetwater Authority and ratepayers more than \$1 million in project costs.

A study that attempted to characterize and evaluate the overall role of refuge lands in helping to sustain water supplies and water quality has yet to be undertaken. The role of the refuge in contributing to the permeable surfaces within the urban area has not been evaluated for its contribution to stormwater management and natural recharge of drinking water wells, many of which are also operated by the Sweetwater Authority. However, in 2003 American Forests examined San Diego's urban ecosystems and, using CITYgreen software, U.S. Forest Service tools, and other models and analyses, estimated a value for city trees and associated permeable surfaces in providing air, stormwater, and carbon benefits. Refuge managers perceive some potential utility in updating this analysis, specifically to examine the refuge to inform decisions about further urban land acquisitions.

Economic Benefits of Open Space

The San Diego NWR conserves more than 11,500 acres of open space in the foothills and valleys at the perimeter of metropolitan San Diego. One potential—but unknown—economic benefit of this open space is its role in reinforcing infill development and development density within the metropolitan area.

Another as-yet unknown economic benefit of the open space is its provision of recreational opportunities. The 2013 *Banking on Nature* report stated that the total monetary value of economic activity generated by recreational visits to national wildlife refuges nationwide in 2011 totaled nearly \$2.4 billion, generating \$792.7 million in job income and 35,058 jobs (Carver and

Caudill 2013). Other studies have concluded that open space in urban areas can increase economic benefits to nearby private property owners more than open space in rural areas and can have a positive effect on adjacent residential property values, leading to higher property tax revenues for local governments.

A key question is whether the open space boundaries resulting from the San Diego NWR also produce economic benefits in terms of higher property values to homeowners, recreation access, or other values and, if so, how this information might influence decisions regarding the extent and location of additional land conservation.

Social Justice

The Otay Water District, city of San Diego, San Diego County, and the city of Chula Vista have pooled resources for a greenway that will serve to protect the Otay River from its headwaters sources all the way to San Diego Bay. The greenway will provide species with a natural corridor along the watershed and will include public use trails transecting a number of minority and low-income neighborhoods. Although the outdoor recreation benefits of the greenway are qualitatively understood, the economic benefits of open space to these neighborhoods have not been characterized or evaluated. These benefits may include reduced air pollution as well as improved water quality, public health, urban aesthetics, and safety (through reduced flood severity). Better understanding of these potential benefits could inform decisions by refuge managers, the cities, and the county about whether and how to expand the greenway system versus use land for other development purposes.

Biodiversity and Habitat Protection

The San Diego NWR provides a contiguous and connected set of protected lands that contribute to maintaining important habitat types and biodiversity. The economic benefits of this service have not been fully characterized or evaluated. An ecosystem services framework could assist refuge managers and others in prioritizing acquisitions of the additional 27,000 acres needed to attain the MSCP goal of protecting 175,000 acres by helping them evaluate the acquisitions' comparative return on investment. Longer term, it could help inform decisions about whether and how to expand the MSCP system beyond that goal, if deemed necessary for future development mitigation.

Shoreline Protection

San Diego County has 70 miles of shoreline. Its coastal communities are evaluating ways to protect it, deal with sea level rise and saltwater intrusion, meet navigation needs, and so on. Better understanding of natural systems strategies, their benefits, tradeoffs, and cost-effectiveness could inform decisions about shoreline management. The San Diego NWR hopes to promote the restoration of properties in south San Diego Bay by sharing information with local governments about the ecosystem services associated with restoration, especially those that may not get counted under a more traditional cost-benefit financial framework.

Key Players

A key question for the San Diego NWR is how and whether it should take a leadership role in incorporating an ecosystem services approach as it works with partners on natural resource management in the region. Neither the refuge nor the main regional decision-making entities have applied an ecosystem services framework to characterize and evaluate natural resources and land management options in any systematic way.

Although the refuge does describe its biodiversity, recreation, view shed, and other benefits of the in its planning documents, it has not assessed them in ecosystem services terms. The city of San Diego has shown strong interest in understanding and considering natural systems in its

planning decisions, an interest reflected in its cooperation with American Forests to use CITYgreen software to assess the air and water quality, carbon, and other benefits of urban tree canopy and permeable surfaces. Several other groups of decision makers, such as those engaged in social justice and transportation planning issues, have not used an ecosystem services framework.

Though many public and private sector decision-makers in the San Diego region do not specifically use an ecosystem services framework, the region (with SANDAG leadership) has pioneered some innovative policy tools that implicitly incorporate “value of nature” considerations. The centerpieces of these efforts are the city of San Diego’s Multiple Species Conservation Program and the San Diego Association of Governments’ Environmental Mitigation Program.

Several state-level activities could drive ecosystem services evaluations, particularly those under Assembly Bill 32: Global Warming Solutions Act (AB 32). This act, which was signed in 2006, led the state to set a limit for greenhouse gas emissions in 2020 at 1990 levels. AB 32 further led the state to adopt cap-and-trade regulation that allows major sources of greenhouse gases to trade enforceable emissions permits with one another as the state gradually lowers the overall emissions cap.

Many nongovernmental organizations and academic institutions are interested in building knowledge about ecosystem services:

- The Nature Conservancy (TNC) has a project on urban forests and their associated ecosystem services. Its Coastal Resilience Network along the Ventura Coast and San Francisco Bay may expand into the San Diego region.
- The Energy Policy Initiative Center at the University of San Diego recently conducted an analysis of regional emissions and strategies to achieve AB 32 targets (Anders 2008). Among other factors, this report explored the role of agriculture, forestry, and land use within the San Diego County as both generators and storage of greenhouse gasses.
- The California Landscape Conservation Cooperative is assessing living shoreline (nature-based) solutions to coastal climate change-related challenges.⁶

Other potential partners that may have an interest in advancing an ecosystem services approach to assessing and evaluating natural systems and informing decisions about priorities and tradeoffs include the California Waterfowl Association, California Coastal Conservancy, and River Partners.

Funding

The San Diego NWR has federally appropriated funding for its planning and management, including preparation of its Comprehensive Conservation Plan. Land acquisitions funding could potentially come from the TransNet EMP, North American Wetlands Conservation Act grants, Landscape Conservation Cooperative grants, and the U.S. Fish and Wildlife Service (FWS).

Existing Resources

The San Diego region and SANDAG have a long history of regional and local planning and have committed extensive resources to developing data sources on demographics, zoning densities, economic trends, water quality and supplies, air quality, land cover, land costs, and so on. The

⁶ <http://californialcc.org>.

city of San Diego has upgraded its vegetation classification data through fine-scale mapping at the one-hectare level. The San Diego NWR Comprehensive Conservation Plan incorporates much of this information as well as draws on its own species and habitat-related databases and state-based information.

The FWS Division of Economics has conducted two pilot studies that could be useful or extended for a more localized study of the San Diego NWR. One study examined the effects on housing values of proximity to a refuge (Taylor, Liu and Hamilton). A second study examined the ecosystem services and valuation associated with four selected refuges across the nation (Patton, Bergstrom, Covich, and Moore 2012). Both studies could serve as a basis for conducting a quantitative assessment of some of the ecosystem services currently provided by the San Diego NWR.

A recent survey of 45 California refuge units suggested that many are looking for assistance to (1) manage pests and invasive species (2) develop habitat management plans and inventorying and monitoring plans, (3) support water resource inventory and assessments, and (5) collect, manage, and analyze GIS and other data.

Options Considered

The San Diego NWR faces resource management issues for which an ecosystem services framework could be useful. These include decisions about how to prioritize acquisition of additional lands, opportunities to contribute to carbon sequestration needs within the context of AB 32, assessment of watershed quality, assessment of shoreline management options, and assessment of options for contributing to urban quality of life. The refuge faces major tradeoffs: provision of recreation access versus protection of biodiversity and habitat benefits for which the refuge was established in the context of the MSCP. An ecosystem services framework could help the refuge strategically manage resources to maximize benefits to trust resources and the general public, thereby fostering popular support for its conservation activities.

Analysis

Some of the San Diego NWR's analysis of its wildlife, water, and recreation benefits provides a building block for ecosystem services analysis. Other organizations have done some work relevant to that analysis. For example, the Energy Policy Initiative Center at the University of San Diego School of Law (EPIC) characterized carbon sequestration provided by natural land cover in the region, and American Forests evaluated some benefits of urban tree canopy. The California Landscape Cooperative Conservation network might partner with the refuge on a pilot project to determine the usefulness of an ecosystem services approach to landscape management.

References

Anders, S., D. DeHaan, N. Silva-Send, S. Tanaka, and L. Tyner. 2008. *San Diego County Greenhouse Gas Inventory: An Analysis of Regional Emissions and Strategies to Achieve AB 32 Targets*. Energy Policy Initiatives Center, University of San Diego School of Law. <http://catcher.sandiego.edu/items/epic/ESPReport1.pdf>.

Carver, E., and J. Caudill. 2013. *Banking on Nature: The Economic Benefits to Local Communities on National Wildlife Refuge Visitation*. Division of Economics, U.S. Fish and Wildlife Service. <http://www.doi.gov/news/loader.cfm?csModule=security/getfile&pageid=380921>.

Patton, D., J. Bergstrom, A. Covich, and R. Moore. 2012. *National Wildlife Refuge Wetland Ecosystem Service Valuation Model, Phase 1 Report: An Assessment of Ecosystem Services associated with National Wildlife Refuges*. Prepared for the Division of Refuges and Division of Economics, U.S. Fish and Wildlife Service. University of Georgia. http://www.fws.gov/economics/Discussion%20Papers/USFWS_Ecosystem%20Services_Phase%20I%20Report_04-25-2012.pdf.

Taylor, L.O., X. Liu, and T. Hamilton. 2012. *Amenity Values of Proximity to National Wildlife Refuges*. Center for Environmental and Resource Economic Policy, North Carolina State University. <http://www.fws.gov/economics/Discussion%20Papers/2012.4.NWRSAmenityReportApril2012withCovers8.pdf>.

How to cite:

Scarlett, L. and E. Maillett. 2014. "Incorporating Consideration of Ecosystem Services into Plans for the San Diego National Wildlife Refuge." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

Acknowledgments:

The authors thank the following individuals for sharing their time and expertise: Jill Terp, refuge manager, San Diego National Wildlife Refuge; Andrew Yuen, project leader, San Diego National Wildlife Refuge Complex, and Bill Tippets, senior project director, The Nature Conservancy. Any errors or omissions in this case study are solely attributable to the authors.

U.S. FISH AND WILDLIFE SERVICE

**Using an Ecosystem Services Management Framework to
Pursue Watershed-Wide Project Priorities in the
Silvio O. Conte National Fish and Wildlife Refuge and
Connecticut River Watershed**

Authors

Lynn Scarlett, The Nature Conservancy
Edward Maillett, U.S. Fish and Wildlife Service

Created 2014



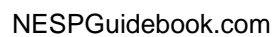
Photo courtesy of U.S. Fish and Wildlife Service

The Silvio O. Conte National Fish and Wildlife Refuge (NFWR) is located in New England's Connecticut River Watershed—New England's largest watershed and home to a diverse group of plant and animal species as well as 400 towns and cities with more than two million residents.¹ The Connecticut River starts in the mountains of northern New Hampshire above Fourth Connecticut Lake near the Canadian border and empties into the Long Island Sound at Old Saybrook and Old Lyme, Connecticut (Figure 13). The 400-some-mile river flows through both rural and urban areas in New Hampshire, Vermont, Massachusetts, and Connecticut.

The waters of the Connecticut River have played an important role in the watershed's history. They powered its mills, factories, cities, and towns; provided transportation for its people and goods; and irrigated its rich farmland. After years of overuse and abuse, the river was dubbed "the most beautiful sewer in the world." Concerned with the high level of pollution, federal, state, and local governments have spent more than \$600 million to clean up the river and improve the quality of its fish and wildlife habitat. Today, the Connecticut River and its tributaries are regaining their status as unique resources that provide habitat for fish, waterfowl, and other wildlife species, including such threatened or endangered species such as the Atlantic and shortnose sturgeon, dwarf wedge mussel, Puritan tiger beetle, Jesup's milk vetch, and small-whorled pogonia. The watershed also provides its residents and visitors many recreation and environmental education opportunities.

¹ <http://www.fws.gov/r5soc/>.

In 1991, the U.S. Congress recognized the uniqueness of the Connecticut River Watershed and called on the U.S. Fish and Wildlife Service (FWS) to establish the first-ever national wildlife



refuge defined by watershed boundaries. Passage of the Silvio O. Conte National Wildlife Refuge Act directed the FWS to form and lead a coalition of partners to work cooperatively to:

- Conserve, protect, and enhance the Connecticut River valley populations of Atlantic salmon, American shad, river herring, shortnose sturgeon, bald eagles, peregrine falcons, osprey, black ducks, and other native species of plants, fish, and wildlife;
- Conserve, protect and enhance the natural diversity and abundance of plant, fish and wildlife species, and the ecosystems upon which these species depend within the refuge;
- Protect species listed as endangered or threatened, or identified as candidates for listing, pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.);
- Restore and maintain the chemical, physical, and biological integrity of wetlands and other waters within the refuge;
- Fulfill the international treaty obligations of the United States relating to fish and wildlife and wetlands; and
- Provide opportunities for scientific research, environmental education, and fish and wildlife-oriented recreation and access to the extent compatible with the other purposes stated in this section.²

As of June 2012, the refuge comprised approximately 36,000 acres extending from northern Vermont and New Hampshire to southern Connecticut. The Nulhegan Basin Division in Vermont's Northeast Kingdom accounts for 26,738 acres and is the largest tract in the refuge. The smallest tract, Third Island, is only 3.8 acres in Massachusetts.

Critical Issues

The Silvio O Conte NFWR faces seven critical issues—how best to:

- Protect rural working landscapes and minimize impacts on agriculture and forestry practices;
- Educate people about their co-dependent relationship with the environmental and biological amenities of the watershed, a task that may require development of different strategies for rural, suburban, and urban residents;
- Keep the water in the Connecticut River and its tributaries clean for human health and recreation, biological diversity, and wetlands functionality;
- Identify and remove barriers that critically impede passage for fish and other species within the watershed, a task that may require replacement of old culverts with archway passages and Remove dams that are no longer productive;
- Improve public access to the Connecticut River and its tributaries to improve recreational opportunities (hunting, fishing, and wildlife viewing);
- Develop partnerships with state and local groups to identify and prioritize needs; and
- Control invasive species.
-

Motivation for Exploring an Ecosystem Services Management Framework

Since passage of the Silvio O. Conte National Wildlife Refuge Act, the FWS has formed many productive partnerships but lacks a framework through which partner groups can reach agreements on how best to pursue watershed-wide project priorities. The FWS believes an ecosystem services management framework can be useful in coordinating work on three of

² http://www.fws.gov/r5soc/library/about/Conte_NFWR_Act.pdf; <http://www.fws.gov/Endangered/pdfs/esaall.pdf>.

these priorities: controlling for catastrophic flooding events, protecting ecosystem services endangered by agricultural use of land area along the Connecticut River, and improving environmental education and outreach capabilities.

In 2011, Hurricane Irene caused an estimated \$1.2 billion in significant flooding and damage to the communities in the upper watershed states. In Vermont, culverts and bridges were not able to handle the increased flows associated with the storm and more than 200 bridges and 500 miles of roads were damaged or destroyed. Six Vermont residents lost their lives, and thousands were left homeless. Ninety percent of the state's 251 towns suffered infrastructure damage.³ The storm awakened communities to the need to design and build infrastructure more in tune with natural systems.

Heavy conversion to agricultural use of land area along the Connecticut River in Vermont, New Hampshire, and Massachusetts has left little natural area for floodplain protection. Expanding the riparian corridor along the Connecticut River would help to limit runoff into the Connecticut River during large flooding events, and it would help absorb high runoff, acting as a protective barrier to downstream communities and property. In addition, widened riparian barriers would help to absorb agricultural runoff and reduce sedimentation, thus keeping the river waters cleaner, providing important habitat for birds and animals, and potentially serving as a public access point or trail system.

Because the Connecticut River lacks any consist public right-of-way along its banks, connecting people with the assets the FWS is working to protect is difficult. Development of an ecosystem services management framework could improve environmental education and outreach, one of the establishing purposes of the Silvio O. Conte NFWR.

Decision Context

With regard to adopting an ecosystem services framework, the FWS has two decision contexts.

Enhancing Communication and Community Support

The first motivation for applying an ecosystem services framework is to garner support for land use planning and management actions, which requires the FWS to communicate the benefits of ecosystem services to partners and the 400 individual, autonomous communities in the Connecticut River watershed. This task presents challenges from a resource perspective. One strategy that the service has adopted is to group communities into sub-watersheds. It has found that community leaders and citizens find it much easier to identify with their local watersheds than with the entire basin and that they are more readily able to understand and accept ecosystem services management that is framed within a sub-regional spatial scale.

Developing an ecosystem services framework would also greatly help the FWS Northeast Region better compete for Land and Water Conservation Fund dollars. These monies flow from oil and gas development royalties and are used to help protect highly valued, at-risk natural lands. Because the price of land is relatively higher in the northeastern United States than in other areas of the country, the Northeast Region can conserve a smaller amount of acreage with allotted monies than other FWS regions. The irony is that the high price of real estate in the northeastern United States reflects a large number of competing uses for the land from a populace that is also much larger than other areas of the country. Consequently, small acreages can have large flows of ecosystem services in the northeast due to the larger affected

³ http://www.huffingtonpost.com/2013/08/28/hurricane-irene-2-years-later_n_3827088.html.

population than larger acreages in less populated areas. An accounting of ecosystem services flows could help the region better justify high dollar purchases of relatively smaller parcels given the potentially larger flow of associated services to the impacted community.

Land acquisition, a traditional conservation tool, is limited to a few high priority sites in the Silvio O. Conte NFWR. The refuge also uses innovative partnerships to improve conservation efforts, investigate important questions, foster conservation leadership, and educate citizens about critical issues. In these ways, the refuge serves as a leader and catalyst to help citizens protect the Connecticut River watershed's special nature and pass it on to future generations.

Enhancing Use of Natural Solutions

The second motivation for applying an ecosystem services framework is to help local communities better understand and evaluate options for providing flood protection and water quality. In the wake of Hurricane Irene, there are local pressures to rebuild culverts using traditional design practices, yet some empirical evidence suggests that restoring wildlife-friendly corridors could offer benefits both for fishing and for flood management. The U.S. Forest Service began removing old-style culverts some years ago. Areas in which these changes were made suffered far less damage from flooding, erosion, and sedimentation than those areas still served by traditional culverts.⁴ Although the up-front costs of the wildlife-friendly culverts exceed those of traditional culverts, their life-cycle costs may be lower. In addition, the wildlife-friendly culverts provide other ecosystem services, including contributions to enhanced fish populations. Coupling these benefits with avoided costs from flood damage may make the wildlife-friendly culverts cost-effective.

In addition to options for re-designing culverts, there may be opportunities to re-manage, reconnect, and restore more natural river flows and, as a result, enhance the ecosystem services. However, assessing these opportunities requires a more complete understanding of ecosystem services benefits as well as trade-offs associated with dam removal.

Partnership Efforts

Federal agencies, non-profits, and academia are working with the FWS to protect and restore the lands and waters of the Connecticut River Watershed and to understand the ecosystem services associated with that effort. With the North Atlantic Landscape Conservation Cooperative, in which the Silvio O. Conte NFWR lies, the FWS has initiated an in-depth landscape conservation design pilot study to develop and provide tools and information to guide decision makers and inform conservation actions to more effectively address threats, limiting factors, and uncertainties.⁵ The study will also help decision makers efficiently achieve objectives and ensure functional systems under current and predicted future conditions as well as link site-scale actions to landscape and regional-scale goals.

The FWS is working with the University of Massachusetts Northeast Climate Science Center to understand the effects of a changing climate on the frequency and intensity of precipitation events, impacts on agricultural practices, impacts on fish and wildlife, invasive species, and forest resilience.⁶

The University of Massachusetts Civil and Environmental Engineering Department is developing a basin- wide hydrological model of the Connecticut River system. Its model will help decision

⁴ Gillespie, N., et.al., "Economic and Ecological Benefits of Stream Simulation Designs." *Fisheries* 39 (2).

⁵ <http://northatlanticlcc.org/>.

⁶ <http://necsc.umass.edu/>.

makers better understand how changes in water flows and timing will affect ecosystem services, including hydropower production, flood control, water supplies, and recreational uses.

The Nature Conservancy (TNC) operates the Connecticut River Program, which promotes the conservation and restoration of lands and watersheds throughout the basin for the betterment of the communities, fish, and wildlife in the four-state area.⁷ The program has three main strategies. The first is restoring more natural water flows. To do this, TNC has been identifying dams that critically impede natural flows, adversely affecting downstream systems and migratory passage for fish and wildlife. The second strategy is reconnecting all of the waterways in the system. Many of the smaller tributaries have been diked, damned, or impeded by improperly sized culverts that have collectively blocked important spawning and nesting habitat for native fish and dependent species. The third strategy is protecting and restoring the remnant floodplain forests of the Connecticut River and its tributaries. This lack of a natural buffer has intensified flooding impacts on downstream communities.

The Trust for Public Lands (TPL) has conserved more than 170,000 acres in the Connecticut River Watershed.⁸ These acres comprise farmlands with highly productive soils; cold-water fishery habitats, especially those capable of supporting Eastern Brook Trout; and open spaces that benefit local communities.

The non-profit Connecticut River Council, established in 1952, develops programs to educate the public about the watershed's importance, works to remove barriers to fish passage, gets involved in dam relicensing activities to ensure that operations are balanced with protections and improvements for the river, and advocates for reducing the flow of untreated sewage and runoff from surrounding communities into the river system.⁹

Funding

Various funding sources help sustain conservation activities in the Connecticut River watershed. At a national level, funding for planning comes from landscape conservation cooperatives, land and water conservation funds, wildlife refuge system appropriations, and other grants from federal, state, and local agencies as well as from nonprofit foundations. Many of the non-profit entities are funded through private donors. State and local funding is limited due to existing economic conditions. The U.S. Army Corps of Engineers owns and operates 14 flood control dams in the watershed and provides funding for their operations and repairs. Other dams are owned by electric utilities, other private-sector entities, and state and local governments. Some funds for culvert repairs and replacement after Hurricane Irene came from the Federal Emergency Management Agency, but there are restrictions on the use of such funds, in particular, on whether they can be used for natural infrastructure and redesign of culverts.

The Natural Resources Conservation Service within the U.S. Department of Agriculture offers a variety of incentives for land conservation.¹⁰ Landowners and farmers can qualify for financial, technical, and educational assistance through the following programs:

- Agricultural Management Assistance: funds cost-share projects for addressing erosion, water quality, and other matters

⁷ <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/connecticut/connecticutriver/>.

⁸ <http://www.tpl.org/our-work/land-and-water/connecticut-river>.

⁹ <http://www.criver.org/>.

¹⁰ <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/>.

- Conservation Reserve Program: pays rent for land to protect erodible and environmentally sensitive lands
- Conservation Reserve Enhancement Program: retires lands to address specific environmental concerns
- Environmental Quality Incentives Program: funds reduction of pesticides and herbicide use, livestock waste management, and more
- Farmland Protection Program: funds the purchase of development rights to keep productive land in agriculture
- Wetlands Reserve Program: reimburses landowners for restoring and protecting wetlands
- Wildlife Habitat Incentives Program: funds cost-share projects and provides assistance for wildlife habitat development

Grants for habitat restoration projects can also be obtained from a variety of other non-federal sources, including the National Fish and Wildlife Foundation, the American Sportfishing Association, American Rivers, and the Upper Connecticut River Mitigation and Enhancement Fund.

Options and Trade-offs

Because the Silvio O. Conte NFWR must be managed at a watershed level, the FWS confronts countless trade-offs in determining how best to expend its limited resources to optimize returns for the natural communities that it is required to preserve, protect, and enhance. To successfully achieve this objective, it must also consider how its activities might affect the needs of and the livelihood and economic opportunities of 2.3 million people, a task complicated by that population's spatial and demographic diversity. Upstream management actions often have large potential returns as the benefits flow downstream; however, these actions often come at a disproportionate cost to the smaller upstream communities.

Development of an ecosystem services management framework could help better frame trade-offs and opportunities. Even evaluations of trade-offs in small-scale projects could benefit from consideration of associated ecosystem services. Partners must reach case-by-case agreement on the ecological and economic returns to replacing culverts, dismantling or changing the operational structure of dams, and protecting lands through purchase or easements. An ecosystem services management framework would provide the language to articulate the level of services and the distribution of benefits and costs attributable to project proposals or actions.

At the 2009 Governor's Conference, New England governors agreed to develop land conservation initiatives that would keep farmlands in farming, keep forests as forests, connect people to the outdoors, protect wildlife habitat, and safeguard coastal and estuarine lands. Achieving these objectives—particularly given funding limitations—will require advances in how to think of trade-offs and opportunity costs using an ecosystem services management framework. Use of such a framework in decision making would help all parties efficiently achieve the governors' goals.

Efforts to Understand the Provision and Beneficiaries of Ecosystem Services

Several efforts are ongoing to improve understanding of the provision and beneficiaries of ecosystem services in the Connecticut River Watershed.

The Water Resources, Climate, and Society at the University of Massachusetts is developing detailed models of the watershed to better understand its complex hydrology and how climate

change and changes in socio-economic conditions factor into hydrological changes.¹¹ The objectives of one of the group's projects, being conducted in cooperation with The Nature Conservancy and the U.S. Army Corps of Engineers, are to

- Create micro-models of regional climate conditions and scenarios to better understand the effects on sub-watersheds of changing conditions of precipitation events;
- Construct seasonal streamflow forecasting capabilities so that water managers can improve their ability to manage reservoir releases;
- Develop decision support tools to guide river operations with the express goal of optimizing river flows under current conditions and streamflow forecasts for power production, flood control, water supply, and replication of natural streamflow conditions; and
- Encourage stakeholder involvement by developing a basin-wide hydrological model that will be accepted by stakeholder groups as a reasonable and unbiased tool for guiding decisions to manage flow operations to optimize power production, flood control, water supply, and natural flows for the benefit of native species.

Development of this model entails many smaller research projects designed to provide important data for modeling the watershed. One such project, designed and funded with the help of The Nature Conservancy, is the Mitchell Brook Culvert Replacement Study. This study is designed to reveal the importance of restoring small stream tributaries for fish passage. Thus far, data suggest that small streams are very important refuges for native species such as Eastern Brook trout. The small tributaries provide important refuge for small fry from larger predators, allowing them a greater chance to survive to adulthood. Small tributaries also offer shelter during high water runoff events in main channel streams. The study is also examining the effects of culvert replacement on the viability of roads during flood events. Replacing small, undersized culverts with larger, bottomless culverts that allow year-long fish passage also allows more water to flow downstream without backing up behind undersized culverts and blowing out roads. The Mitchell Brook study will help determine the cost-effectiveness of replacing the watershed's tens of thousands of improperly designed culverts.

The Nature Conservancy has also funded a study that examines the feasibility of valuing the natural infrastructure in the Connecticut River.¹² The study specifically considered how best to value the river's remaining floodplains from an ecosystem services perspective. Services provided by the floodplains include contributions to water quality, carbon sequestration, and recreation.

Finally, as noted above, the U.S. Fish and Wildlife Service is initiating a study that will consider how best to develop a basin-wide landscape conservation design for the Connecticut River Valley. The goal is to optimize a sustainable natural environment and ecosystem for native plants, fish, and animals while accommodating sustainable, natural growth of local economies.

¹¹ <http://cee.umass.edu/water-climate-society>.

¹² K. Johnson, *Floodplains by Design: Valuing Natural Infrastructure in the Connecticut River*. North America Freshwater Program.

Acknowledgments:

The authors are extremely grateful to the following individuals: Nancy McGarigal, refuge planner, Northeast Region, U.S. Fish and Wildlife Service; Kimberly Lutz, director, Connecticut River Program, The Nature Conservancy; Richard Palmer, university director, Northeast Climate Center, University of Massachusetts; and Keith Nislow, Northern Forest Research Station, U.S. Forest Service. Any errors or omissions contained in this report are solely attributable to the authors.

How to cite:

Scarlett, L., and E. Maillett. 2014. "Using an Ecosystem Services Management Framework to Pursue Watershed-Wide Project Priorities in the Silvio O. Conte National Fish and Wildlife Refuge and Connecticut River Watershed." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

U.S. Forest Service

Application of Ecosystem Services Concepts to Planning and Implementation Processes in the Inyo, Sierra, and Sequoia National Forests

Authors

Debra Whittall, U.S. Department of Agriculture Forest Service
Mark Metcalfe, U.S. Department of Agriculture Forest Service
Joe Stringer, Retired, U.S. Department of Agriculture Forest Service
David Saah, Spatial Informatics Group and University of San Francisco

Created 2014



Motivation

Provision of ecosystem services is a major objective of a new planning rule adopted by the U.S. Department of Agriculture (USDA) Forest Service for the development of National Forest System (NFS) land management plans. The 2012 Planning Rule states:

The purpose of this part [36 CRF 219.1(c)] is to guide the collaborative and science-based development, amendment, and revision of land management plans that promote the ecological integrity of national forests and grasslands and other administrative units of the NFS. Plans will guide management of NFS lands so that they are ecologically sustainable and contribute to social and economic sustainability; consist of ecosystems and watersheds with ecological integrity and diverse plant and animal communities; and have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future. These benefits include clean air and water; habitat for fish, wildlife, and plant communities; and opportunities for recreational, spiritual, educational, and cultural benefits.¹

Once forest plans are developed consistent with this rule, they will provide direction for all management activities occurring on NFS lands.

Decision Context

The 2012 Planning Rule establishes an iterative planning process for NFS lands. The first step is an assessment of existing trends and conditions in the planning area, followed by an evaluation to determine if current management requires change. This information is used to develop a proposed revised forest plan in conjunction with an environmental impact statement prepared according to National Environmental Policy Act (NEPA) procedures.² The information is also used to consider alternative approaches to address management needs and evaluate environmental impacts, including economic and social effects.

Once a revised plan is adopted, the plan is implemented through management activities designed to meet objectives established in the plan and move the project area toward desired conditions. These management activities are developed through site-specific analysis following NEPA procedures. Monitoring plans help determine whether these objectives are satisfied. The monitoring provides information used in evaluating possible adaptive management strategies to better meet plan objectives or in determining to amend the plan.

Location

The Forest Service is applying ecosystem services concepts to planning and implementation processes at three national forests in the Pacific Southwest Region: Inyo, Sierra, and Sequoia.

¹ http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362536.pdf. Ecosystem services are defined in the 2012 Planning Rule as “Benefits people obtain from ecosystems, including: (1) *Provisioning services*, such as clean air and fresh water, energy, fuel, forage, fiber, and minerals; (2) *Regulating services*, such as long term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood control; and disease regulation; (3) *Supporting services*, such as pollination, seed dispersal, soil formation, and nutrient cycling; and (4) *Cultural services*, such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences and tourism opportunities.” 36 CFR 219.19.

² <http://ceq.hss.doe.gov/>.

As part of the region's forest plan revision process, the agency completed several documents to better understand the current conditions and trends relating to forest lands in the southern Sierra Nevada. These documents, released in 2013, are described below.

Bio-regional Assessment: This assessment takes a holistic look at the landscapes in and around 10 Sierra Nevada national forests.³ It addresses water quality and quantity, fire resilience, sustainable recreation, ecological integrity, and community resilience—services that cross administrative and political boundaries, thus highlighting the importance of interagency, intergovernmental (tribal), and public-private coordination of management goals and actions.

Forest Assessments: These assessments provide an understanding of the existing ecological, economic, and social conditions relating to current land management on a specific national forest. They offer ground-level, forest-specific views of 15 topic areas detailed in the *Living Assessment* at the *Our Forest Place* website.⁴

Science Synthesis: This synthesis is a science-based document that integrates the best current science about social, economic, and ecological resources across the Sierra Nevada. This document is reviewed by scientists and provides a scientific context for land managers making resource decisions about forest uses.

Key Players

To organize for forest plan revision under the 2012 Planning Rule, the region established the following roles:

- **Responsible Official:** Forest supervisors oversee the planning process for their units and are responsible for developing a revised plan and environmental impact statement (EIS) in accordance with the 2012 Planning Rule and NEPA. They utilize their leadership teams as needed to establish forest priorities to meet planning objectives and timelines.
- **Forest Plan Steering Committee:** The committee is composed of supervisors from those forests engaged in forest plan revision and up to three regional directors. It provides for the oversight of the regional revision process, offers strategic guidance for collaboration, and thinks critically and collaboratively to provide direction and to develop strategies for accomplishing plan revision and resolving emerging issues of process, substance, and organization.
- **Regional Planning Director:** This director provides strategic vision and overall leadership and management of the region's revision process. He or she also serves as chair of the Forest Plan Steering Committee.
- **Regional Directors:** These directors are responsible for providing program direction and staff support throughout the plan revision process to ensure that programs are consistent with the direction in the 2012 Planning Rule and directives for the appropriate program area.
- **Collaboration and Communication Leader (Regional Social Scientist):** This leader ensures development and implementation of collaboration and communication plans.
- **Regional Planning Team Leader:** This leader ensures timely completion of planning process documents in compliance with legal and regulatory requirements; coordinates all phases of work among forest planners, regional program managers, and the regional

³ These forests include the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sierra, Sequoia, and Inyo national forests as well as the Lake Tahoe Basin Management Unit.

⁴ <http://ourforestplace.ning.com/>.

planning team; and ensures planning documents reflect a scope and scale appropriate to the requirements of the planning rule and directives.

- **Regional Planning Team (RPT):** This team is composed of a team leader, an ecologist, an economist, a social scientist, a wildlife biologist, a hydrologist, a recreation planner, and a writer/editor. It serves as the principle interdisciplinary team for forest plan revisions across the region.
- **Forest Planners:** These planners provide forest-level coordination and communication with the forest supervisor, forest leadership team, forest staff, stakeholders, and regional planning team on the forest plan revision.
- **Regional and Forest-level Program Specialists (Extended Interdisciplinary Team):** These specialists complement the RPT and assist with the development of forest planning work products as necessary.

The region realizes that management of the national forests overlaps with important responsibilities of other state and federal agencies in California. To enhance alignment of forest planning with the roles and responsibilities of other agencies, the region has engaged agencies early and frequently as the plan revision process continues and especially as the environmental impact statement is developed.

The External Agency Coordination Plan describes the framework that is being used to coordinate forest plan revisions for the Sierra, Sequoia, and Inyo national forests with other government agencies. The forest supervisors coordinate with their counterparts in other agencies when the agencies have local offices near the national forests. The regional planning staff has the primary responsibility for coordinating with the headquarters offices that are located in Sacramento or San Francisco.

The plan recognizes two distinct types of relationships with other agencies: those that have direct responsibilities with national forest planning and those with overlapping or parallel responsibilities with forest planning. National forest planning is guided by many federal laws and regulations administered by other federal agencies. The federal Endangered Species Act is administered by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration Fisheries Service. Compliance with NEPA, including the reviews of environmental impact statements, is the responsibility of the U.S. Environmental Protection Agency. The EPA is also responsible for overseeing states' administration of the Clean Air Act and Clean Water Act.

Some state agencies have additional responsibilities within California government for tracking national forest planning. The California Natural Resources Agency is responsible for overseeing natural resource programs for the entire state. The California Board of Forestry and Fire Protection is responsible for assessing federal forest management for the California Legislature and Office of the Governor. The California Department of Forestry and Fire Protection (Cal Fire) is a partner agency with the Forest Service in overseeing and managing wildland fire protection and forest management programs in California.⁵ The California Department of Fish and Wildlife has jurisdiction over the vast majority of plants and animals in the state, and the Department of Water Resources directs water management for California. In addition, the California Air Resources Board and the California Water Quality Control Board are responsible for overseeing implementation of the federal Clean Air Act and Clean Water Act, respectively. The State

⁵ <http://www.fire.ca.gov/>.

Historic Preservation Office has responsibility for ensuring compliance with the National Historic Preservation Act.

Many other government agencies manage programs that overlap with or influence national forest management. For example, the National Park Service, the Bureau of Land Management, and the California Department of Parks and Recreation manage public forests and rangelands near the Sierra, Sequoia, and Inyo national forests in the southern Sierra Nevada. The California Department of Transportation manages state highways on national forests, and the Sierra Nevada Conservancy invests considerable state funds on public forests. Many county governments are also affected by the management of national forests in their areas.

Alignment of national forest management with the work of these agencies is desirable. The region also plans to engage the agencies early and often during the forest plan revision work for the Sierra, Sequoia, and Inyo national forests. The primary venue for updating state and federal agencies will be through bimonthly briefings to the California Biodiversity Council's Interagency Alignment Team (IAT). The regional planning staff will be responsible for these briefings. Supervisors of the Sierra, Sequoia, and Inyo national forests will coordinate work with county governments and local offices of state and federal agencies.

In February 2010, the Forest Service and the University of California convened a conference on pre- and post-wildfire forest management for restoration and resiliency. At the close of the conference, participants provided recommendations for additional discussion and work that can be categorized into four broad topic areas: strategic fuels treatments across landscapes with mixed ownerships, adaptive management, increasing public and agency education, and ecosystem services. The Forest Service and stakeholders formed a new collaborative working group in California: the Sierra-Cascades Dialogue Group.⁶

The group considers both public and private lands in an "all lands" approach to planning and conservation (i.e., all land within the Sierra Nevada bio-region, irrespective of jurisdictional or ownership boundaries). It seeks to deepen understanding, build trust, and strengthen relationships among participants with diverse positions to improve the capacity of the Forest Service and its stakeholders to reach supportable decisions. As of June 2014, the group had held 13 dialogues, averaging 140 participants and representing a range of interest groups such as county governments, locally elected officials, environmental organizations, fire safety councils, industry, public land managers, private landowners, recreation groups, rural community governments, scientists, state government, tribes, and water agencies. All dialogues are open to the public. The organizers are committed to achieve age, cultural, geographic, and socio-economic diversity among participants.

The dialogues are based on best practices in the field of public participation (Bohm 1996; Carpenter and Kennedy 1988; Innes and Booher 2010; Straus 2002). Each dialogue includes a professional facilitator who has natural resource planning experience and who also has advanced training in conflict analysis and resolution, a Forest Service social scientist who serves as the convener, and a 20-member steering committee that is responsible for designing the dialogue sessions.

The Sierra-Cascades Dialogue Group is grappling with topics of significance to the Sierra Nevada bio-region, including ecological restoration, improvement of social and economic conditions in rural communities, use of best available scientific information, and access and

⁶ <http://www.fs.usda.gov/detail/r5/workingtogether/?cid=stelprdb5349218>.

recreation. Importantly, outcomes from the dialogues lead to development of the bio-regional assessment and the science synthesis, neither of which are required by the 2012 Planning Rule yet were identified by dialogue participants as important in achieving effective forest planning.

Existing Resources

Existing information has been leveraged in several ways:

In a science synthesis report, the Pacific Southwest Research distilled recent peer-reviewed science to promote better understanding of current management challenges. The report focuses on published literature that represents significant advances in thinking about particular challenges, including ecosystem services.

Breaking from traditional public involvement strategies, the Regional Office developed a unique web-based planning tool called “Our Forest Place” and the “Living Assessment” to encourage stakeholders to play an active role in developing bio-regional and forest-level assessments.⁷ These online tools allow stakeholders to communicate with one another and effectively assist the agency in writing current condition and trend assessments.

Organizational Capacity

The Forest Service is recognizing the need for improved transitions between outgoing and incoming leaders. Good transition management between the agency leader with whom groups have been working and the new leader is especially important. Capacity to solve natural resource-related problems over the long run depends on the quality of long-term relationships among agencies, other organizations, and the public.

Throughout the revision process, key vacancies and a series of acting assignments have impeded the continuity of plan revision actions. Without this continuity, an aggressive timeline began to dominate the plan revision process. To meet interim milestones, public involvement was curtailed. Because of the reduction in public involvement, stakeholders as well as agency staff felt their input was not heard, leading to a reduced level of trust both internally and externally. Opposition to shortened public involvement and internal tensions eventually led to the extension of the timeline. Interim managers are needed to ensure that leadership is kept abreast of real-time tradeoffs among timelines, public expectations, and employees’ work-life balance.

Assessment of Ecosystem Services

Using information from the science synthesis, the Sierra Cascades Dialogue, and the “Living Assessment,” the Regional Planning Team wrote a draft assessment of ecosystem services in the bio-region of the Sierra Nevada. This assessment compiled and analyzed existing internal and external information to identify the landscapes across the bioregion that provide key ecosystem services and to ascertain the condition of the services in these locations with respect to wildfire, vegetation disease, and mortality.⁸

The objective of this assessment was to illuminate both the provision (supply) and the use (demand) of the bio-region’s ecosystem services, setting the stage for development of transparent land management actions and alternatives to achieve the desired conditions

⁷ <http://ourforestplace.ning.com/>; <http://livingassessment.wikispaces.com/>.

⁸ The methodologies and findings of this assessment are detailed in *DRAFT Ecosystem Services for the Bioregion – A Summary for Forest Plan Revision*, an unpublished 2013 report on file with the U.S. Department of Agriculture Forest Service Region 5, Vallejo, California..

identified in the forest plan revision. For example, identifying the underlying resources important to the provision of a service allows for identification of the appropriate metrics and data to define the resources' current condition and for determination of the resources' health, whether declining, stable, or improving. Management alternatives can then be evaluated in terms of how they affect the provision of ecosystem services and the benefits to people arising from improved conditions.⁹

The assessment focused on ecosystem services (1) most important to people in the broad landscape, (2) most affected by the land management plan, and (3) considered final ecosystem goods or services. *Final ecosystem goods and services* are defined as components of nature directly enjoyed, consumed, or used to yield human wellbeing. Their benefits (e.g., water purification and recreation) result from their direct enjoyment or use by the public. They are not processes, which are more difficult to relate to benefits (e.g., pollination and nutrient cycling are critically important to people, but we have little direct connection to these services so it is difficult to directly experience their value). Both of these characteristics make the concept of ecosystem services more understandable and relatable to traditional market goods, which in turn makes it easier to talk about, measure, and communicate the benefits of these services to people (Landers et al. 2012; Boyd and Banzhaf 2007).

The Bio-regional Assessment examined the following ecosystem services:

- Provisioning services (timber, grazing, energy—biomass, geothermal, hydropower, and wind/solar)
- Cultural services (recreation, aesthetics, cultural heritage, sense of place)
- Regulating services (water quality, water regulation, carbon sequestration and regulation, fire resilience)
- Supporting services (biodiversity)

Many other services that provide an important benefit to people (e.g., food, genetic resources, medicines and pharmaceuticals, and air quality) may be added to this analysis.

Analysis

Once the landscapes that are important for the provision of ecosystem services are identified, the current health of the processes and resources that support their provision must be determined. This work highlights those landscapes that are a priority for action to ensure continuation of the benefits provided by ecosystem services. The declining health of an underlying resource that supports a service places provision of the service in jeopardy. For example, decreasing vegetative cover threatens the benefits obtained from carbon sequestration.

Information from the assessment on ecosystem services will be used to

- Develop **roles and contributions** documents that highlight the benefits people obtain from forest ecosystem services;
- Identify the risk of interruption or loss of these benefits and therefore identify the **need to change** forest plans to better ensure sustainability of ecosystem services;

⁹ The assessment was quickly conducted according to the 2012 Planning Rule and uses only immediately available data. It identified data gaps so that they could be revisited.

- Identify the **indicators** that can be used to examine the potential environmental consequences of alternate actions to meet the analytical requirements in NEPA; and
- Establish post-plan revision **monitoring programs** on the basis of these ecosystem service metrics.

Tradeoffs

Analysis for environmental consequences entails understanding the effects that management alternatives will have on ecological, social, and economic resources and the resulting implications for forest ecosystem services. That is, management alternatives that effect resources such as vegetation, air, soils, rivers, wildlife, and meadows will affect benefits to people such as forest products, water quality, grazing, biodiversity, energy generation, recreation, and scenery.

Part of the Forest Service's analysis process is developing a means-ends approach to clarify these connections between management alternatives and outcomes to benefits. Such an approach will allow the Forest Service to identify the impacts and tradeoffs of given management alternatives, understand how resulting changes in resource conditions relate to changes in benefits, and identify how those changes to benefits can be measured. Individual resource specialists will conduct their analysis within this framework to determine environmental consequences of management alternatives. The means-ends approach being developed for this effort has additional benefits for forest plan revision:

- **Integration** of ecological, economic, and social factors as effects on resources (the ecological) are directly connected to benefits to people (the economic and social),
- Establishment of a **transparent analysis process** that highlights the connections between management actions and outcomes and that can be shared during collaboration,
- Identification of **key indicators** that will be important in monitoring and implementing adaptive management strategies, and
- Use of the framework at the programmatic plan revision level to **maintain consistency at the project level** once revised plans are in effect.

Such an approach is not without its challenges, namely, data gaps, decision making in the absence of a common measure of effects (e.g., wildlife habitat may be measured in acres, timber in board feet, recreation in visitor days, and carbon sequestration in tons of carbon), and uncertainty in the face of incomplete information and differing scientific opinion.

Implications

Uncharacteristic wildfires threaten to interrupt or remove altogether the landscape's ability to provide the benefits obtained from ecosystem services. The Forest Service examined this threat to ecosystem services in order to demonstrate how assessment information can be used to inform forest planning and management. Preliminary results indicate that the following lands in the bio-region are at risk for uncharacteristic fire:

- 99% of the important timber-producing land;
- 90% of the important carbon sequestration land;
- 74% of the land with the most valuable assets for protecting water quality;
- 87% of the land with the most valuable assets for supporting water supply;
- 89% of the Forest Service recreation facilities;
- 91% of the locations in the bio-region that provide habitat for important ethno-botanical species for cultural heritage uses;
- 62% of the land important to providing terrestrial biodiversity;
- 86% of the land important to providing aquatic biodiversity;
- 83% of the land with high potential for providing solar energy, 46 percent of the land with high potential for wind energy, and 97 percent of the land with high potential for geothermal energy; and
- 45% of existing hydroelectric facilities and 23 percent of the acres in existing electricity transmission corridors.

Planning and management can utilize this assessment information to determine the need for planning alternatives and management options that reduce the potential interruption and loss of services on these lands. This information can also be used to prioritize management activities to reduce risk on those landscapes that simultaneously provide multiple services as well as to inform the monitoring necessary to ensure the services' sustainability.

Public Participation and Collaboration

The goal of the national forest plan revision process is to develop, consistent with legal mandates, forest plans responsive to those who are affected by or have an interest in the management of the forests. The 2012 Planning Rule requires each national forest to provide meaningful opportunities for public participation throughout the plan revision process (36 CFR § 219.4).

The most appropriate public participation methods are determined on the basis of the phase of planning, the work product, budget, and staff capacity. These methods are

- Informing—providing participants and the general public with balanced and objective information and assisting them in understanding work products prepared as part of the planning process.
- Consulting—obtaining participants' feedback on draft work products.
- Involving—working directly with participants to ensure that their concerns and aspirations are consistently understood and considered in the development of work products.
- Collaborating—working directly with participants in preparing to make decisions at various points within the planning process, including (but not limited to) development of alternatives and identification of a preferred alternative. The communication and collaboration leader will create opportunities for dialogue to

explore different perspectives, balance a variety of needs, and identify areas of common ground that can inform draft work products.

Work products may include information on legal and regulatory requirements and the planning process, lists of available scientific information, summaries of trends in forest conditions and drivers of forest change, and alternatives for analysis.

Independent research has also contributed to the collaborative process. The University of Queensland–Australia and the University of California–Berkeley conducted a public participation geographic information system (PPGIS) study to better understand stakeholder values as they relate to locations in the Sierra, Sequoia, and Inyo national forests (Brown, Kelly, and Whittall 2013). The Sierra Nevada Values Mapping Project discovered, described, and documented the nature and extent of the values that the public finds within the Sierra, Sequoia, and Inyo national forests. It created a website (www.landscapemap2.org/sierra) to allow members of the public to identify the places they value and share their views about what they consider important about the three forests. Users dragged and dropped markers onto a Google® Map of the national forest study area. Each respondent's contribution was combined with other respondents' contributions to ensure that no contribution was individually identifiable. The study was submitted as public input to the Sierra, Sequoia, and Inyo national forests' ongoing forest plan revision efforts.

The Forest Service Pacific Southwest Region has begun working with underserved communities, particularly Latinos, the largest population group in the counties associated with the Sierra, Sequoia and Inyo national forests. In 2013, it entered into a contract with Voces Inc. to develop a Latino engagement guide for forest plan revisions. The guide reflects data collected from Latinos in a small focus group representing the national profile of Latinos as well as in-depth, in-person interviews with nearly 50 Latinos in the San Joaquin Valley. An overwhelming fact emerged: Very few Latinos know what the national forests are or where the nearest one is located. Most have no personal experience with them. Consequently, Latinos will be mostly unable to give meaningful input to national forests plans. To gather meaningful input from Latinos, the Forest Service must first help the Latino community gain awareness of and knowledge about national forests.

Significant trust issues and barriers exist between most parts of the Latino community and governmental entities. To engage the Latino community, the Forest Service is identifying community leaders and recruiting them to serve as trusted community contacts.

Youth have proven to be excellent trusted community contacts within the Latino, African American, and Hmong communities in the southern Sierras. Initially, youth participated in Forest Service-sponsored workshops designed to identify their core values and the connection of those values with a forested landscape. The exercise begins with an explanation of the concept of Gross National Happiness, used in the country of Bhutan, to define prosperity in healthy terms and to measure actual wellbeing rather than consumption. Participants are able to draw conclusions about their own connections to forested land by answering three questions: What makes you happy? How is that happiness is connected to the land? What rules would everyone have to live by to ensure happiness?

The workshops have demonstrated the strong connection urban youth have to the land

and enabled them to share this connection with friends and family. Participants have increased their confidence and are better able to voice their opinions during public workshops on forest plan revision.

More than 100 tribes, both federally recognized and non-federally recognized, exist in California. These tribes are the original land managers of our public lands and provide a wealth of traditional knowledge critical to building resilient communities and forested ecosystems. The Forest Service honors the government-to-government relationship with federally recognized tribes and seeks their involvement as well as that of non-federally recognized tribes throughout the forest plan revision process. A Forest Service tribal liaison coordinates quarterly tribal forums. The success of these forums hinges on attendance by a line officer, a traditional blessing given by one of the tribal elders at the forum opening and closing, written materials, a meeting space organized so that all participants can face one another, encouragement of active listening and storytelling, and follow through on commitments.

References

- Bohm, D. 1996. *On Dialogue*. New York: Routledge.
- Boyd, J., and S. Banzhaf. 2007. "What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units." *Ecological Economics* 63: 616–626.
- Brown, G., M. Kelly, and D. Whittall. 2013. "Which 'Public'? Sampling Effects in Public Participation GIS (PPGIS) and Volunteered Geographic Information (VGI) Systems for Public Lands Management." *Journal of Environmental Planning and Management*. doi:10.1080/09640568.2012.741045.
- Carpenter, S., and W.J.D. Kennedy. 1988. *Managing Public Disputes*. San Francisco: Jossey-Bass.
- Innes, J., and D. Booher. 2010. *Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy*. New York: Routledge.
- Landers, D., A. Nahlik, and P. Ringold. 2012. "Ecosystem Services ... a Tricky Path Forward to Implementation: Why? How Do We Proceed?" Environmental Protection Agency Western Ecology Division presentation to NSC&NHC, April 24.
- Straus, D. 2002. *How to Make Collaboration Work*. San Francisco: Berrett Koehler.

How to cite:

Whittall, D., M. Metcalfe, J. Stringer, and D. Saah. 2014. "Application of Ecosystem Services Concepts to Planning and Implementation Processes in the Inyo, Sierra, and Sequoia National Forests." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

National Oceanic and Atmospheric Administration

**Sustaining Ecosystem Services
across Public and Private Lands:
The Cool Soda All Lands Restoration Proposal**

Author

Nikola Smith, U.S. Forest Service

Created 2014



Photo courtesy of Johan Hogervorst

Motivation

The Willamette National Forest (WNF) is one of two forests in the U.S. Forest Service (USFS) Pacific Northwest Region pioneering an ecosystem services (ES) approach to project-level planning. Following a workshop presenting preliminary work on such an approach at the Deschutes National Forest (DNF) (see agency example 7), WNF supervisor Meg Mitchell and WNF staff implemented a project-level case study in the Sweet Home Ranger District. This project focuses on the 10,000-acre Soda Fork Creek drainage in the upper South Santiam River in Linn County, Oregon. The planning area was named “Cool Soda” due to the proximity of Cool Camp, an historic trail shelter and later a logging camp located at the top of the Soda Fork watershed.

The USFS’s application of ES concepts to WNF and DNF project-level planning reflects three objectives: to highlight the goods and services provided by forests to people; to encourage integrated, outcomes-based approaches to resource management; and to support collaborative project visioning, development, and implementation. The USFS is also interested in how national forests can contribute to sustainable economic development, including through recreation, tourism, and diversified forest products. By emphasizing connections between economic resilience and ecological resilience, an ES planning approach can inform decisions about how to sustainably manage lands for public benefit.

Decision Context

The Cool Soda case study takes an “all lands” approach, meaning it addresses management opportunities across all ownerships in the planning area. Under the Forest Service Planning Rule, such an approach engages the public “early and often to build a common understanding of the roles, values and contributions of NFS [National Forest Service] lands within the broader landscape.”¹ This process emphasizes participation by local citizens, subject-matter experts, and stakeholders to share understanding of landscape-scale ecological processes across ownerships and to identify community values in forest restoration.

The Cool Soda case study takes an ES approach to inform planning as well as strengthen communication about the intent and rationale for Forest Service management actions. Cascade Timber Consulting, a manager of privately owned timberlands in a checkerboard pattern with the national forest, is a key collaborator in the study, as is the South Santiam Watershed Council. The opportunity to work across jurisdictions is a strong driver of the project, with dual objectives to improve landscape outcomes and create and sustain jobs in the rural community of Sweet Home, Oregon.

Location

The project area was chosen for its checkerboard ownership pattern, which is 40% national forest and 60% private timberland managed by Cascade Timber Consulting (CTC) for Hill Family Properties. For the past 100 years, CTC and the Forest Service have had a cooperative relationship concerning management of roads, tree genetic research, and noxious weeds. Given this historic positive relationship, CTC, the Sweet Home Ranger District, and the South Santiam Watershed Council initiated the project to apply ES concepts in a collaborative “all lands” approach to forest management. A primary objective of the process was to frame management objectives in terms of ecosystem services provided across jurisdictions.

¹<http://planningrule.blogs.usda.gov/2010/07/16/all-lands-approach/>

In the Cool Soda planning area, vegetation consists of western hemlock and Pacific silver fir plant associations, with a small mountain hemlock component. The fire regime is a combination of mixed severity and stand replacement. The area includes existing and potential habitat for Upper Willamette River Spring Chinook and Upper Willamette River Winter Steelhead, anadromous fish native to the region that are listed as threatened under the Endangered Species Act. The landscape also includes sites sacred to Native American tribes as well as historic “way trails” that served as important trade routes for the area’s earliest inhabitants.

Through the late 1980s, management of public lands and of private lands was very similar. Many miles of roads across ownerships are under long-term cost share agreements, meaning they are maintained jointly by the WNF and CTC. In 1994, the Northwest Forest Plan (NWFP) was adopted for the federal forests within the range of the Northern Spotted Owl. The plan shifted focus from timber harvest to a combination of ecological restoration and resource protection. Under the NWFP, the lands in the Cool Soda area are predominantly characterized as “matrix,” meaning their management emphasizes timber production outside of stream-side riparian reserves. The mixed public/private ownership of the area offers a unique opportunity to cooperatively develop a restoration plan to sustain ecosystem services across a diverse landscape.

Key Players

The Sweet Home Ranger District designed a series of four workshops to inform the planning process as well as a “knowledge transfer week,” during which experts shared key information regarding physical sciences, vegetation, wildlife, aquatics, and social/cultural components of the landscape. Federal, state, and local agencies were involved as knowledge transfer presenters, workshop participants, or both. They included the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, National Marine Fisheries Service, Oregon Department of Fish and Wildlife, Oregon Department of Forestry, Oregon Department of Environmental Quality, Linn County Parks Department, and the Linn County Board of Commissioners. Although federal agencies shared their national perspectives, the process emphasized a local and regional focus.

Involvement was voluntary, though consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service during the National Environmental Policy Act (NEPA) process will be required under the Endangered Species Act to assess the potential impacts of proposed management actions on threatened species, including the Northern Spotted Owl, Upper Willamette River Chinook Salmon, and Upper Willamette River Steelhead.

Non-governmental organizations, businesses, and consultants were involved as presenters, workshop participants, or both and included the Oregon Forest Resources Institute, Forest Service Employees for Environmental Ethics, American Forest Resource Council, Melcher Logging, Sweet Home Economic Development Group, Oregon Wild, Cascadia Wildlands, Rocky Mountain Elk Foundation, University of Oregon, Oregon State University, and Portland State University. Private citizens were also active in the process.

The USFS Pacific Northwest Region’s lead soil scientist and the Sweet Home District Ranger triggered the analysis by their desire to demonstrate the use of a participatory planning process that applied ecosystem services concepts. The Cool Soda Core Team, with representation from key disciplines, was designated to draft the restoration plan in coordination with other staff. The team was co-led by the WNF hydrologist and the Sweet Home Ranger District planner. Additional team members included the district’s wildlife biologist, hydrologist, fisheries

biologist, recreation and cultural coordinator, and the Pacific Northwest Region's ecosystem services specialist. Representatives from Cascade Timber Consulting and the South Santiam Watershed Council also served as members. The team coordinated the analysis with other Forest Service staff, including representatives from timber, special forest products, botany, silviculture, ecology, geology, soils, cultural resources, fire and fuels, and public affairs. The USFS Pacific Northwest Research Station also prepared presentations for Knowledge Transfer Week and participated in workshops.

Programmatic responsibility was shared by the Cool Soda Core Team as well as staff at the district and regional levels. The team designed workshops to incorporate stakeholder priorities and adjacent land management objectives. Cascade Timber Consulting has jurisdiction over activities on private lands in the planning area and has already begun wildlife habitat improvements. The District Ranger will ultimately select the proposed management actions on national forest lands, which will be implemented by Forest Service staff, with possible support from partners and local citizens. Stream restoration projects and culvert upsizing have been assessed through NEPA as categorical exclusions. Large wood stream restoration was completed in August 2013. Culvert upsizing to allow fish spawning gravel to move downstream is expected to be completed in summer of 2014. The Oregon Watershed Enhancement Board, USFS, and the South Santiam Watershed Council jointly funded a fish habitat improvement project described in a USFS [video](#). Vegetation management projects will be evaluated through NEPA using an environmental assessment, which is expected to be released for public comment in 2014 and implemented beginning in 2015. Projects included in the assessment are bough and timber harvest, huckleberry planting, wildlife browse enhancement, and fuel reduction treatments.

Existing Resources

The Cool Soda project planning process was designed by the Cool Soda Core Team under the mentorship of the regional soil scientist, who had implemented participatory planning for projects in the Siuslaw National Forest, and with the assistance of the regional ecosystem services specialist, who helped integrate ecosystem services components. The team primarily relied on tools and data sources generated by or readily available to the USFS, including Landtype Association Mapping, which set the stage for understanding the geological and ecological drivers in the area.² NetMap, a community-based watershed science system developed by Earth Systems Institute, was used to assess potential fish habitat distribution.³ This modeling was supplemented by field collection of hydrologic and fish habitat-related data. Potential natural vegetation mapping, which identifies the plant community reflecting the capability of a land area, informed understanding of vegetation types, historical range of variability, and fire regimes.⁴ The team also had access to Gradient Nearest Neighbor (GNN) mapping of existing vegetation to determine the project area's structural condition. Field-stand exam data informed assessments of timber volume.⁵ Field surveys, particularly for the red tree vole, helped the team understand which of the mature forest areas were occupied by threatened and endangered species.

² Land type associations (LTAs) integrate both biotic and abiotic factors at eco-region delineations (1:100,000) and provide information about how landscapes are formed based on geology, geomorphology, soils, and climate. LTAs help managers comprehend the arrangement, patterns, and capacities of various portions of a landscape as well as the main drivers of ecological processes. The USFS Pacific Northwest Region LTAs are being mapped and described. Please contact Karen Bennett, regional soil scientist, at kabennet@fs.fed.us for current information.

³ <http://www.netmaptools.org>

⁴ http://ecoshare.info/uploads/gis/swovz120309_metadata.htm

⁵ <http://www.fsl.orst.edu/lemma/main.php?project=imap&id=home>

Tools and methodologies developed by the Deschutes National Forest were also consulted in trade-off assessments. To minimize trade-offs, the team considered specific locations on the landscape where ecological structures, processes, and functions could best support particular land uses or objectives. The team used these ecological attributes to characterize the inherent capacity of a site to provide ecosystem services under properly functioning conditions. Ultimately, the team tied the ES assessment to priorities that emerged from collaborative workshops, linked those priorities to the inherent capacity of the planning area or particular features in that area, and recommended projects and outcomes on the basis of that capacity. Overall, this effort, conceived by the team, was conducted “from the ground up.”

Development of the Cool Soda Restoration Proposal was financed directly or in kind by three USFS deputy areas: the Pacific Northwest Research Station, State and Private Forestry, and the National Forest System. The Pacific Northwest Regional Office contributed the staff time of the regional soil scientist and ecosystem services specialist. The WNF hydrologist provided leadership, and the WNF assistant fisheries biologist was a member of the team. The Forest Service also financed publication of the proposal, which has been used to increase exposure for the project and attract outside funding for implementation. The Oregon Department of Fish and Wildlife, the Oregon Watershed Enhancement Board, the South Santiam Watershed Council, and other partners have contributed funds for project implementation on public and private land in the planning area.

The WNF forest supervisor recognized that allowing the Sweet Home Ranger District to experiment with a novel planning process would result in higher up-front costs for NEPA as well as delay production of accomplishment targets. However, the intent of the project is to make a greater initial investment in collaborative planning with the expectation that doing so increases public participation and trust early in project development. This participatory approach has the potential to enhance project implementation by fostering stakeholder confidence in the management proposal and by leveraging the support of partners and stakeholders. Cascade Timber Consulting and the South Santiam Watershed Council also generously contributed employee expertise to Core Team meetings and workshops, and this joint-ownership greatly strengthened the potential of the restoration proposal.

Organizational Capacity

ES programming and case studies are strongly supported by the WNF forest supervisor and Sweet Home District Ranger as well as by the USFS Pacific Northwest Regional Office. Leadership’s interest in the potential of an ES approach to add value to public land management is a primary driver of this work. The Forest Service as a whole is beginning to formalize consideration of ecosystem services in land management policy, including its 2012 planning rule. The agency has convened a national team to develop relevant resources for managers.

As federal budgets and staffing levels decrease, the agency needs to pursue efficient and cost-effective approaches to ES assessment to minimize burdens on employees. Because the cadre of USFS economists is particularly small, the agency can benefit from training in methodologies for valuing ecosystem services in quantitative and qualitative as well as monetary and non-monetary terms as appropriate. Within the National Forest System, it would be most useful to train managers in how to tie their understanding of the ecology of a landscape to the ecosystem services it provides. This understanding would support holistic, sustainable approaches to multiple-use management beyond economic valuation. Federal land managers

need to increase their ability to map and understand ecosystem services provided by specific landscape components and to appreciate differences across landscapes and management alternatives.

Training options include (1) development of a mobile team of staff within or across regions to help national forest and district staff conduct ES analysis and (2) training of key staff, particularly in natural resource specialties (hydrology, soils, wildlife, fish, vegetation), at regional and forest levels. Engaging external experts in this information exchange would help the USFS learn from innovation in other organizations and sectors. Training across federal agencies would also reduce duplication and promote consistency.

A significant organizational constraint faced by the Forest Service is a budgetary structure that inadvertently creates siloed approaches to resource management and accomplishment reporting by establishing separate budgets and performance targets for individual resource programs (timber, recreation, aquatics, and so on). An ES approach can support and be supported by integrated, outcomes-based budgeting and performance measures that articulate the goods and services provided by ecological systems as well as by management coordinated across resource program areas.

Options Considered

A primary aim of the Cool Soda all lands approach was to characterize the inherent capacity of the landscape to provide ecosystem services, to compare that capacity to current conditions, to highlight how forest management activities affect ecosystem services, and to design a restoration proposal that sustains those services. Through a collaborative process (see below), management objectives were organized into three thematic areas: streams and wild fish, forests and wildlife, and community and culture. The Forest Service team and workshop participants identified projects to address those objectives and to highlight ecosystem services, or benefits from nature, that would be supported by those projects. Table 4 provides examples of objectives, projects, and benefits from nature that were outlined.

Table 4. Benefits from Nature.

Objectives	Potential Projects	Benefits from Nature
<i>Streams and Wild Fish</i>		
<ul style="list-style-type: none"> • Recover steelhead and Chinook habitat • Minimize road impacts on aquatics • Maintain upland and riparian large wood sources 	<ul style="list-style-type: none"> • In-stream wood placement • Riparian vegetation enhancement • Culvert replacement to improve wood and gravel routing • Culvert replacement to restore aquatic organism passage • Road sidecast pullback 	<ul style="list-style-type: none"> • Wild fish • Clean cold water • Aquatic species diversity and habitat • Traditional and cultural uses • Aesthetics • Recreation
<i>Forests and Wildlife</i>		
<ul style="list-style-type: none"> • Promote tree growth and forest health • Enhance high-quality early seral habitat • Develop wildlife travel corridors • Minimize introduction and spread of invasive species 	<ul style="list-style-type: none"> • Timber harvest • Thinning to enhance forest complexity and diversity • Vegetation treatment to enhance early seral habitat • Planting of high-quality forage • Meadow and wetland restoration • Snag and down wood creation • Invasive species control 	<ul style="list-style-type: none"> • Timber products • Traditional and cultural special forest products • Native plant species diversity • Wildlife species diversity • Clean water • Aesthetics and spiritual values • Climate regulation
<i>Community and Culture</i>		
<ul style="list-style-type: none"> • Foster collaborative approaches to land management • Decrease fire risk • Enhance and protect tribal resources • Maintain administrative and public access • Provide recreation opportunities • Support a sustainable natural resource-based economy 	<ul style="list-style-type: none"> • Partnerships with schools, businesses, and user groups • Land exchange (to protect tribal sacred sites) • Traditional burning • Cooperative road management • Fuel reduction • Harvest special forest products • Interpretive signs • Trail development 	<ul style="list-style-type: none"> • Timber products • Clean water • Wildlife species diversity and habitat • Traditional cultural and special forest products • Recreation • Aesthetics and spiritual values • Environmental education • Public health • Jobs

The Cool Soda all lands approach was structured around several assessments and workshops. At five days of knowledge transfer sessions, referred to as Knowledge Sharing Week, 38 experts from the Forest Service (Research and Development and National Forest System), other federal agencies, academic institutions, and non-governmental organizations shared key information about the planning area with the Cool Soda Core Team on:

- physical sciences (geology, geomorphology, soils)
- vegetation (plant associations, rare and sensitive plant species, forest health)
- wildlife (habitats, threatened and endangered species)
- social/cultural matters (tribal history and current uses, local economic concerns)
- aquatics (hydrology, stream system dynamics, aquatic habitats, water quality issues)

The team built on information communicated during Knowledge Sharing Week and presented key ideas in a stakeholder workshop to explore the inherent capacity of the landscape. The ES concept was communicated in terms of “benefits from nature” that the planning area provides. The core team made connections between the sub-watershed’s structure and intrinsic capacity to provide those benefits. The team also shared a preliminary list of services (Table 4), which workshop participants refined and prioritized.

The existing condition of the landscape was presented at a subsequent workshop. It was characterized in terms of historic land uses, natural disturbances, and field data collection. Core team members prepared information on landscape challenges (e.g., densely stocked vegetation, lack of diversity in early seral habitat, limited recreation opportunities, landslide threats, undersized culverts), compared them to desired conditions, and proposed management activities for moving the landscape toward those conditions. Initial ideas were shared at a collaborative workshop for further refinement and development by constituents. The collectively designed restoration proposal was then presented to stakeholders at a final workshop.

The collaborative process described above shaped planning outcomes in several ways. For example, Cascade Timber Consulting’s concerns about loss of vegetation on plantations due to elk forage contributed to the district’s recommendations for enhancing an elk habitat corridor on public lands. The district also designed fire breaks to protect private timber. For its part, CTC agreed to plant native nutrient shrubs and limit herbicide use to restore the understory on private lands. The district and CTC are pursuing a joint permitting system for special forest products harvesting. Priorities expressed by other stakeholders included development of trail networks, fuel wood gathering, and enhancement of cultural resources, including huckleberry and cedar.

The interdisciplinary and holistic nature of the landscape assessment contributed to integrated project design. Vegetation management projects were not solely driven by timber objectives but were informed by goals for recreation, wildlife habitat, cultural values, and watershed functions. This multi-faceted approach, described in the full restoration proposal, did not compromise forest product goals but did strengthen social license for implementation by emphasizing how vegetation treatments support a variety of landscape functions.

Analysis

The project workshops identified demand for services and public values. The ecological production of ecological services was characterized in terms of connections among landscape structures, processes, and functions. Core team members drew on the above-described data sources on vegetation characteristics (potential and current), fish distribution (NetMap), and hydrological models (USGS StreamStats and NetMap). They also consulted satellite imagery, field data, and the input of experts who participated in Knowledge Sharing Week. They used this information to identify landscape features and locations that had the potential to provide ecological services, such as flat, open areas for elk habitat or vegetation conducive to special

forest products. They designed management actions to build on these services. In addition to proposing management activities, the team characterized the potential outcomes of those actions—for example, the percent of a wildlife corridor that would be restored or the total cubic yards of sedimentation that would be avoided. These potential outcomes provided context for each action and highlighted its importance and impact.

Trade-Offs

Many of the ideas to sustain ecosystem services in the Cool Soda planning area emerged from collaborative workshops and information about benefits provided by the sub-watershed. Creating a forum for information exchange increased stakeholders' understanding of the landscape, enhanced their appreciation for diverse perspectives, and highlighted the fact that the USFS is working to sustain multiple ecosystem services across the sub-watershed and to minimize trade-offs. The core team aimed to maximize beneficial outcomes by proposing management activities in locations that are most conducive to positive results for specific resources or ES objectives. For example, the team recommended a culvert replacement to remove the last remaining human-caused fish habitat blockage in the sub-watershed and to restore the flow of durable gravels, which supply critical spawning substrate to endangered species. In terms of traditional USFS accomplishment reporting, this action would have been described as simply restoring 0.25 mile of stream, omitting its importance for fish or water quality. The team also highlighted activities that will support ecosystem services across resource areas. Fire breaks, for example, reduce fire risk, protect private property, produce commercial timber products, create needed open areas for early seral species and cultural resources like huckleberry, and can be developed into mountain bike trails. Because a primary goal of the project was to sustainably manage the landscape while supporting the Sweet Home community, the restoration proposal also highlighted the potential employment opportunities that would result from management actions. The goal was to serve as many management objectives as possible, but to do so in a site-specific fashion, according to the inherent capacity and current condition of specific locations or landscape features.

Implications

The Cool Soda process emphasized the participatory proposal development phase of NEPA to create restoration recommendations that are strongly informed by stakeholder and expert input. This process creates broad ownership in land management planning. Engaging constituents in workshops throughout the process also increases transparency and improves information sharing about the rationale for Forest Service management objectives and actions.

Forest Service staff began their assessment with an understanding of the inherent capacity of the landscape and aimed to sustain a range of ecosystem services appropriate to that landscape, rather than driving the planning process with single-resource objectives. This interdisciplinary approach highlighted connections among landscape structures, ecological processes and functions, and public benefits, and it informed spatially explicit planning to enhance beneficial outcomes and minimize trade-offs. The resulting restoration proposal was in plain language, highlighted benefits provided by the Cool Soda area, and demonstrated how stakeholder input was applied. The district plans to use a similarly simple, easily understood style throughout the NEPA process to promote information exchange and public participation in project-level forest management.

The Cool Soda process initiated a larger collaborative land management effort in Linn County, in particular, development of the South Santiam Community Forest Corridor in cooperation with representatives of federal, state, county, and private organizations. Oregon governor John

Kitzhaber designated this venture an Oregon Solutions project, which supports priority community governance endeavors. The USFS Pacific Northwest Regional Office contributed \$10,000 to help with staffing and implementation. The Sweet Home Ranger District also worked with Linn County and other partners to receive a grant from the Federal Lands Access Program. Funds will be used to assess the livability of Sweet Home as a gateway to public lands. These successes demonstrate how relationships developed in ecosystem services projects can leverage additional resources for restoration and natural resource management across sectors and landscapes.

Acknowledgments:

Participants in and contributors to the Cool Soda All Lands Restoration Proposal process include the USFS Core Team (Karen Bennett, Johan Hogervorst, Anita Leach, Tiffany Young, Jon Meier, Lance Gatchell, Brett Blundon, Kimberly Hoover, and Jeremy Hobson), the Cascade Timber Consulting Core Team (Dave Furtwangler, Bill Marshall, and Milt Moran), and Eric Hartstein of the South Santiam Watershed Council.

The restoration proposal was developed through workshops with stakeholders from numerous federal, state, and local agencies, academic institutions, economic development organizations, and non-governmental organizations. The leadership of Meg Mitchell, Willamette National Forest supervisor, and Cindy Glick, Sweet Home district ranger, was instrumental in this innovative approach to forest management.

How to cite:

Smith, N. 2014. "Sustaining Ecosystem Services across Public and Private Lands: The Cool Soda All Lands Restoration Proposal." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

U.S. FOREST SERVICE

An Ecosystem Services Approach to Management of a Complex Landscape: The Marsh Project

Authors

Tim Foley, U.S. Forest Service
Joe Bowles, U.S. Forest Service
Nikola Smith, U.S. Forest Service
Pete Caligiuri, The Nature Conservancy

Created 2014



Photo Courtesy of Laura Crane, The Nature Conservancy

Introduction and Location

In 2012, the Department of Interior (DOI) established the Solar Energy Program, as approved through the Record of Decision (ROD) for the Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS).

Geographically, the program covers approximately 100 million acres and 89 Bureau of Land Management (BLM) land-use planning units in Arizona, California, Colorado, Nevada, New Mexico, and Utah (see Figure 14). As described in the Solar PEIS, the program defined how utility-scale solar energy would be considered and developed on public lands administered by the BLM.

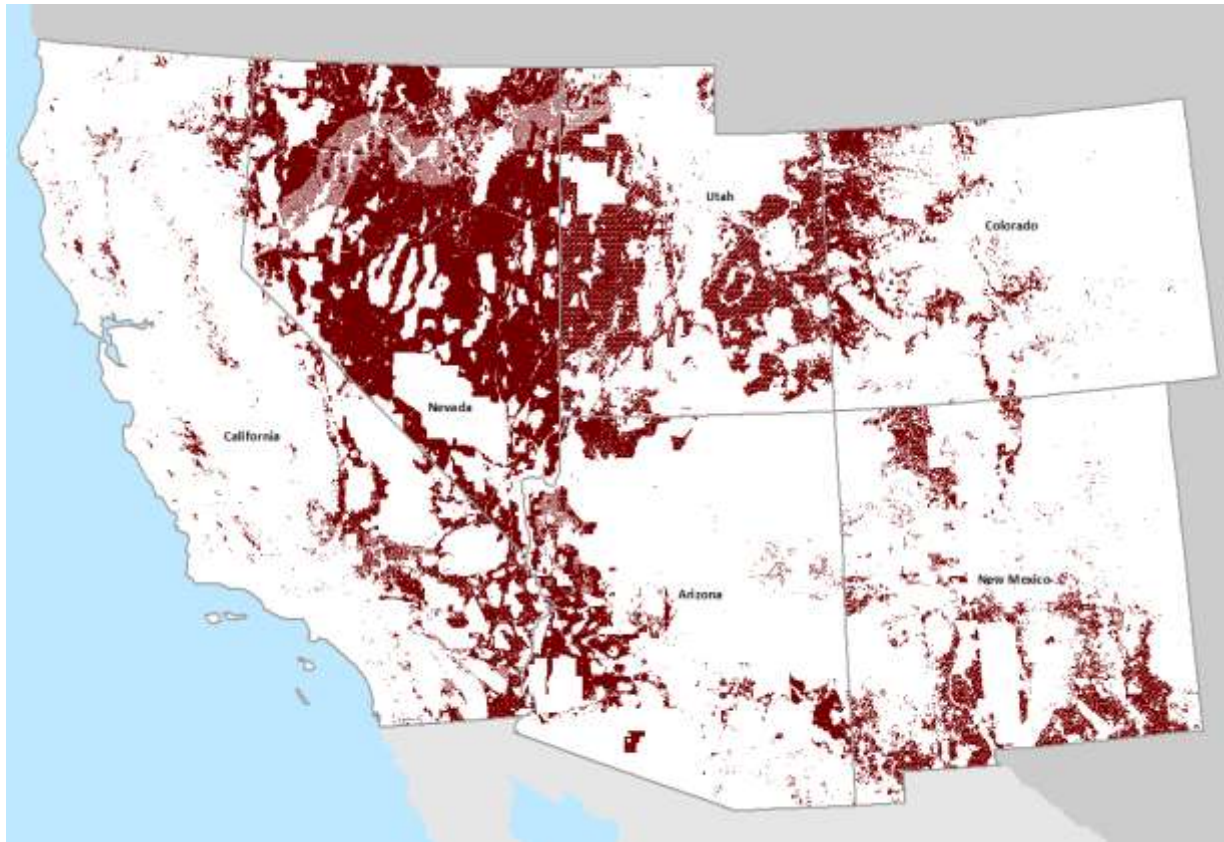
Further, the program established solar energy right-of-way authorization policies and required environmental impact minimization measures, or “design features,” for industry use on public lands. In terms of public lands allocation, the program also defined three types of land use zones in relation to utility-scale solar energy: (1) *exclusion areas* or BLM lands where utility-scale solar energy is not allowed (79 million acres); (2) *variance areas* as well as a variance process defining where and how solar energy might be considered case by case on the basis of environmental concerns and a more localized, regional analysis (19 million acres); and (3) initial *solar energy zones* (SEZs), where solar energy development is the priority land use allocation (285,000 acres). At the time of the ROD, the initial SEZs would provide enough land, if developed, to power 7 million homes with clean energy.¹

Utility-scale solar energy development often requires new infrastructure, including the solar installation plus associated infrastructure such as power lines and substations, to be built on large acreages (1–9 acres/MW). If not sited carefully, this infrastructure can pose serious threats to wildlife, habitats, and water resources. However, with smart planning, including intelligent siting and design features, it is possible to develop clean, renewable energy while also protecting ecosystem function and ecosystem services. In the locations covered by the Solar Energy Program, key ecosystem services and functions include protection of clean air, carbon sequestration from plants and microbiotic soils, and other regulating services; protection of clean water and recharge of groundwater aquifers through maintenance of soil stability and hydrologic function and other critical provisioning services; and sustained protection of wildlife, habitats and corridors to maintain biodiversity, and other supporting services. Additionally, the program considers recreation, open space, views, and tribal sacred space—all a fundamental component of cultural identity in the U.S. west.

The Solar Energy Program offers a framework for integrating these ecosystem services at both a larger, regional scale and at a more local or project-level scale. For example, decisions about where to prioritize the siting of utility-scale solar energy development as well as key areas that should be avoided due to ecosystem services-related conflicts (i.e., sustained biodiversity, recreational settings, or tribal sacred areas) occur at a regional level. Decisions about where to invest in nature to offset the unavoidable impacts of development also happen at a regional level, as do decisions about whether solar energy is appropriate in the variance lands. Finally, decisions about further minimizing impacts from development activities and ongoing operations occur at a local level.

¹ Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern State, Bureau of Land Management, October 2012 (ROD, October 2012).

Figure 14. Public Lands Included in the Solar Energy Program.



Source: The Nature Conservancy.

Motivation

The BLM and the U.S. Department of Energy (DOE), through its Energy Efficiency and Renewable Energy Program, initiated the Solar Energy Program in 2008. At the time, the BLM was overwhelmed with a large number of permit applications for utility-scale solar energy project proposals, particularly in Arizona, California, and Nevada. The Solar PEIS document notes that the BLM was answering the “need to respond in a more efficient and effective manner to the high interest in siting utility-scale solar energy development on public lands and to ensure consistent application of mitigation measures; avoidance, minimization, and compensation for the unavoidable impacts of such development.”²

The BLM was also responding to multiple congressional and administrative mandates to increase renewable energy production on its lands, while meeting its Federal Land Policy and Management Act of 1976 (FLPMA) mandate: “the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people without permanent impairment of the productivity of the land and the quality of the environment.”³

² ROD, October 2012

³ The Federal Land Policy and Management Act of 1976 Public Law 94-579; <http://www.blm.gov/flpma/FLPMA.pdf>.

Related renewable energy mandates include the following:

- In Executive Order 13212, Actions to Expedite Energy-Related Projects, the President ordered that executive departments and agencies “...take appropriate actions to expedite projects that will increase the production, transmission, or conservation of energy.” Moreover, “For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections.”⁴
- In Secretarial Order No. 3285A1, the Secretary of the Interior announced a policy goal of identifying and prioritizing specific locations on public lands that are best suited for large-scale production of solar energy.⁵
- In Section 211 of the Energy Policy Act of 2005, Congress instructed the Secretary of the Interior, within 10 years of enactment of the act, to “...seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity.”⁶
- The Energy Independence and Security Act of 2007 requires the DOE to facilitate integration of utility-scale solar energy into regional electricity transmission systems, and Executive Order 13514 requires federal agencies to help advance local efforts for renewable energy development.⁷

Finally, the BLM was responding to demands of state-level renewable energy portfolio standards, including the identification of development focus areas with high solar resource potential. Given these mandates and other market forces, the reasonably foreseeable development scenario (RFDS) developed for the Solar Energy Program estimated that the amount of solar energy generation on BLM lands in the study area over the 20-year study period would be about 24,000 MW; that generation necessitates the corresponding dedicated use of about 214,000 acres of BLM-administered lands.⁸ Prior to the program, BLM solar policies guided resource managers to address environmental concerns for solar projects on a case-by-case basis; the program established policies and guidance that take a programmatic approach to assessing impacts and siting solar development to avoid, minimize, and offset impacts on a regional scale.

At the same time, multiple environmental NGOs, including Defenders of Wildlife, The Wilderness Society, and The Nature Conservancy, were also interested in developing a regional approach to siting solar energy development in the desert southwest given the expected demand. They viewed such an approach as part of their larger efforts to reduce the impacts of energy development, while promoting renewable energy sources.

Decision Context

The BLM’s stated objectives for managing utility-scale solar development are as follows:

⁴ Executive Order 13212, Actions to Expedite Energy-Related Projects, May 2001; <http://www.gpo.gov/fdsys/pkg/FR-2001-05-22/pdf/01-13117.pdf>.

⁵ Secretarial Order No. 3285A1, Issued in March 2009 and amended February 2010; http://www.drecp.org/whatisdrecp/docs/DOI_Secretarial_Order_3285_A1.pdf.

⁶ Section 211, of the Energy Policy Act of 2005 (P.L. 109-58); <http://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf>.

⁷ <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>; http://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf.

⁸ Final Solar PEIS, July 2012. See <http://solareis.anl.gov/documents/fpeis/index.cfm>.

- Facilitate near-term utility-scale solar energy development on public lands,
- Minimize potential negative environmental impacts,
- Minimize potential negative social and economic impacts,
- Provide flexibility to the solar industry to consider a variety of solar energy projects (e.g., location, facility size, and technology),
- Optimize existing transmission infrastructure and corridors,
- Standardize and streamline the authorization process for utility-scale solar energy development on BLM-administered lands, and
- Meet projected demand for solar energy development (as estimated by the RFDS developed for the PEIS).⁹

The BLM can achieve these goals through landscape-scale planning and the application of the mitigation hierarchy, which is to avoid impacts associated with development of solar energy, to minimize those impacts, and, only then, to compensate for unavoidable impacts. The BLM applies the mitigation hierarchy through planning processes at (1) the programmatic level, which established Solar Energy Program and defined land use allocations; (2) a regional scale to determine whether additional avoidance areas are needed, where additional development is appropriate, and where the investment to compensate for the impacts of renewable energy development should occur; and (3) the local or project level, where additional decisions are made for minimizing impacts and measuring unavoidable impacts.

Avoidance is the least costly and most effective step in the mitigation hierarchy to meet goals related to the long-term viability of wildlife and ecosystem function, to achieve a balance of development and conservation, and to protect ecosystem services. Specifically, the avoidance step refers to identification of places that are too important for species, habitats, ecological function, and other ecosystem services values to allow development. Avoidance (or exclusion) areas are avoided entirely with respect to development activities. Through Solar Energy Program, the BLM proactively identified, at the programmatic level, exclusion areas. Some of these areas include lands designated by the BLM as areas of critical environmental concern (ACECs), habitat designated critical by the U.S. Fish and Wildlife Service for fauna and flora, and federally designated national conservation areas, national monuments, national trails, wilderness areas, and wilderness study areas.

The BLM also implemented an innovative approach to incorporating the avoidance principle: proactively identifying and promoting solar energy development in areas with the least conflict with environmental and other values. At the time of the ROD, the Solar Energy Program identified 17 solar energy zones (SEZs). By identifying where solar energy development is preferred, the BLM intends to help drive solar energy development in ways that avoid important ecological areas and concentrate development in areas of relatively low impact.

The Solar Energy Program also provided guidelines for a variance process to identify additional solar energy zones. The process involves landscape-scale analyses to evaluate the regional importance of locations and to select areas for solar energy development that protect ecological, cultural, and recreational values, while also meeting the needs of solar energy developers. The BLM retains the authority to determine if additional exclusion areas are necessary when a solar energy developer proposes a project in a variance area.

⁹ ROD, October 2012.

Minimization of solar energy development impacts, either for an entire solar energy zone or for a project, is achieved, in part, through required design features (e.g., identification of parcels that should not be released for lease due to local environmental values, reconfiguring of a project to avoid a desert wash, or requirements to use technologies that minimize water use). Avoidance of ecological features at the local or project level constitutes minimization of impacts. It is not characterized as the avoidance step in the mitigation hierarchy, because the larger ecosystem function is compromised in development areas, and indirect impacts from development generally affect adjoining lands.

Compensation measures are actions taken to offset residual impacts of development after applying appropriate avoidance and minimization measures. Through the Solar Energy Program and with the support of its Interim Policy on Regional Mitigation, the BLM is again taking a proactive, regional approach to identifying the most strategic places to invest in protection of wildlife and ecosystem services and the best actions to take at these places.¹⁰ For each solar energy zone, the BLM is developing regional mitigation strategies and a regional mitigation plan. The latter allows for prioritization of mitigation investments on the basis of multiple conservation goals. As envisioned, regional mitigation plans will simplify and improve the mitigation process for future SEZ projects to promote coordination of mitigation actions to yield the greatest benefit. The plans include detailed data analysis about impacts, using finer-scale information than the analysis that established exclusion areas and solar energy zones. Additionally, when a solar developer requests a permit, a site-level environmental assessment will be undertaken to quantify impacts to resource values and connect those impacts to mitigation actions laid out in regional mitigation plans. The first pilot project to develop a regional mitigation strategy was undertaken for the Dry Lake solar energy zone in Nevada. It was released in March 2014.¹¹

Near-term utility-scale solar energy development is facilitated through proactive identification of solar energy zones, allowing the BLM to minimize potential negative environmental, social, and economic impacts as well as to optimize existing transmission infrastructure and corridors to known locations for concentrated development. By focusing development in solar energy zones, the BLM can direct its limited capacity to processing those applications that have the highest probability of approval, given the analysis underlying SEZ identification. Solar PEIS standardizes and streamlines the authorization process for solar energy development within solar energy zones, and the variance process provides flexibility to the solar industry to develop a range of projects.

¹⁰ Bureau of Land Management, Interim Policy on Regional Mitigation, IM 2013-142 (June 2013); http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-142.html.

¹¹ Bureau of Land Management, Solar Regional Mitigation Strategy for the Dry Lake Solar Energy Zone, Tech Note 444 (2014). Bureau of Land Management, Southern Nevada District Office, Las Vegas, NV.

Table 5. BLM Decision Context.

	Programmatic	Land use planning	Permit decision
Scale	West-wide	Regional or landscape level	Site specific
Process	Public process for programmatic Solar PEIS	Public process through resource management plan (RMP) development/ amendment or regional mitigation strategy development	Public process initiated externally through permit application or competitive bid
Evaluation	Programmatic environmental impact statement (EIS) to assess demand, resources, environment, alternatives	Regional environmental impact statement to assess demand, resources, environment, alternatives	Guided by RMP; solar energy development requires a site-specific environmental impact assessment
Function	Identifies avoidance areas and solar energy zones	Identifies variety of land uses and where they may or may not occur	Evaluates alternatives, including siting, construction, operations, and decommissioning
Requirements	Programmatic EIS	EIS	EIS of environmental assessment or EIS of project
Decisions	Exclusion areas, solar energy zones, variance process, design features, best management practices (BMPs)	Resource allocations	Decisions to deny or grant the permit or to grant it with stipulations such as BMPs and compensatory mitigation
Monitoring	Guidelines	Monitoring plan	Compliance monitoring

Source: Adapted from G. Toevs and M. Dwyer, “Integrating Ecosystem Services and Adaptive Management” (2013).

In the interest of increasing effectiveness in the management of the nation’s public lands, the BLM has identified several opportunities to improve the process described above by more explicitly integrating ecosystem services into land use planning and land-use allocation decisions:

- Integrate the assessment of impacts to ecological systems and the services they provide into the assessment of impacts in both the allocation of resources and the authorization of specific projects.
- Include guidance for decision-makers for considering tradeoffs between demands for products (i.e. water, energy) and impacts to ecological systems and the services they provide (e.g., water dynamics, nutrient cycling).
- Use information gained from implementation of the BLM Assessment, Inventory, and Monitoring System to

- Validate or revise the assumptions made to estimate potential environmental, social, and economic impacts, including addressing the identification, production, and valuation (monetary and non-monetary) of ecosystem services;
- Assess the relative effectiveness of resource allocation strategies, project siting criteria, and stipulations to achieve sustainable yield; and
- Use analysis of monitoring information to help guide future siting decisions and best management practices for operation.¹²

Key Players

The Energy Efficiency and Renewable Energy Program was initiated by the BLM and the DOE, and its development involved multiple stakeholders as well as specialists in solar energy, wildlife and special status species, vegetation, air quality, outdoor recreation, landscape architecture, archaeology, paleontology, hydrology, soils, sociology, and economics.¹³

The Solar PEIS was completed by the BLM Renewable Energy Coordination Office in conjunction with BLM renewable energy programs in Arizona, California, Colorado, New Mexico, Nevada, and Utah under an interagency assistance agreement with the DOE Argonne National Laboratories Environmental Services Division. In compliance with NEPA, the program's development included significant public involvement. The solar industry, utilities, and the environmental NGO community also played a significant role.

In addition to the BLM and DOE, 19 federal, state, and local cooperating agencies are involved in the Solar PEIS: U.S. Department of Defense; U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service (FWS); U.S. National Park Service (NPS); U.S. Environmental Protection Agency, Region 9; U.S. Army Corps of Engineers, South Pacific Division; Arizona Game and Fish Department; California Energy Commission; California Public Utilities Commission; Nevada Department of Wildlife; N-4 Grazing Board, Nevada; Utah Public Lands Policy Coordinating Office; Clark County, Nevada, including Clark County Department of Aviation; Dona Ana County, New Mexico; Esmeralda County, Nevada; Eureka County, Nevada; Lincoln County, Nevada; Nye County, Nevada; and Saguache County, Colorado.

Funding

To develop all SEZ regional mitigation strategies and adaptive management pilot projects, the BLM is leveraging existing renewable energy program funds allocated by Congress.

Existing Resources

BLM Rapid Ecoregional Assessments

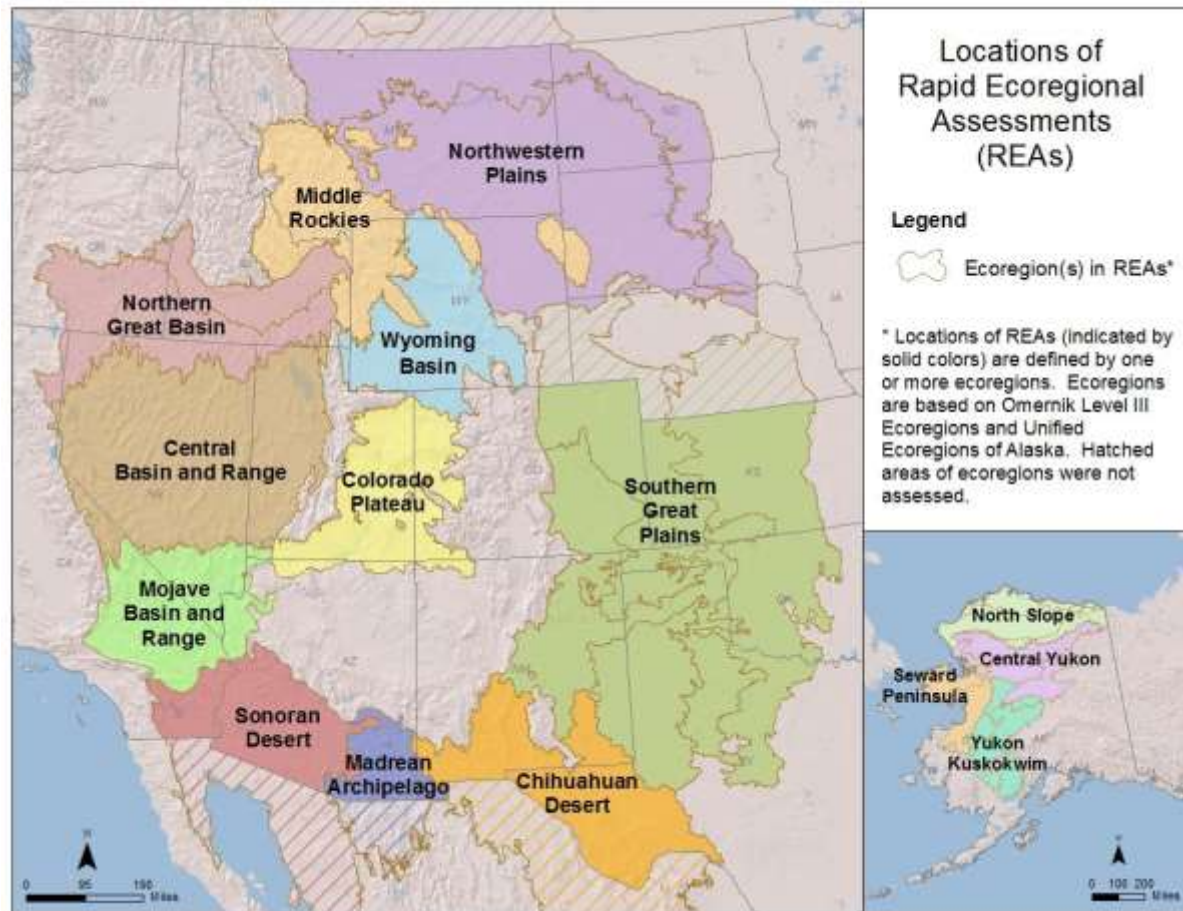
The Solar Energy Program uses analysis completed through BLM's rapid ecoregional assessments (REA) process. REAs provide regional baseline information regarding ecological values, conditions, and trends within ecoregions. REAs identify regionally important habitats for fish, wildlife, and species of concern and "the potential of these habitats to be affected by four overarching environmental *change agents*: climate change, wildfires, invasive species, and development (both energy development and urban growth)."¹⁴ The Solar Energy Program draws from numerous REAs completed in the six-state region (see Figure 15).

¹² G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).

¹³ See <http://energy.gov/eere/office-energy-efficiency-renewable-energy>.

¹⁴ See http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html.

Figure 15. Locations of BLM Rapid Ecoregional Assessments



Source: http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas/ecomap.html.

BLM Assessment, Inventory and Monitoring (AIM) Strategy

The long-term solar monitoring and adaptive management plan identified in the Solar Energy Program will be based on BLM's AIM Strategy developed in 2011.¹⁵ It will also incorporate the national landscape monitoring framework, Greater sage-grouse habitat analysis, and other local management-driven monitoring efforts.

Transmission Planning Efforts

The Solar Energy Program incorporates multiple transmission planning efforts, including the Western Governors' Association Renewable Energy Zone Project, the California Renewable Energy Transmission Initiative, and the *Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE/EIS-0386) PEIS in evaluating electricity transmission access issues associated with solar energy development in the six-state area.¹⁶

¹⁵

http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/ib_attachments/2012.Pa.r.53766.File.dat/IB2012-080_att1.pdf.

¹⁶ See <http://solareis.anl.gov/eis/how/index.cfm>.

FWS and NPS Data

The FWS provided data for desert tortoise habitat and identified priority desert connectivity areas within the variance zones. The NPS provided data for natural, cultural, and visual resources and identified areas where there would be a high potential for resource conflicts. These data will be used during pre-application meetings to assess the impacts of potential solar energy development projects in the variance zones.

Desert Renewable Energy Conservation Plan

In 2011, the state of California called for development of the Desert Renewable Energy Conservation Plan (DRECP). Like the Solar Energy Program, the plan aims to facilitate renewable energy development while protecting desert ecosystems and species.¹⁷ Unlike Solar Energy Program, which is limited to BLM-managed lands, DRECP includes both private and public lands, and it must develop a reserve design that will lead to the recovery of covered species in addition to identifying zones for renewable energy development. The participating parties include the California Energy Commission, the California Department of Fish and Wildlife, the California Public Utilities Commission, California Independent System Operator, the BLM, the U.S. FWS, the NPS, the U.S. EPA, and the DOD. DRECP will be informed by and might refine the decisions in Solar PEIS for public lands in California deserts.

NGO Expertise

Multiple environmental NGOs, including Defenders of Wildlife, The Wilderness Society, and The Nature Conservancy, supported development of Solar PEIS through technical assistance as part of their larger efforts to reduce the impacts of energy development while promoting renewable energy development.

Options and Tradeoffs Considered

In addition to making regional land use decisions about where solar energy development may or may not occur, the Solar Energy Program provides a framework for evaluating options and tradeoffs at the local level to mitigate (avoid, minimize, offset) direct, indirect, and cumulative impacts.

The relevant ecosystem services at the larger scale might focus on habitat fragmentation, potential impacts on endangered species, water contamination and soil erosion, potential disruption of ecosystem functions and processes regulating biological communities, and climate change impacts. Ecosystem services at the local scale might focus on conflicting demands for products (e.g., water, energy) and on the impacts of disturbance of flora and fauna or of disruption of ecosystem processes (e.g., water dynamics, nutrient cycling).¹⁸

Tradeoffs at the programmatic scale were evaluated through identification of exclusion areas, where utility-scale solar development would not be allowed because of the high level of conflict with ecosystem services and cultural values, and solar economic zones, where solar energy development was prioritized in areas with the least conflict.

Exclusion areas were identified on the basis of the following criteria:

- Areas of critical environmental concern;

¹⁷ See <http://www.drecp.org/>.

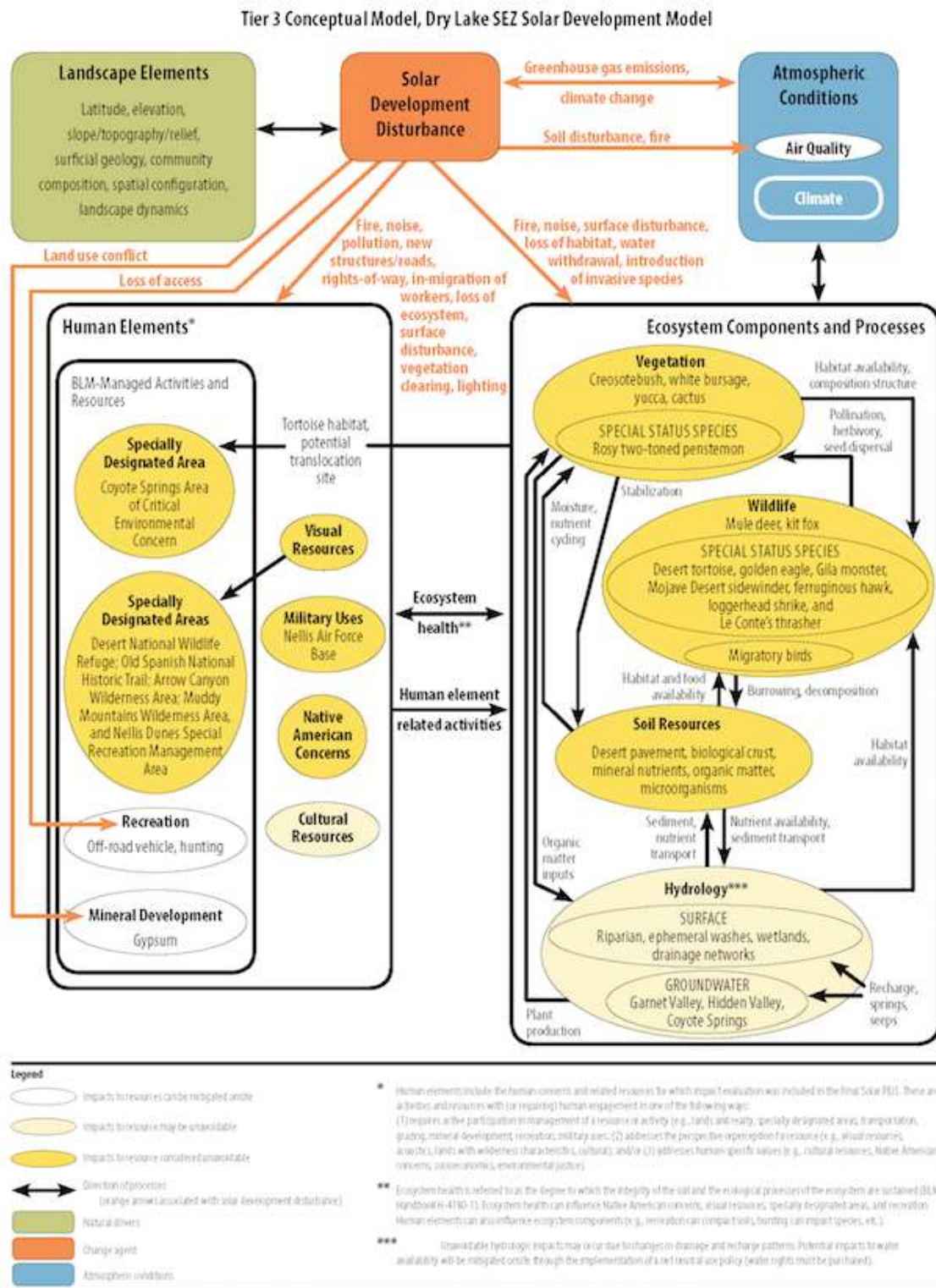
¹⁸ G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).

- Desert wildlife management areas;
- Critical habitat areas for species protected under the Endangered Species Act;
- Protection for lands with wilderness characteristics;
- Special recreation management areas;
- Sensitive species habitat: (Sage-grouse core areas, nesting habitat, and winter habitat; Mohave ground squirrel habitat; flat-tailed horned lizard habitat; fringe-toed lizard habitat);
- California desert conservation area;
- Desert Tortoise connectivity corridors;
- Big game migratory corridors;
- Visual resource management;
- National recreation, water, or side and connecting trails and national back country byways;
- BLM National Landscape Conservation System and national scenic and historic trails;
- National historic and natural landmarks;
- Traditional cultural properties and Native American sacred sites;
- Wild, scenic, and recreational rivers;
- Old growth forest; and
- ROW exclusion and avoidance areas.¹⁹

Tradeoffs at the regional level will be analyzed through the development of regional mitigation strategies as established by the Solar Energy Program (see Figure 16). Tradeoffs at the local level will be analyzed through the project-level NEPA process. This process includes analysis of unavoidable direct, indirect, and cumulative impacts that contribute to loss of ecosystem services as well as strategies for off-site mitigation, monitoring, and adaptive management. Regional mitigation plans will establish a crediting methodology for assessing impacts and determining mitigation actions. Individual permits will be granted with stipulations reflecting these requirements.

¹⁹ ROD, Table A-2 Exclusions under BLM's Solar Energy Program (October 2012).

Figure 16. Dry Lake Regional Mitigation Strategy Conceptual Model.



Source: Bureau of Land Management.

Analysis at the project level may incorporate impacts on

- Soils and nutrient cycles (erosion and carbon sequestration)
- Wildlife
- Special status species
- Vegetation
- Invasive/noxious weeds
- Hydrology
- Riparian function
- Visual resources
- Specially designated areas
- Military uses
- Cultural resources
- Native American concerns

Analysis

Solar PEIS provides a summary-level assessment of potential ecosystem service impacts, including impacts on rangeland resources, recreation lands, military and civilian aviation, soil resources, mineral resources, water resources, vegetation, wildlife and aquatic biota, special status species, air quality and climate, visual resources, acoustic environment, paleontological resources, cultural resources, native American concerns, and transportation.²⁰

In addition, the BLM has developed action plans for each of the solar economic zones as part of the supplement to the draft Solar PEIS. These action plans described additional data that could be collected for individual zones and proposed data sources. These data will inform development of the regional mitigation strategies.

However, the BLM faces a number of challenges in evaluating impacts to ecosystem services. First, ecosystem functions vary significantly across the area covered by the program. Second, the long-term impacts of solar energy installations on certain functions such as soils are not yet well understood. Third, there is little qualitative research on the assessment of “tradeoffs” for ecosystem services—that is, whether greenhouse gas savings from solar electricity outweigh the lost carbon sequestration from disturbing soils. Fourth, there are questions about the appropriate scale at which ecosystem services and impacts to them should be evaluated.

An ecosystems services impact assessment can help value impacts that are hard to monetize (e.g., viewsheds, access to public lands, water and air quality), but it requires a high level of in-house expertise that the BLM and even many conservation NGOs do not have, and some of the valuation methods are immature. Therefore, the BLM contracted with outside scientists to evaluate cumulative impacts to ecosystems services, including a small contract to Colorado State University. BLM also drew from an ecosystems services analysis done for the San Pedro River Watershed in Arizona.²¹

Implications

The Solar Energy Program could significantly reduce the impacts to ecosystem services functions from solar energy development over a 20-year timeframe. It reduces landscape-scale impacts by centering development in solar economic zones where environmental, social, and cultural conflict is relatively low. At the same time, the program provides a framework for assessing and mitigating individual project-level impacts. The program reflects a significant

²⁰ Final Solar PEIS (July 2012). See <http://solareis.anl.gov/documents/fpeis/index.cfm>.

²¹ K.J. Bagstad, D. Semmens, R. Winthrop, D. Jaworski, and J. Larson, *Ecosystem Services Valuation to Support Decisionmaking on Public Lands: A Case Study of the San Pedro River Watershed, Arizona*, USGS Scientific Investigations Report 2012-5251 (2012).

change in the BLM's land-use planning and permitting decision processes (e.g., from a case-by-case analysis to a programmatic analysis of ecosystem functions).

The ecosystem services framework facilitates impact assessments that could help avoid unintended consequences (e.g., cumulative impacts to water quantity or soil quality) and valuation of nonmarket benefits (e.g., access to public lands), which can help the BLM achieve its multiple use mandate.

Acknowledgments:

Thanks go to the following reviewers: Rebecca Moore, Rob Winthrop, Gordon Toevs, Mike Dwyer, and Joe Vieira at the Bureau of Land Management and Lynn Scarlett at The Nature Conservancy.

How to cite:

Foley, T., J. Bowles, N. Smith, and P. Caligiuri. 2014. "An Ecosystem Services Approach to Management of a Complex Landscape: The Marsh Project." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

U.S. Forest Service

**Ecosystem Services and Land Management Plan Revision:
Preliminary Observations of Three Ecosystem Services
Evaluation Framework Workgroup Members**

Authors

Chris Miller, U.S. Forest Service
Kawa Ng, U.S. Forest Service
Nikola Smith, U.S. Forest Service

Created 2014



Photo courtesy of the U.S. Forest Service

To comply with the requirements of the 2012 National Forest Land Management Planning Rule, the National Forest System is revising land management plans for national forests, grasslands, and prairies.¹ This case example presents preliminary observations regarding application of ecosystem services concepts to this effort.²

Decision Context and Agency Capacity

Regulatory Background and Policy Direction

Planning for the management and use of the National Forest System (NFS) must conform to the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) as amended by the National Forest Management Act of 1976 (NFMA), implementing regulations in 36 CFR Part 219, the National Environmental Policy Act (NEPA) associated regulations in 40 CFR 1500-1508 and 36 CFR 220, and Multiple-Use Sustained-Yield Act of 1960 (MUSYA).³ Each NFS unit (i.e., national forest or grassland) has a land management plan developed in compliance with the 1982 planning rule, which was revised on April 9, 2012 (77 *Fed. Reg.* 21162).⁴

The 2012 planning rule was developed after more than two and a half years of public input, including more than 300,000 public comments. Its framework sets forth process and content requirements to guide the development, amendment, and revision of land management plans to maintain and restore NFS land and resource ecosystems while providing for ecosystem services and multiple uses. Specifically, it states:

§ 219.1 Purpose and applicability... (c) Plans will guide management of NFS lands so that they... have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future...

§ 219.6 Assessment... (b) In the assessment for plan development or revision, the responsible official shall identify and evaluate existing information relevant to the plan area for: ... (7) Benefits people obtain from the NFS planning area (ecosystem services)...

§ 219.8 Sustainability... (b) Social and economic sustainability. The plan must include plan components... to guide the plan area's contribution to social and economic sustainability, taking into account: ... (4) Ecosystem services...

§ 219.10 Multiple use... (a) Integrated resource management for multiple use. The plan must include plan components... for integrated resource management to provide for ecosystem services... When developing plan components for integrated resource management, to the extent relevant to the plan area and the public participation process and the requirements of §§ 219.7, 219.8, 219.9, and 219.11, the responsible official shall consider: (1) ecosystem services...

¹ http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362536.pdf.

² The authors have had limited opportunity to review early-stage plan revisions under the 2012 planning rule. Therefore, this paper represents a preliminary understanding of the U.S. Forest Service's experience with addressing ecosystem services.

³ RPA:

<http://www.fs.fed.us/emc/nfma/includes/range74.pdf#search='Forest%20and%20Rangeland%20Renewable%20Resources%20Planning%20Act%20of%201974'>; NFMA: <http://www.fs.fed.us/emc/nfma/includes/NFMA1976.pdf>; MUSYA: <http://www.fs.fed.us/emc/nfma/includes/musya60.pdf>.

⁴ <http://www.fs.fed.us/emc/nfma/includes/nfmareg.html>.

The 2012 planning rule defines ecosystem services as benefits people obtain from ecosystems, including

- Provisioning services, such as clean air and fresh water, energy, fuel, forage, fiber, and minerals;
- Regulating services, such as long-term carbon storage, climate regulation, water filtration, soil stabilization, flood control, and disease regulation;
- Supporting services, such as pollination, seed dispersal, soil formation, and nutrient cycling; and
- Cultural services, such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

The 2012 planning rule seeks to ensure that ecosystem services are not overlooked by requiring forest plans to include components, such as standards and guidelines, designed “to provide for ecosystem services and multiple uses” (36 CFR 219.10(a)). Ecosystem services are benefits that the national forests and grasslands have always provided while being managed for multiple use. The Multiple-Use Sustained-Yield Act calls for national forests and grasslands to be managed for “outdoor recreation, range, timber, watershed, and wildlife and fish purposes” (16 USC 528). The planning rule requires that plans provide for ecosystem services as part of integrated resource management.

The ecosystem services provided for in the 2012 planning rule are clearly related to multiple-use management. For example, the ecosystem services of water filtration, purification, and storage and flood control are all generated by and support effective management for watershed purposes. The 2012 planning rule provides an integrated resource management approach whereby interdependent elements of sustainability are considered as a whole, instead of as separate resources or uses. The mix of plan components in each land management plan will reflect local conditions in the broader landscape, the best available scientific information, and public input.

Early Adopter Observations

Eight national forests and grasslands have been selected to be the first to revise their land management plans using the 2012 planning rule. These early adopters include the Nez Perce and Clearwater National forests in Idaho, the Chugach National Forest in Alaska, the Cibola National Forest in New Mexico, the El Yunque National Forest in Puerto Rico and California’s Inyo, Sequoia, and Sierra national forests. Some are in the process of conducting assessments (developing core teams, obtaining input from planning team staff, and preparing for public engagement). Others are finalizing assessments and beginning to develop alternative plan components that guide contributions to ecosystem services, and some are considering strategies for analyzing potential changes in ecosystem services and conducting trade-off analyses. The key players in these efforts have been Forest Service staff at individual units, regional offices, and enterprise units (where resource and discipline-specific capabilities can be contracted out).

Approaches to ecosystem service assessments are not prescribed by the 2012 planning rule, and therefore they vary. In one case, the regional office assembled an ecosystem services assessment team from teams of national forest planning specialists. In another case, a Forest Service unit is working with an academic program, state agencies, and research organizations.

Forest Service research staff (1) develop strategies and general technical reports that provide advice for addressing ecosystem services in land management planning, (2) participate in agency ecosystem service workgroups, and (3) manage a forum for agency practitioners to communicate and coordinate work related to ecosystem services. In Region 5 (California National Forests), for example, Forest Service research station staff have been involved in developing strategies for an ecosystem services assessment and are assisting with implementation. Third-party contractors are helping with community participation/engagement processes and evaluating and quantifying ecosystem services with GIS-based tools.

Analysis and Implications

Regulatory Background and Policy Direction

The types of ecosystem services to be considered in a specific land management plan will depend on the individual Forest Service units, will be identified during the assessment phase, and may be tracked throughout the planning process. Services incorporated in the plan may be but are not required to be included in the monitoring program.

Forest Service directives (i.e., Forest Service Handbook) for implementing the 2012 planning rule were proposed and published for public comment in 2013 and are expected to be finalized in 2014. According to the proposed directives, the ecosystem services that are to be identified and evaluated are those that “are most important to people in the broader landscape and those that would be most affected by the land management plan” (i.e., “key” ecosystem services). The proposed directives identify six types of information that should be but are not required to be considered in ecosystem services assessments:

- Key ecosystem services contributions by the plan area;
- The geographic scale at which the plan area contributes to ecosystem services (e.g., watersheds, counties, regional markets, or eco-regions);
- The condition and trend of these key ecosystem services;
- Drivers likely to affect future demand for and availability of key ecosystem services;
- The stability or resiliency of the ecosystems or key characteristics of ecosystems that currently maintain the plan area’s key ecosystem services; and
- The influence of non-NFS lands or other conditions beyond the authority of the Forest Service that influence the plan area’s capacity to provide ecosystem services.

Identification of key ecosystem services should be collaborative and influenced by the best available scientific information.

Because many ecosystem goods and services exist outside of traditional market economies, researchers and others often use non-market values to quantify them. The 2012 planning rule does not require the Forest Service to determine non-market values or to quantify non-market benefits, but it does require plan components to guide contributions to economic sustainability. Consideration of market and non-market benefits may be carried out qualitatively or quantitatively, which may encompass monetary or non-monetary metrics. Additionally, in a number of sections (e.g., assessment at § 219.6(b), social and economic sustainability at § 219.8(b), and multiple use at § 219.10(a)), the planning rule requires consideration of ecosystem services and multiple uses, including provisioning, regulating, and cultural services, all of which involve numerous non-market goods and services. These requirements, in combination with public participation throughout the planning process (§ 219.4), are expected to

improve the Forest Service's ability to acknowledge the relative values of market and non-market goods and services.

As part of the process to comply with the National Environmental Policy Act (NEPA), environmental documents supporting planning decisions are expected to discuss comparative benefits and tradeoffs associated with key ecosystem services. The Forest Service is aware of many methods and tools to do so (e.g., InVEST, ARIES, Solves, habitat benefit transfer, and spatial benefits analysis). These methods and tools vary in complexity and data/time requirements. To help Forest Service planners evaluating ecosystem services, the agency is developing its own guidance, including drafts of an ecosystem services evaluation framework (ESEF) (see Appendix A).

Early Adopter (and ESEF) Observations

Identification of Ecosystem Services

Early adopters are drafting initial lists of ecosystem services for their respective units. These lists reflect the influence of the Millennium Ecosystem Assessment (MEA) classification system.⁵ The services thus far identified include

Provisioning services

- Timber
- Grazing (livestock forage)/range
- Water quantity (and quality)
- Clean air
- Animals and plants as food
- Energy (biomass, geothermal, hydropower, and wind/solar)
- Wood as renewable energy and fuel source

Cultural services

- Recreation (including hunting, fishing, developed recreation, and wildlife viewing)
- Aesthetics
- Cultural heritage and sense of place
- Education, science, and health
- Research (support or source of scientific knowledge)
- Tribal knowledge

Regulating services

- Water quality
- Water regulation (quantity and timing)
- Water filtration
- Flood control
- Carbon sequestration (and climate regulation)
- Fire resilience

Supporting services

- Biodiversity

⁵ <http://www.millenniumassessment.org/en/index.html>.

- Sustaining biodiversity, intact ecosystems, and connectivity for global ecological processes
- Nutrient cycling

Managers of early-adopter forests have interpreted application of the classification of ecosystem services within the MEA in various ways, as indicated by the inclusion of water quantity in both provisioning and regulating services. Some early adopters include supporting services as candidates for key ecosystem services; others, including Region 5, do not. The Region 5 bioregional assessment focuses on final ecosystem services, defined as "...components of nature, directly enjoyed, consumed, or used to yield human well-being," and states that "except for biodiversity, supporting services are not identified as key services but rather become the important underlying processes that help to provide the key services." The Region 5 bioregional assessment also emphasizes the dependence of final ecosystem services on ecological integrity and sustainability (which includes the provision of biodiversity) and notes that the 2012 planning rule requires that national forests be ecologically sustainable.⁶ Another early adopter draft assessment also notes that ecosystem services serve as a bridge between ecosystems and human systems.

Selection Criteria

The number of ecosystem services addressed during plan revision could become overwhelming as engagement with the public expands. To prevent this situation from occurring, the Forest Service has emphasized selection of key ecosystem services.⁷ For that task, national forest staffs may adopt variations of selection criteria according to

- Interpretations of and relative weights placed on the services most important to people and most affected by the land management plan,
- Prioritization of final rather than intermediate services, and
- Definition of a service or benefit.

Information Needs

To productively discuss selection of ecosystem services, both the FS units and the public need information that allows them to

- Differentiate between supply and demand for services;
- Identify risks and stressors;
- Characterize preferences, needs, or values; and
- Link services to plan components.

⁶ "A stated purpose of the 2012 forest planning rule is that "Plans will guide management of NFS lands so that they are ecologically sustainable and contribute to social and economic sustainability" (36 CFR 219.1(c)). The integration of ecological sustainability with social and economic sustainability is fundamental to the capacity of an ecosystem to provide services to human communities. According to the 2012 planning rule, ecological sustainability "refers to the capability of ecosystems to maintain ecological integrity." (36 CFR 219.19). Ecological integrity is further defined in the rule as "The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence" (36 CFR 219.19).

⁷ Proposed Forest Service Handbook 1901.12 (13.2): "The intent is not to identify all possible ecosystem services provided by the plan area but to identify those ecosystem services that are most important to people in the broader landscape and those that would be most affected by the land management plan. The key ecosystem services identified in the assessment are expected to be tracked further in the planning process."

Questions can be raised about what level of baseline information is needed to provide a foundation for initiating productive dialogue for identifying key ecosystem services. Too much complexity may hinder initial stages of public and staff engagement; too little information may lead to expansive sets of ecosystem services that creates process burden without helping to focus plan revision on important issues. Some FS units may opt to provide lists of services to jump-start discussion, but doing so could bias the selection process. Alternatively, some units (for plan revision and project development) have asked their staff or the public to describe how they benefit from the national forest or what they value in it. They then relied on agency staff to differentiate between resources, functions, and services and subsequently identified a list of key services.

Assessment Scale

National forests may contribute to an ecosystem service, the production of which relies on inputs from areas beyond the national forest boundary. The scale of demand for (or population of beneficiaries) may differ from the scale of ecosystem service production. Scale options include bioregions, individual forest plan areas, and sub-plan areas.

Collaborative Capacity

Within the Forest Service, capacity for collaborative engagement during assessment of ecosystem services varies from national forest to national forest. Strategies (in order of increasing level of rigor) may include the following:

- Initial reliance on staff, followed by public input and comment
- Solicitation of public input through public meetings and comment opportunities; and
- Building of participatory capacity by assessing public knowledge of ecosystem services within communities surrounding the national forest, exploring (researching) options for fostering dialogue/improving understanding, and identifying and leveraging existing programs (e.g., land owner incentive conservation programs) for information about ecosystem service awareness and knowledge.

Some early adopters have held workshops to facilitate identification and selection of ecosystem services. Lessons from those workshops are presented in Appendix B.

Analytical Methods and Tools

Many methods and tools have been developed or are in development to assess ecosystem services and, more specifically, to value these services using quantitative and monetary measures. These tools, including InVEST, ARIES, Solves, and Habitat Benefit Transfer, range in complexity and data requirements. All these tools and methods must satisfy best available scientific information requirements. Data availability and quality constraints may prove to be a limiting factor in the application of some tools. The U.S. Geological Service and Bureau of Land Management report *Ecosystem Services Valuation to Support Decision-making on Public Lands—A Case Study of the San Pedro River Watershed, Arizona* compares some of spatial landscape-level tools, but early adopters have not reached the phase of planning that would involve these types of tools.⁸

⁸ <http://pubs.usgs.gov/sir/2012/5251/sir2012-5251.pdf>.

The draft Ecosystem Services Evaluation Framework (ESEF) report and supporting material summarize the functions as well as the advantages and disadvantages of applying some ecosystem service methods and tools in national forest management. The ESEF report is intended to be an advisory (non-authoritative) document that provides a generic set of steps and considerations (criteria) for developing strategies and selecting tools to assess ecosystem services during collaboration and decision making. ESEF steps do not reflect the ecosystem service requirements of the 2012 planning rule; however, the ecosystem services evaluation framework can serve as a resource for addressing ecosystem services in planning. Appendix A describes the framework and efforts to apply portions of it in plan revision.

Some early adopters received assistance with assessment and evaluation of ecosystem services, including identification and selection of key ecosystem services, at workshops. The workshops provided a venue for testing different approaches for facilitating discussions about ecosystem services as they relate to planning. Appendix B summarizes lessons from these workshops, with a focus on the El Yunque National Forest.

Ecosystem Service Tradeoffs

None of the early adopters have reached the stage of tradeoff analysis, but they expressed interest in such analysis when examples were presented in workshops. Staffing and information constraints are likely to be a challenge for conducting tradeoff analysis.

Appendix A: Draft Ecosystem Services Evaluation Framework

The Ecosystem Services Evaluation Framework (ESEF) report is an advisory (non-authoritative) document for evaluating ecosystem services and incorporating them into decision making. Intended users include Forest Service planners and project developers who are responsible for (1) collaborating with the public and advancing a common understanding of the potential values and tradeoffs associated with changes in ecosystem services resulting from management decisions and (2) analyzing and summarizing benefits (or net benefits) and tradeoffs among management alternatives as well as contributing to the standardization and defensibility of ecosystem service evaluations.

The ESEF report outlines three broad, iterative steps (that reflect guidance from other agencies) as well as subtasks for framing and describing the set of important and relevant benefits that people receive from national forest and national grassland resources:

1. Characterize important and relevant ecosystem services and Forest Service contributions to those services
 - a. Describe objectives and scope of decision or action
 - b. Adopt or develop underlying ecosystem services classification structure (e.g., Millennium Ecosystem Assessment classification system)
 - c. Identify important ecosystem services that are relevant to the decision
 - d. Describe how changes in NFS lands affect ecosystem services (incremental effects)
2. Characterize qualitative and quantitative values and dollar indicators for ecosystem services
 - a. Identify the types of values associated with important ecosystem services
 - b. Select methods and tools for characterizing values
 - c. Characterize values for important ecosystem services
3. Apply results (e.g., tradeoff analysis) to decision making or modify prior steps

Neither dollar values nor cost-benefit analysis are emphasized in steps 2 and 3.

Each step and subtask is accompanied by a set of analytical considerations or criteria to identify appropriate tools or to develop analytical strategies/expectations. In addition, each step provides case studies and examples of practices/tools. Templates are included to help users implement the steps.

The ESEF report was developed by a workgroup made up of staff from different deputy areas: Research and Development, State and Private Forestry, and National Forest System. This workgroup shared information about ecosystem service methodologies, including metrics for tracking ecosystem services or ecological conditions for incentive programs.

ESEF steps, subtasks, and considerations were developed to provide a generic framework to address ecosystem services for a variety of decision-making contexts. They do not correspond to the ecosystem services requirements of the 2012 planning rule, nor do they reflect expectations for how to address ecosystem services.

Early adopters of the USFS 2012 Planning Rule have used the ESEF report to different degrees. Some early adopters extracted specific information (e.g., considerations, recommendations, example practices, and case study references) to assist them in developing

their own strategy for assessing ecosystem services—that is, to help them (1) describe the link between supporting services and other types of ecosystem services, (2) differentiate intermediate ecosystem services linked to ecosystem conditions and trends from final services that apply more directly to human systems, and (3) list factors affecting the value of ecosystem services.

Other early adopters found the ESEF report complex and lengthy, leading to the authors to develop templates in the form of Excel tables, which were also viewed as too complex or constraining. The ESEF workgroup then developed one template table to facilitate identification of a preliminary list of key ecosystem services. In one attempt to introduce and use the simplified table through conference calls with a planning team, some team members expressed discomfort with the questions posed in the table. In another case, template table questions for initiating dialogue regarding ecosystem services were further distilled into two questions posed to the public (through an interactive Web site): “I benefit from the forest because....” and “have the benefits you receive from the forest been changing over time?”

In yet another case, the ESEF workgroup used the report to craft a set of questions to facilitate face-to-face discussions with selected early adopters. These discussions focused on identification and preliminary assessment of key ecosystem services through questions such as “what services are important to people in the broader landscape?” and “what services would be affected by the forest plan?” The ESEF workgroup also used lists of considerations in the ESEF to frame discussion for identifying indicators and methods for characterizing and changes in the supply and demand of ecosystem services.

Appendix B: Early Adopter Workshops

The ESEF workgroup held workshops in the summer of 2013 with three early adopters of the USFS 2012 Planning Rule. One workshop included participants from agencies and organizations outside of the Forest Service; two workshops involved participants from the Forest Service alone. The workshops focused on ecosystem services assessment and evaluation to help meet the needs and intent of the rule. They included presentations/instruction, large group discussions, and breakout sessions to identify and select key ecosystem services, to identify indicators and methods for evaluating changes in services, and to evaluate tradeoffs among ecosystem services outcomes. A description of the El Yunque National Forest workshop follows, along with a summary of feedback from participants and the workshop cadre (ESEF workgroup members who include staff from the Washington D.C. and regional offices).

El Yunque National Forest Workshop

El Yunque National Forest, formerly known as the Caribbean National Forest, is located in northeastern Puerto Rico on the slopes of the Sierra de Luquillo mountains.⁹ It encompasses 28,000 acres, making it the largest block of public land in the Commonwealth. El Yunque is the only tropical rainforest in the National Forest System. It supports unique vegetation and habitats and offers tremendous recreation value, clean water, and cultural benefits.

Like many urban forests, El Yunque is affected by development pressure. Concern about related impacts on ecosystem services led the forest to partner with Tania López-Marrero at the USFS Southern Research Station to identify the perspectives of stakeholders on the benefits the forest provides. The project had four primary objectives:

- Assess stakeholders' knowledge of El Yunque's ecosystem services and the factors influencing their availability
- Document the geographic distribution of land cover around El Yunque, particularly the distribution and expansion of urban land cover affecting the national forest and its ecosystem services
- Develop geographic data and a resulting map that can assist in land-use planning efforts that support El Yunque and its ecosystem services, including identification of priority areas
- Explore the potential role of local landowner-incentive conservation programs, including conservation easements, land donations, and land purchases.

The study area included eight municipalities that have a portion of El Yunque within their boundaries. Stakeholders included scientists and forest managers who work in El Yunque, municipal planners and community groups, residents, and nearby landowners. Workshop participants engaged in exercises to list, rank, score, and map services they valued. These services included (in approximate order of importance):

- Water
- Water purification
- Air purification
- Natural hazard moderation
- Carbon sequestration
- Fauna, flora and their habitats

⁹ <http://www.fs.usda.gov/elyunque>.

- Recreation
- Maintenance of biodiversity
- Research and education
- Forest products
- Economic development
- Scenic value
- Human well-being
- National patrimony

Workshop participants were asked to identify change drivers affecting El Yunque's ecosystem services. Land cover change was the most negative change driver; protected area designation was the most positive.

El Yunque staff benefitted greatly from this research as they began to prepare for Forest Plan Revision in 2012. In June 2013, staff participated in a workshop designed by the USFS Ecosystem Services Evaluation Framework (ESEF) team, which was led by the Ecosystem Management Coordination Office and included staff from the national Forest Management Office as well as the Northern and Pacific Northwest regions. The El Yunque National Forest Planning Team leader played a critical coordination role and provided feedback on workshop strategy and implementation. Planning team members included a forester, wildlife biologist, and recreation specialist. Other workshop participants included representatives of non-governmental organizations, Puerto Rican government agencies, and the research community.

The workshop focused primarily on identification and assessment of key ecosystem services and on work needed for subsequent planning stages in which planning teams develop plan alternatives and describe their effects. Workshop participants reviewed the 2012 planning rule's ecosystem services content and directives as well as existing information about ecosystem services provided by El Yunque NF and surrounding natural areas.

Services of particular importance included water, recreation, biodiversity, and scenic values. National patrimony was also stressed as a unique service that contributes to cultural identity, history, and sense of place. The significance of national patrimony for constituents and workshop attendees demonstrates the influence of cultural and social values on identification of ecosystem services provided by a landscape. Participants also discussed the importance of highlighting how supporting and regulating services are critical underpinnings of the forest system and cautioned against focusing on final goods and services alone.

Attendees reported enjoying the collaborative process of identifying services. They also acknowledged that such a process could potentially lead to an extensive list of services and discussed the importance of balancing public preferences with a sound understanding of the ecology of the forest and its capacity to sustainably provide specific services that people value.

Following the ecosystem services identification phase, participants selected "key" ecosystem services and discussed the conditions of and the trends and risks for each service. They also discussed data sources that could be used to assess the services. Presentations emphasized that effective ecosystem service indicators are those that measure changes in ecosystem services supply and benefits and that address

- *Incremental changes*, including those resulting from plan components

- *Forest conditions* related to resources and ecological conditions, infrastructure, and use
- *Broad landscape conditions*, including populations benefitting from services, large landscape-scale processes, and complementary contributions by other lands

Workshop facilitators asked that conditions, trends, and risks be considered separately for supply and demand, but it became apparent that doing so was a challenge, because factors affecting supply can be related to demand and vice versa. Increasing demand for drinking water due to population pressure, for example, poses a risk to supply. A more effective approach would be to pose questions such as “how does the condition or trend of water resources affect recreation opportunities and vice versa?” Participants agreed that it is also important to be spatially explicit about conditions, trends, and risks. Spatial specificity can also help minimize tradeoffs by focusing actions in locations that maximize beneficial outcomes and minimize negative ones.

The ESEF workgroup reviewed selected analytical tools and methods for assessing and evaluating tradeoffs among ecosystem services. This portion of the workshop was particularly engaging, because it addressed practical application of ecosystem services concepts. In forest planning, non-monetary measures of ecosystem services value might be most feasible or appropriate. These measures can include other quantitative assessments such as use or satisfaction (e.g., number of visitors accessing trails), qualitative descriptions of importance, or participatory ranking.

The workshop demonstrated that expansion of content related to assessment tools and methods, including development of follow-up training, would be beneficial. Workshop participants expressed interest in webinars and resources that support implementation of concepts introduced in the workshop. Training might include demonstrations of the use of USFS analytical tools and data sources to address ecosystem services and tradeoffs in environmental impact statements.

The workshop provided an effective forum for developing and testing material for demonstrating how ecosystem services frameworks highlight connections between the ecology of the landscape and public benefits, and how they draw attention to stressors on the system (e.g., population growth and climate change) that affect management decision-making. This workshop also demonstrated that simultaneous consideration of processes, functions, benefits, and trends can support better-informed planning activities.

Overall Lessons from All Three Workshops

The ESEF workgroup facilitated workshops for two national forests in addition to the El Yunque event described above. These workshops demonstrated two overarching needs: to provide a general overview of the ecosystem services concept and to clarify several terms and concepts.

Providing a General Overview of Ecosystem Service Concept

An overview or outline of the entire process is needed to clarify how the different stages of ecosystem service assessment and analysis build on one another. Workshop leaders need to explain why ecosystem services are incorporated into the 2012 National Forest Land Management Planning Rule and to stress ecosystem services’ contributions to social and economic sustainability.

Clarifying Terms and Concepts

Workshop leaders should clarify several terms and concepts. First, they need to clarify supporting and regulating services in the context of intermediate and final ecosystem services and to highlight connections between interim and final services in the context of management activity. They should allow open discussion at the services identification stage and then rely on workshop participants to differentiate between intermediate and final services.

Second, workshop leaders should clarify differences between ecosystem conditions/stocks contributing to ecosystem services and the benefits derived from those conditions/stocks. In that regard, they should consider diagramming the links between ecological conditions and ecosystem services. Differentiating between supply and benefits (e.g., meeting public needs) of ecosystem services is critical to tradeoff analysis.

Third, workshop leaders should differentiate between how ecosystem services are addressed in assessments as compared with evaluations (e.g., environmental impact statements). Discussion of both tasks in a single workshop may not be practical.

How to cite:

Miller, C., K. Ng, and N. Smith. 2014. "Ecosystem Services and Land Management Plan Revision: Preliminary Observations of Three Ecosystem Services Evaluation Framework Group Members." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

U.S. Forest Service

Integrating Ecosystem Services into U.S. Forest Service Programs and Operations

Authors

Robert Deal, U.S. Forest Service
Emily Weidner, U.S. Forest Service
Nikola Smith, U.S. Forest Service

Created 2014



Photo courtesy of the U.S. Department of Agriculture

Introduction and Decision Context

The concept of ecosystem services has emerged to describe the broad suite of goods and services that people receive from nature. It highlights the importance of sustainably managing public and private lands to ensure that these benefits continue into the future and is closely aligned with the U.S. Forest Service (USFS) mission to “sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.” In response to growing interest in ecosystem services, the USFS is identifying needs and opportunities to incorporate ecosystem services concepts into USFS programs and activities. USFS employees are applying these concepts to forest planning and management, contributing to the development of markets and payment incentives for private forest conservation and restoration, developing innovative all-lands models for collaborative forest management across ownerships, and advancing the field of ecosystem services research.

Existing Resources and Organizational Capacity

The ecosystem services concept is not entirely new in USFS programs and operations. The Ecosystem Services and Markets program area was first established in the State & Private Forestry (S&PF) deputy area in 2006, and key ecosystem services activities subsequently emerged within the Research and Development (R&D) and National Forest System (NFS) deputy areas. Research scientists are assessing key production functions and research methodologies on market and nonmarket values of public and private forestlands. Although the NFS has no staff group specifically dedicated to ecosystem services topics, it has been a leader in various ecosystem services efforts, most notably in pioneering watershed investment partnerships and in including ecosystem services language in the 2012 USFS Planning Rule, which marks the first time ecosystem services has been codified in USFS policy.¹ The rule directly calls for addressing ecosystem services in forest plans, assessments, and project implementation. A formal process for applying the ecosystem services concept in forest planning is being developed by the USFS Ecosystem Services Evaluation Framework (ESEF) team.

In late May 2012, a cross-deputy USFS community of ecosystem services practitioners held its first-ever Ecosystem Services Champions Forum to begin a dialogue on strategic direction for the agency around ecosystem services. In January 2013, the Associate Deputy Chiefs (ADC) signed a charter to establish the National Ecosystem Services Strategy Team (NESST). At the team’s core are scientists from the R&D deputy area, program specialists from the S&PF deputy area, and NFS planners and economists. The purpose of NESST is “to collaboratively develop national strategy and policy around ecosystem services and integrate it into Forest Service programs and operations.” The team represents the agency’s first effort to look broadly across all deputy areas and comprehensively assess opportunities to incorporate ecosystem services approaches into USFS programs and activities.

National Ecosystem Services Strategy Team (NESST) Overview and Objectives

NESST has several objectives. One is to develop a shared language and understanding of ecosystem services in order to clearly articulate the ecosystem services concept both internally for the agency and externally with USFS stakeholders. Another objective is to assess opportunities to integrate ecosystem services approaches into USFS programs and activities through investigation of legal authorities, current guidance, best management practices, managerial tools, and needs and capacity requirements. An interim report will describe this work, but a central goal of NESST is to collaboratively define ecosystem services policy and

¹ See http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362536.pdf.

institutionalize it through publication in the *U.S. Forest Service Manual*, the *U.S. Forest Service Handbook*, or both.

Identifying Opportunities

NESST has developed an inventory of USFS programs and activities with potential for integrating an ecosystem services approach into operations. These opportunities fall into three categories: analysis and decision making, measurement and reporting, and investment in ecosystem services partnerships.

The USFS is extensively involved in decision making, funding allocations, and priority setting for both public and private forests. Ecosystem services concepts can support all of these activities. The 2012 Planning Rule mandates that forest plans “guide management of NFS lands so that they ... have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future” (77 FR 21162, Section 219.1). This directive is being implemented by a number of “early adopter” forests. Other efforts to incorporate ecosystem services into agency decision making include consideration of the services in project-level National Environmental Policy Act analyses and damage assessments. The USFS is also helping states address ecosystem services flows, benefits, or values in statewide forest action plans.

Rather than focusing on outputs (e.g., acres treated), the traditional USFS performance metric, ecosystem services measurement and reporting focuses on outcomes, impacts, and benefits. The agency is using these types of metrics in accomplishment and performance reporting. For example, in November 2012, the USFS Sustainable Landscape Board of Directors was tasked to work with the Strategic Performance, Budget, and Analysis Office to improve agency-wide performance measures to better capture the outcomes and impacts of agency activities. The agency is also supportive of ecosystem services metrics in measuring environmental credits in ecosystem service markets. It has been involved with the Counting on the Environment project that developed an integrated, functions-based protocol for calculating ecosystem services provided by restoration of wetlands, riparian areas, salmonid habitat, and prairie.² Finalized in 2009, this protocol is being used as a national model for ecosystem services markets.

The USFS has been increasingly involved in ecosystem services partnerships. In the watershed investment arena, it collaborated with the Denver Water Board to cooperatively commit \$32 million for improved forest restoration work in Denver’s municipal watershed to avoid damage to water quality caused by large wildfires. In November 2012, the city of Flagstaff, Arizona, passed a bond measure committing \$10 million to the USFS for improved forest restoration to reduce risk of flooding in Flagstaff.

The USFS is exploring other innovative financial partnerships with recipients of ecosystem services benefits such as electric utilities interested in contributing to fire risk reduction in areas that may threaten power lines. Other ecosystem services investment opportunities include helping incentivize private landowners to provide ecosystem service benefits to the public (through the Cooperative Forestry Assistance Act programs, environmental markets, and other initiatives), and mitigating environmental damages to National Forests.³ One example is a collaborative effort with the Eugene Water and Electric Board to design a voluntary payment incentive program that protects high-quality riparian areas on private lands to benefit Eugene, Oregon’s drinking water supply.

² See http://willamettepartnership.org/ongoing-projects-and-activities/wp_nrcs_project2pager-11-06-08-_2_.pdf.

³ See <http://www.house.gov/legcoun/Comps/Cooperative%20Forestry%20Assistance%20Act%20of%201978.pdf>.

Next Steps

The USFS has already taken advantage of some opportunities to take an ecosystem services approach in its programs and activities—the USFS Planning Rule is a good example. NESST identified five focus areas for taking advantage of potential additional opportunities:

- **Policy Development:** Develop broad national policy to support an ecosystem services approach. Policy could clarify USFS roles, requirements, and legal sideboards for some programs and activities.
- **Guidance:** Develop a detailed process for applying ecosystem services policy in decision making. The ESEF has developed ecosystem services guidance for one existing agency policy.
- **Data, Tools, and Research Methodologies:** Develop an effective approach to translate biophysical outputs and spatial units of management activity into ecosystem services metrics. USFS Research & Development is beginning to develop some of these metrics, methodologies, and valuation techniques, as are USFS partners and academic institutions, but many gaps remain, particularly with regard to implementation.
- **Capacity:** Build support for ecosystem services approaches throughout the USFS by developing (1) one shared definition of ecosystem services; (2) training, internal communications, and recommendations for implementing ecosystem services into agency programs; and (3) articulating the concept's relevance to the agency's mission.
- **Communications and Collaborations:** Develop effective communication on the ecosystem services concept with the public to better describe how forests provide important benefits, including non-market (cultural, recreational, spiritual) values.

NESST is developing a cohesive vision for how ecosystem services can be integrated into USFS programs and activities. The agency has already succeeded at several efforts in this area. Most notably, the ESEF team was formed to facilitate implementation of the ecosystem services provisions of the 2012 Planning Rule. Similar groups are forming to focus on other opportunities for incorporating ecosystem services into the national Inventory, Monitoring, and Assessment framework and into restructuring of national performance measures. NESST provides broad national-scale direction for the agency but will depend on examples of ecosystem services approaches that are implemented at the project and forest scale. These efforts can leverage partnerships with non-governmental organizations and private forest landowners and managers. These groups can help the agency fully incorporate ecosystem services into decision making, measuring, and reporting, and can support and catalyze effective investment in ecosystem services.

How to cite:

Deal, R., E. Weidner, and N. Smith. 2014. "Integrating Ecosystem Services into U.S. Forest Service Programs and Operations." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

National Oceanic and Atmospheric Administration

A Heuristic Framework for Evaluating Ecosystem Services in Coastal and Marine Environments: Marine InVEST

Authors

Mark Plummer, National Oceanic and Atmospheric Administration
Micah Efron, National Oceanic and Atmospheric Administration
Howard Townsend, National Oceanic and Atmospheric Administration

Created 2014



Photo courtesy of the National Oceanic and Atmospheric Administration

Project Overview

Many scientific diagnoses of declining marine species and habitats and of recreational use patterns along U.S. coasts point to upland and freshwater sources of imperilment. A growing number of scientists argue that the best hope for protecting marine resources for multiple uses is to consider larger-scale processes, including activities that take place on land, when designing management strategies. But how inclusion of land- and water-use practices in strategies to sustain coastal marine resources affects management outcomes is poorly understood. The goal of this research is to assess the importance of including these practices in the management of coastal marine resources, using an ecosystem services framework. An ecosystem services framework provides a clear and novel path forward—one that integrates ecological processes with socioeconomic behavior and values.

The specific objectives of the research are to develop a set of linked watershed-marine models with ecosystem service outputs to evaluate management strategies for coastal resources and to apply those models to three case studies: Puget Sound, Galveston Bay, and Chesapeake Bay. In each case, we compare the strength and influence of watershed activities on key ecosystem services and ask how outcomes of marine resource management strategies are affected by including coastal watershed processes. We also explore a limited set of climate change scenarios. We estimate ecosystem services and their values using production function approaches, focusing on how changes in system function driven by land use management and climate change lead to changes in the provisioning of food from selected fisheries. Future work may extend this analysis to aquaculture, recreation, and coastal protection.

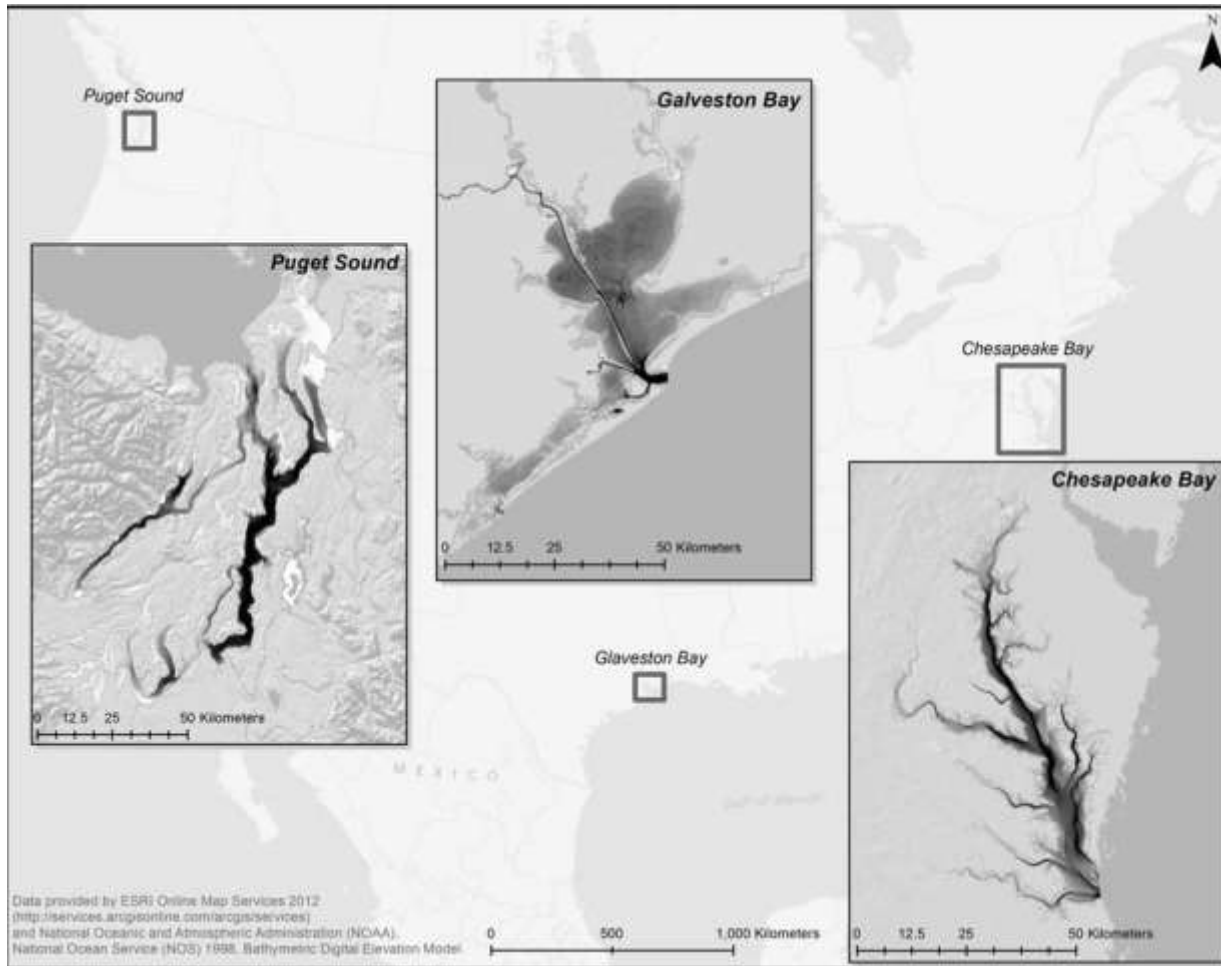
Project Description

This project originated from staff-led interest. Staff recognized that many diagnoses of declining marine species and habitats along U.S. coasts point to upland and freshwater stressors; however, few studies have examined how and whether activities on land affect marine resources, and few management efforts have used quantitative linkages between land use management and marine resources to inform decision making. Similarly, although the effects of climate change on coastal systems are fairly well quantified, few studies have explored how alternative land- and water-use management strategies and climate scenarios will likely influence the delivery of marine ecosystem services. Although NOAA may have no direct connection with the development and implementation of these management strategies, it can provide scientific support to state and other agencies that are responsible for land- and water-use policies.

NOAA/NMFS scientists from the Northwest Fisheries Science Center, Southeast Fisheries Science Center–Galveston Laboratory, and Habitat Conservation Division/Chesapeake Bay Program teamed with scientists from the Natural Capital project (a partnership of Stanford University, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund) to develop a proposal for funding for the project.¹ The proposal was to develop a set of linked watershed-marine models using an ecosystem services framework to evaluate the effects of management and climate change on ecosystem service outputs. We chose three locations for conducting the analysis: Puget Sound, Galveston Bay, and Chesapeake Bay (Figure 17). We chose these locations on the basis of similarities in important ecosystem services (commercial and recreational shellfish harvests) and the availability of NOAA/NMFS staff in each location.

¹ <http://www.naturalcapitalproject.org>.

Figure 17. Project Locations.



Source: Carey et al. (2013).

The decision to pursue this project was based on no particular NOAA/NMFS (National Marine Fisheries Service) planning or regulatory decision-making processes. Instead, staff viewed the project as an important scientific contribution that could inform and support both such processes and state agency efforts to manage coastal resources. (State fisheries management agencies were not partners in the proposal but were involved on a voluntary basis, providing data on harvest, landings, and licensing.) We did not intend the project to be immediately integrated into a particular agency process; therefore, we did not consider programmatic and implementation responsibility for utilizing project results. If the project were implemented on an operational basis, participation by state fisheries management agencies as well as local land use management/planning agencies would be needed.

In April 2010, we were awarded funding through the Comparative Analysis of Marine Ecosystem Organization (CAMEO) program, a joint program with NOAA/NMFS and The National Science Foundation to hire post-doctoral researchers and contractors to develop linked watershed-marine ecosystem service models to evaluate coastal management.² In addition to the CAMEO

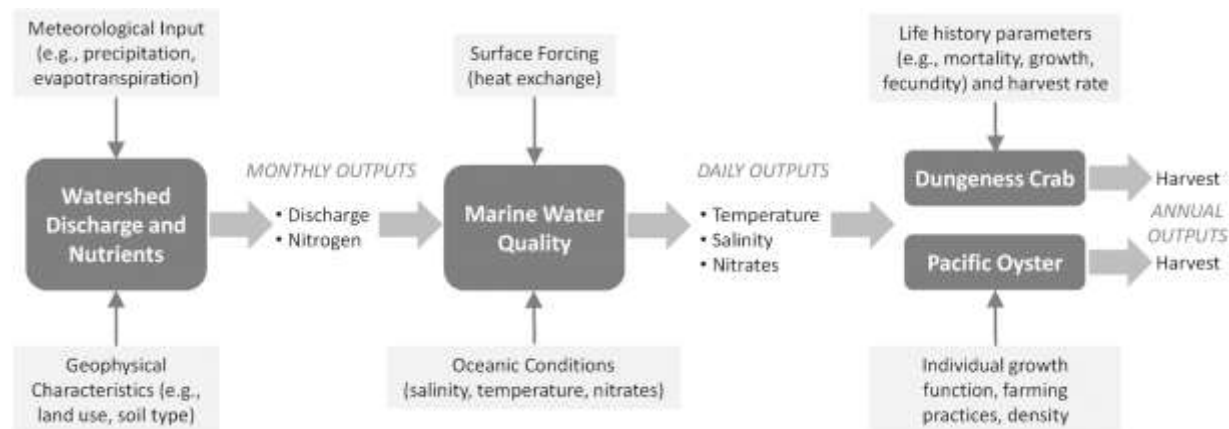
² <http://cameo.noaa.gov>.

funding, which ended in 2012, the project utilized federal staff scientists. Because these staff scientists and their partner scientists at the Natural Capital Project were familiar with scientific literature on ecosystem services and had experience in constructing and using models of ecosystem services supply and demand, they needed no training in conducting ecosystem services analysis.

We first developed and applied our framework to fisheries and aquaculture management in the Hood Canal of Puget Sound. To illustrate the influence of watershed processes on marine ecosystem services provided by the Hood Canal, we modeled the sensitivities of Dungeness crab and Pacific oyster harvests to changes in land use and large-scale ocean and climate drivers. For land use, we evaluated a scenario of possible land cover changes that was previously generated as part of a project to envision possible futures in Puget Sound (Bolte and Vache 2010). Land cover categories included developed, forest, grasslands, planted and cultivated, and wetland land covers, all of which could be affected by land use decisions or restoration and conservation decisions.

The final ecosystem goods and services evaluated were crab and oyster biomasses available for commercial and recreational harvest. The team developed or re-parameterized simple process models to link the land use changes and climate change to (1) watershed discharge and nutrients, (2) marine water quality, (3) Dungeness crab populations available for harvest, and (4) Pacific oyster populations available for harvest (Figure 18). The existing models used in the analysis were drawn from the InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) and Marine InVEST toolbox.

Figure 18. Conceptual Diagram of Watershed Marine Model Linkages.



Source: Toft et al. (2013).

Note: Primary inputs and outputs of each model and temporal resolution of outputs are noted.

For ecosystem services values, the gross commercial value of oyster and crab harvest was measured as the net present value of the biomass based on ex-vessel prices. The recreational value of crabs was measured as willingness to pay for recreational fishing opportunities (as estimated by travel costs).

Because the initial application of the framework was on watershed-marine linkages for a limited set of ecosystem services, we have not yet explored the issue of trade-offs among the full set of ecosystem services covered by the InVEST models. Moreover, because the project has not been implemented on an operational basis, we have neither identified nor developed

governance and management structures for evaluating trade-offs and conflicts between land use planning and fisheries management.

We have published some of these models, which were applied to fisheries and aquaculture management in the Hood Canal of Puget Sound (Toft et al. 2013). We have also explored some of the research questions in the context of loop analysis in all three locations (Puget Sound, Galveston Bay, and Chesapeake Bay) (Carey et al. 2013). A broader framework is under development, pending funding, for the Rappahannock River, Chesapeake Bay, and Galveston Bay.

Decision Context

Holistic ecosystem approaches to marine and coastal management can greatly improve our ability to predict the consequences of management decisions in a complex physical and political environment. Demonstrating the benefits of ecosystem-based management (EBM) approaches can promote cooperation among the various local, state, and federal agencies responsible for stewardship of natural resources. However, implementing ecosystem-based management across vast land and seascapes presents a major challenge. Coordination and collaboration across jurisdictional boundaries is impeded by agencies' differing legislative mandates, priorities, operational processes, and organizational cultures.

As NOAA works with the fisheries management councils to shift from single-species management to an EBM approach, it is crucial that we develop a better understanding of “where marine resource managers should target watershed-based pressures, and under what conditions near-shore strategies are sufficient to protect or recover recreationally, commercially, and culturally important marine species” (Toft et al. 2013). This project, which experiments with a modeling approach to investigate the water quality impacts, under different climate scenarios, of land-based runoff on wild and farmed shellfish, helps advance the emerging science of spatially explicit, production function-based ecosystem services assessments. It has several potential management applications:

- The project shows that shellfish, for the most part, responded positively to increased sources of land-based runoff, but several ecological processes that likely would have had a negative impact on shellfish were not modeled. Thus, land-sea linkages that may affect fisheries should be further investigated. Gaining a better understanding of even the rough magnitude of the potential impacts of specific ecological processes on fisheries would help NOAA determine where to target its mitigation efforts.
- The project demonstrates the importance—and challenge—of attempting to account for all relevant ecological relationships that, taken together, deliver benefits to society. A modeling approach that fails to account for ecological processes on land that affect marine systems or that fails to include a subset of processes within a given system may lead decision makers astray. This point highlights the particular importance of investigating and explicitly stating the uncertainty associated with ecosystem services assessments.
- The project reveals how an ecosystem services framework highlights the need for better integration both within and among natural resources management organizations. Land-based sources of water pollution affect not only fisheries but also other services that NOAA is concerned with, such as beach recreation and protection of threatened and endangered species, not to mention services under the purview of other agencies (e.g., drinking water under the purview of the U.S. Environmental Protection Agency).

Therefore, an ecosystem services framework reveals the benefits of collaboration and potential synergies that might otherwise be overlooked.

In summary, this project emphasizes that the ecosystem services framework has much to offer, but that its full potential cannot be realized until methodological, political, legal, and institutional barriers are overcome. The integrated nature of this framework stands in stark contrast to the silo management approach that often characterizes natural resources management in the United States. NOAA is eager to engage its partners in efforts to tackle management problems from the more holistic perspective that the ecosystem services framework offers.

References

Bolte, J., and K. Vache. 2010. "Envisioning Puget Sound Alternatives Futures." Report prepared for the Washington Department of Fish and Wildlife in support of the Puget Sound Nearshore Ecosystem Restoration Project by the Department of Biological and Ecological Engineering, Oregon State University, Corvallis, OR.

Carey, M.P., P.S. Levin, H. Townsend, T.J. Minello, G.R. Sutton, T. Francis, C.J. Harvey, J.E. Toft, K.K. Arkema, J.L. Burke, C-K Kim, A. Guerry, M. Plummer, G. Spiridonov, and M. Ruckelshaus. 2013. "Characterizing Coastal Foodwebs with Qualitative Links to Bridge the Gap between the Theory and the Practice of Ecosystem-Based Management." *ICES Journal of Marine Science*. doi:10.1093/icesjms/fst012.

Toft, J.E., J.L. Burke, M.P. Carey, C.K. Kim, M. Marsik, D.A. Sutherland, K.K. Arkema, A.D. Guerry, P.S. Levin, T.J. Minello, M. Plummer, M.H. Ruckelshaus, and H.M. Townsend. 2013. "From Mountains to Sound: Modeling the Sensitivity of Dungeness Crab and Pacific Oyster to Land–Sea Interactions in Hood Canal, WA." *ICES Journal of Marine Science*. doi:10.1093/icesjms/fst072.

Acknowledgments:

The Comparative Analysis of Marine Ecosystems (CAMEO) program, a joint NOAA–National Science Foundation program, funded the work described in this report. The Northwest Fisheries Science Center (NOAA Fisheries) and the Natural Capital Project at Stanford University also provided support.

How to cite:

Plummer, M. M. Effron, and H. Townsend. 2014. "A Heuristic Framework for Evaluating Ecosystem Services in Coastal and Marine Environments: Marine InVEST." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

National Oceanic and Atmospheric Administration

Operationalizing and Leveraging an Ecosystem Services Framework for Habitat Conservation: Coastal Blue Carbon

Authors

Ariana Sutton-Grier, University of Maryland and
National Oceanic and Atmospheric Administration

Created 2014

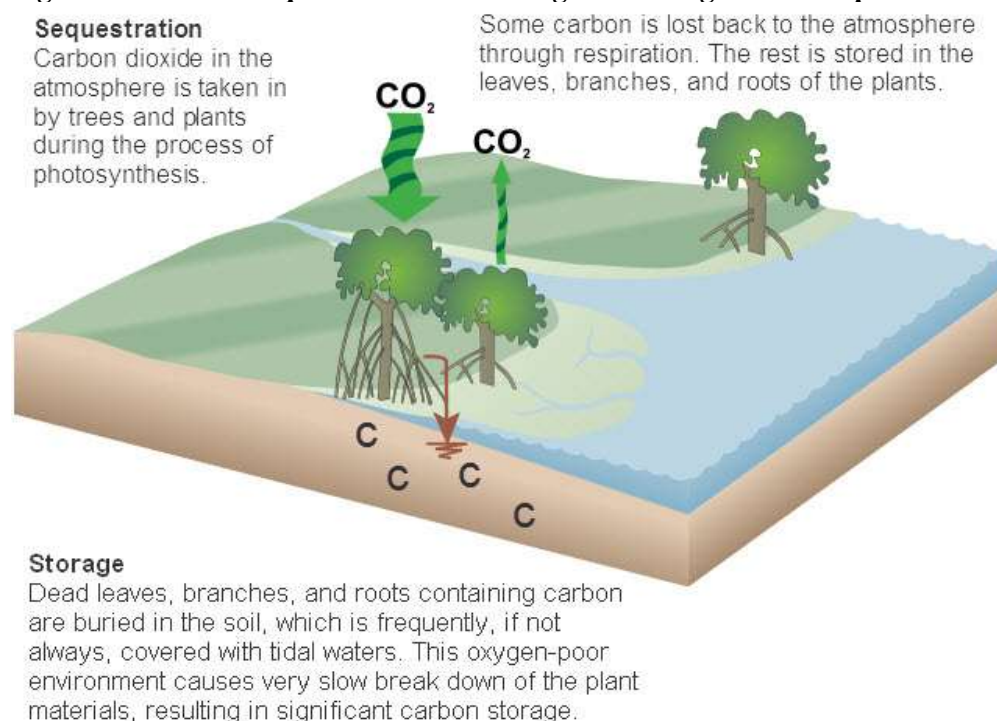


Photo courtesy of the National Oceanic and Atmospheric Administration

Background

Blue carbon is the carbon sequestered (meaning taken up by biological organisms) and stored in marine and coastal habitats (Figure 19). Coastal blue carbon is the portion of blue carbon in coastal habitats, and refers specifically to three habitats: mangroves, salt marshes, and seagrass meadows.

Figure 19. Carbon Sequestration and Storage in a Mangrove Swamp.



Source: NOAA Office of Habitat Conservation.

Coastal habitats play an important role in the global carbon cycle by sequestering large amounts of carbon annually and storing carbon for long periods of time (decades to centuries). Recent studies have determined that blue carbon habitats annually sequester 10 times as much carbon as terrestrial forest ecosystems such that, even though blue carbon habitats represent a smaller total area on the planet, they are an approximately equivalent sink to forest systems (McLeod et al. 2011). Despite the impressive rates of carbon sequestration and storage in coastal ecosystems, however, human activities, including climate change, urbanization, and unsustainable aquaculture, are contributing to the rapid degradation or destruction of these habitats worldwide: 0.7–7% of total global area are lost per year (McLeod et al. 2011). When these habitats are degraded or lost, we lose not only their capacity to sequester carbon each year, but also long-term storage of carbon in their soils; important natural carbon sinks become large greenhouse gas sources. Protecting or restoring these coastal habitats can therefore be a win-win situation that will not only contribute to climate mitigation efforts, but also provide further incentives to conserve ecosystems on which humans depend for a wide variety of other valuable ecosystem services, including nursery habitats for fisheries, storm protection, tourism and recreational opportunities, and water quality improvements.

Figure 20. Examples of Coastal Blue Carbon Habitats.



Source: NOAA.

NOAA's Coastal Blue Carbon Projects

Two primary projects have resulted from NOAA's coastal blue carbon efforts to date. First, in part to meet milestones in the National Ocean Policy related to coastal habitat restoration, NOAA led a policy analysis examining whether coastal blue carbon is currently being included in the implementation of any federal policies.¹ Two studies investigated the potential role of coastal blue carbon in federal regulations and statutes, including the Clean Water Act, the Coastal Zone Management Act, the Natural Resources Damage Assessment process, the Endangered Species Act, the Principles and Guidelines for federal water projects (P&G), and the National Environmental Policy Act (Sutton-Grier et al. 2013; Pendleton and Sutton-Grier et al. 2013). These analyses demonstrated that coastal blue carbon is not included in the implementation of these policies, but that it could be included in all of them without any changes to the legislation. They also determined that if coastal blue carbon were included, the outcome of implementation of these policies, which currently focus on living resources, could change. For example, consider the possible outcome of reflecting carbon services in Clean Water Act mitigation requirements. Because blue carbon habitats have such high rates of carbon sequestration—approximately 10 times that of forested ecosystems (McLeod et al. 2011)—and because they store large amounts of carbon that is decades to centuries old, mitigation ratios that would offset the loss of carbon sequestration and storage would likely be much higher than current mitigation ratios that offset the loss of living resources such as habitat. Or consider the possible outcome of reflecting carbon services in the Natural Resources Damage Assessment process, which involves determining the habitat equivalency for injured ecosystems. If carbon services were to be reflected in coastal ecosystem damage assessments, these assessments would increase sharply. Consequently, more restoration would be necessary to offset the lost services (damages).

Carbon services are not considered in policy implementation because of (1) a lack of guidance on how to incorporate them into that implementation, (2) a lack of standard methods for measuring and valuing them, and (3) a lack of capacity in federal agencies for assessing proposed projects or actions' impacts on them. For more specific details of these analyses, see Sutton-Grier et al. (2013) and Pendleton and Sutton-Grier et al. (2013). Overall, including

¹ <http://www.whitehouse.gov/files/documents/2010stewardship-eo.pdf>.

carbon services in the implementation of federal policies could lead to additional habitat conservation—through additional restoration, as described above, or agency decisions that could lead to additional protection.

A second project is a scientific research project funded at one of the National Estuarine Research Reserve Systems (NERRS) that focuses on understanding how nitrogen pollution affects the sequestration and emission of greenhouse gases (carbon dioxide, nitrous oxide, and methane) in estuarine wetlands.² One of the goals of this effort is to develop a carbon-offset protocol for coastal wetlands, which would allow carbon in wetlands to be included in voluntary markets. (For more information, visit <http://wbnerwetlandscarbon.net/>).

Decision Context

NOAA focuses its coastal blue carbon efforts on carbon sequestration and storage. It wants other federal agencies to recognize that preserving these carbon services leads to protection or restoration of entire ecosystems and hence protects all the other services these ecosystems provide (storm protection, nursery habitat, water filtration, and so on). Valuing the carbon in coastal habitats is one tool that can lead to additional habitat protection or restoration—through changes in the implementation of policies or through additional funding via carbon markets. Thus, for NOAA, the end goal is coastal habitat conservation, and carbon services are one tool to achieve that goal.

NOAA hopes its efforts related to coastal blue carbon will affect planning, management, and implementation of policies in several ways. As mentioned above, the two recent policy analyses (Sutton-Grier et al. 2013 and Pendleton and Sutton-Grier et al. 2013) suggest ways in which the carbon services provided by ecosystems can be incorporated into federal policies and thereby potentially lead to additional habitat conservation. Other NOAA activities support the development of carbon market mechanisms that could promote habitat conservation. For example, NOAA helped fund some studies needed to inform the development of a methodology for getting voluntary carbon credits for restored wetlands. This methodology was submitted for review in December 2013 to the Verified Carbon Standard (VCS).³ If it is approved, anyone around the world could potentially receive carbon credits for wetland restoration projects. Overall, NOAA has supported, and will continue to support, a number of blue carbon science and policy efforts with the end goal of protecting and restoring more coastal habitats in the United States and around the world.

NOAA Coastal Blue Carbon Capacity and Partners

NOAA leadership became interested in coastal blue carbon during the fall of 2010, in large part because of updates presented to NOAA on the work of partners, primarily Conservation International (CI) and Restore America's Estuaries (RAE).⁴ It requested an analysis of the state of coastal blue carbon science and policy and subsequently, a work plan for how NOAA could best leverage its resources and engage in coastal blue carbon activities. To perform these tasks, the NOAA Coastal Blue Carbon team was formed in January 2011. Its ad hoc members come from many of the NOAA line offices. Other team members come from NOAA's International Office, Office of Habitat Conservation, Marine Protected Areas Office, and Climate Program Office.

² <http://www.nerrs.noaa.gov>.

³ <http://www.v-c-s.org>.

⁴ <http://www.conservation.org/Pages/default.aspx>; <http://www.estuaries.org>.

NOAA has capitalized on a great deal of existing resources to make progress on coastal blue carbon. We have used our expertise in coastal habitat science, carbon dynamics of ecosystems, and biogeochemistry to understand the science of blue carbon. We have used our expertise in federal policies related to fisheries and coastal ecosystem management to assess the state of U.S. policy related to blue carbon. We have used our expertise in climate negotiations to understand the international policy landscape related to blue carbon. NOAA has also relied on data available in reports and peer-reviewed publications to inform its analysis of coastal blue carbon science and policy opportunities, particularly to understand the amount and dynamics of carbon sequestered and stored in coastal habitats as well as the negative impacts when these habitats are degraded or destroyed. Although we are not yet calculating trade-offs between carbon services and other ecosystem services in coastal habitats, we are tracking the development of a new tool that will help us do so. The tool Marine InVEST will soon have the capability to model carbon sequestration and storage, allowing us to assess trade-offs between carbon and other ecosystem services when doing coastal and marine spatial planning.⁵

NOAA has two primary coastal blue carbon leaders or champions: Paul Sandifer, chief science adviser for the National Ocean Service, and Craig McLean, deputy assistant administrator for program and administration in Oceanic and Atmospheric Research (OAR). But we have no programmatic home for coastal blue carbon, and no specific office has taken responsibility for implementing actions in the coastal blue carbon work plan. The Coastal Blue Carbon Team has implemented actions as they relate to members' other job duties, such as climate change mitigation and adaptation, international partnerships, and habitat conservation.

No new funding has been directed to NOAA's coastal blue carbon efforts. All these efforts have relied on existing programmatic funding. Additional funding to fill gaps in coastal blue carbon science is particularly needed.

Given its budget constraints, NOAA has relied on its partners to help make progress on blue carbon efforts. We have worked closely with RAE and CI as well as with outside partners, including the International Union for the Conservation of Nature and colleagues in the Nicholas Institute for Environmental Policy Solutions at Duke University. In the spring of 2011, we established the Coastal Blue Carbon Interagency Team, which is co-led by NOAA and the Fish and Wildlife Service (FWS) and includes representatives of the EPA, the U.S. Geological Service, the Forest Service, USAID, and the U.S. State Department. Participation is voluntary, and to date the team has focused on information sharing.

Conclusion

NOAA, like most federal agencies, is working out how best to use an ecosystem services framework to improve its natural resource management. One of our primary responsibilities, protecting fisheries, is a key ecosystem service, but NOAA is also concerned with coastal habitat conservation and restoration, the protection of coastal communities and economies, and marine transportation and commerce, among many other priorities. All of these have connections to ecosystem services and the benefits people receive from healthy oceans and coasts. Our blue carbon efforts are still relatively new, but the hope is that the lessons learned from blue carbon activities and partnerships will help inform the development and application of an ecosystem services framework that can guide future agency activities.

⁵ http://www.naturalcapitalproject.org/pubs/marine/MarineInVEST_Belize.pdf.
NESPGuidebook.com

References

McLeod E., G.L. Chmura, S. Bouillon, R. Salm, M. Bjork, C.M. Duarte, C.E. Lovelock, W.H. Schlesinger, and B.R. Silliman 2011. "A Blueprint for Blue Carbon: Toward an Improved Understanding of the Role of Vegetated Coastal Habitats in Sequestering CO₂." *Frontiers in Ecology and the Environment* 9: 552–60.

Pendleton, L.H., A.E. Sutton-Grier, D.R. Gordon, B.C. Murray, B.E. Victor, R.B. Griffis, J.A.V. Lechuga, and C. Giri. 2013. "Considering 'Coastal Carbon' in Existing U.S. Federal Statutes and Policies." *Coastal Management* 41(5). doi: 10.1080/08920753.2013.822294.

Sutton-Grier, A.E., A. K. Moore, P.C. Wiley, and P.E.T. Edwards. 2013. "Incorporating Ecosystem Services into the Implementation of Existing U.S. Natural Resource Management Regulations: The Case for Carbon Sequestration and Storage." *Marine Policy* 43: 246–253. doi: <http://dx.doi.org/10.1016/j.marpol.2013.06.003>.

Acknowledgments:

The NOAA Coastal Blue Carbon Team helped to move these efforts forward at National Oceanic and Atmospheric Administration and with partners.

How to cite:

Sutton-Grier, A. 2014. "Operationalizing and Leveraging an Ecosystem Services Framework for Habitat Conservation: Coastal Blue Carbon." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

National Park Service

**Estimation of Potential Losses from Ozone Damage to the
Great Smoky Mountains National Park's Climate
Regulation and Water Provision Services**

Author

Andrew Bingham, National Park Service

Created 2015



Motivation

The mission of the National Park Service (NPS) explicitly recognizes the strong connection between natural landscapes and human well-being:

The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.
(<http://www.nps.gov/aboutus/index.htm>)

The public generally appreciates the recreational, educational, and inspirational benefits provided by the national parks, but it may be less aware of the many other vital ecosystem services provided by parks—services that may be relevant to decisions regarding park management and protection. A benefit of applying an ecosystem services framework to decision making is to illuminate the less apparent ecosystem service tradeoffs associated with these decisions.

The NPS undertook a study to educate the public and NPS partner resource management and regulatory agencies about the importance to human well-being of two important services provided by Great Smoky Mountains National Park: climate stabilization (via changes in carbon sequestration potential) and water provision (via streamflow changes). Although national parks are among the most protected areas in the country, some threats to park ecosystems—such as air pollution—originate outside the jurisdiction of the NPS and can have detrimental effects on park resources. Integrating ecosystem service concepts, such as those evaluated in this study, into air quality management decisions provides a more complete picture of the effects of air pollution on people and communities. The NPS accordingly undertook this study to establish the foundation and provide context for measures that other state and federal agencies may undertake to improve air quality.

Decision Context

The National Park Service holds no regulatory authority with respect to air pollution control, yet it is charged in its Organic Act (16 U.S.C. § 1) with conserving resources unimpaired for future generations. It is therefore in the interest of the NPS to work cooperatively with regulators and other stakeholders to prevent or minimize air quality-related threats to national parks.

Ground-level ozone is a human-made pollutant that can damage vegetation and upset the water balance of forest ecosystems. Specifically, ozone damage to vegetation in forests can (1) reduce the potential for the ecosystem to remove carbon dioxide from the atmosphere through reduced tree growth and carbon accumulation, and (2) increase water loss through impairment of leaf stomata, which enhances evapotranspiration, increasing water use by the tree and thereby decreasing streamflow.

This study demonstrates to the regulators and other stakeholders the feasibility and importance of integrating these kinds of ecosystem service concepts into their program and policy analyses. The U.S. Environmental Protection Agency (EPA) is responsible for the development and enforcement of most atmospheric pollutant regulations as directed by the Clean Air Act and its amendments. The EPA sets ambient air standards for several pollutants of concern to the National Park Service, including ozone (O₃), sulfur oxides (SO_x), and nitrogen oxides (NO_x). A primary standard is set for human health protection and a secondary standard is set for environmental and ecosystem protection. Although to date all secondary standards have been

set equal to primary standards, the EPA makes explicit use of effects to ecosystem services in its discussions of secondary standards, as outlined in other case studies in this guidebook. These examples of effects on protected areas such as national parks can help inform regulatory and policy development and implementation.

This framework can provide an additional tool for evaluating effects to park resources from changes to air quality in a number of management contexts. Ecosystem services frameworks are often used to evaluate tradeoffs inherent in alternative land use scenarios. Studies such as this one can help NPS, its partners, and the public better understand tradeoffs and costs associated when air pollution interacts with protected park ecosystems.

Location

This analysis is based on the deciduous forest ecosystems of Great Smoky Mountains National Park. The park, straddling the border of North Carolina and Tennessee, is the headwaters for 45 watersheds, and it protects more than half of the old-growth forest remaining in the eastern United States. The NPS chose this site for study because of observed damage to park resources from ozone pollution, which can sometimes reach levels higher than those in nearby urban areas such as Atlanta or Knoxville. The relatively large area of the park also suggests that the natural benefits it provides to nearby communities are likely substantial. Furthermore, by focusing on this site, the NPS was able to leverage existing site-specific studies quantifying the effects of ozone exposure on tree growth and streamflow and to take the next step toward translating these ecological effects into meaningful measures of changes in human well-being.

Key Players, Existing Resources, and Organizational Capacity

This analysis, undertaken by the National Park Service's Air Resources Division (ARD), is based on existing data and studies in the ecological scientific literature. The NPS as a whole and the ARD specifically have a strong commitment to developing an ecosystem services approach to highlight the positive contributions of protected areas to human well-being. NPS ARD staff have been building the skills and capacity needed to use ecosystem services frameworks to protect park resources from damaging air pollution.

Although no mandate requires this analysis, the NPS undertook it in recognition of the critical need for information on the implications of air quality management on protected landscapes and their associated ecosystem services. The NPS hopes to promote interest in further studies to better quantify the effects of air quality changes on ecosystem services. Subsequent studies may benefit from a broadened scope and additional primary data gathering and therefore would likely require additional funding and capacity, which might be obtained through partnerships with other experts (such as modelers), other agencies, academics, and other stakeholders.

Analysis

Using peer-reviewed studies conducted on similar ecosystems in and near Great Smoky Mountains National Park, the NPS estimated the potential loss from ozone damage to two ecosystem services: climate regulation (through the intermediate service of carbon sequestration) and water provisioning (through streamflow). These ecosystem functions benefit humans by helping to mitigate climate change and all its negative impacts and by providing downstream beneficiaries with water for drinking and other household use, agriculture, recreation, and hydropower.

Quantified changes to the ecosystem due to air pollution have been translated into changes in the benefits humans receive from these same ecosystems. The study employs the following general methodology:

- Compare ecosystem services production at different ozone concentrations in order to estimate changes in that production at alternative ozone concentrations. Ozone levels to be compared were those used in peer-reviewed and published studies in and near the park.
- Using empirical values from existing studies, calculate effects over the scale of the entire park. This task was achievable because the data were from ecosystems in or near the park and because the studies aggregated individual species' responses to provide an estimate of the overall forest response.
- Identify meaningful indicators of the effects of these ecological changes on people and quantify the magnitude of those effects. Once estimates for carbon sequestration and streamflow reductions from ozone damage over the entire park were obtained, they were translated into tailpipe emissions and population served. These indicators were chosen due to their familiarity and importance to the general public and decision makers.

By quantifying the reduction in tree growth and streamflow due to ozone damage over the entire area of Great Smoky Mountains National Park, this analysis found that carbon sequestration losses in the park can reach 500,000–960,000 tons of carbon per year when ozone concentrations are at high levels. It also found that when ozone concentrations are raised by 25%, streamflow may be reduced by 109.6 million cubic meters during the dry months of August through October. Although rough, these estimates reveal the potential magnitude of the effects that air pollution can have on ecosystems and the services they provide.

Figure 21. Potential Magnitude of Air Pollution Effects on Ecosystem Services.

Study	ANPP g C m ⁻² yr ⁻¹	GSMNP t yr ⁻¹	Is 40% of (t)	Difference (t)	Equal to cars yr ⁻¹
Busing (2005)	860	1,437,760	2,396,266	958,506	688,686
Curtis <i>et al.</i> (2002)	446	745,629	1,242,714	497,085	357,156

Deciduous in GSMNP (m²): 1.67 billion

Avg Car Emissions yr⁻¹ (t C): 1.4

In addition to quantifying resource losses, this analysis transferred these losses to other metrics in order to make the information more understandable and relevant for policy makers and the general public. The 500,000–960,000 tons of annual carbon sequestration loss is equivalent to the amount of carbon emitted by approximately 360,000 to 690,000 automobiles per year. Approximately 109.6 million cubic meters of reduced streamflow is equivalent to the amount of water used by some 500,000 local residents during a three-month period. These findings help illuminate the important contributions that ecosystems without ozone damage make to human well-being and highlight the need to mitigate pollutant source emissions.

Implications

This analysis is the first step in illustrating how underappreciated benefits that protected lands provide to people and communities are threatened by air pollution. Ideally, it will provide additional justification for reducing pollution emissions that lead to high levels of ozone as well as promote additional research on the effects of air pollution on ecosystem services.

The purpose of translating the loss of carbon sequestration in terms of automobile emissions and the reduction of streamflow to impacts on a variety of municipal water users was to articulate for policy makers and the public two of the services provided by an ecosystem in the

absence of ozone pollution. The NPS may examine other ecosystem services and consider other benefit-relevant indicators to communicate this information as part of future studies. The ability to translate the detrimental effects of air pollution on park resources into tangible effects on people is crucial to demonstrating that sound air quality management has numerous anthropic benefits.

Monetizing changes to ecosystem services is not always appropriate or necessary. Because NPS is not focused on balancing multiple uses in the same manner as some other federal agencies, it thinks that monetization would not be an appropriate approach. Articulating benefits derived from protected ecosystems can be more informative for decision makers and stakeholders, though monetization could be undertaken in a subsequent analysis, for example, by evaluating carbon change using social cost of carbon values. Uncertainty in monetary estimates as well as unfamiliarity in translating aggregate monetary damages to a personally meaningful value also inhibits the value of monetization for conveying the extent of damages to non-experts. However, in many cases, the use of benefit-relevant indicators (such as water consumption in this analysis) or other metrics (such as tailpipe emissions) can be not only more appropriate, but also more powerful in conveying the various ways that air pollution impacts on an ecosystem can personally affect those who depend on the resources that a park provides.

Acknowledgments:

The author would like to thank Maura Flight of Industrial Economics, Incorporated for her valuable support and assistance in the development of this case study, as well as NESP and Katie Locklier who also provided helpful guidance and input.

How to Cite:

Bingham, Andrew. "Estimation of Potential Losses from Ozone Damage to the Great Smoky Mountains National Park's Climate Regulation and Water Provision Services"

s

National Park Service

Determining Links to the Human Beneficiary: Report from the Air Quality and Ecosystem Services Workshop

Author

Andrew Bingham, National Park Service

Created 2015



Motivation

In line with its mission, the National Park Service (NPS) frequently cooperates with other natural resource management agencies and experts to improve understanding of the connection between natural systems and human well-being. The effects of air pollution on ecosystem function have been a particular focus of the NPS's Air Resources Division (ARD). Air pollution can have many different effects on ecosystems. Fertilization (also known as eutrophication) of landscapes due to excess nitrogen deposition can alter plant communities and decrease biodiversity. Excess nitrogen and sulfur can also lead to acidification of soils, lakes, and streams, leading to loss of vital nutrients and harm to aquatic species. Critical loads (the level of deposition from the atmosphere below which no adverse impacts are thought to occur according to current knowledge) have been identified for many ecosystem components around the country and are used to pinpoint areas where air pollution may be harming ecosystems.

As described in the US Environmental Protection Agency (EPA) Science Advisory Board's report *Valuing the Protection of Ecological Systems and Services*, a challenge in communicating why ecological changes matter to people is that ecological effects are often described in terms that are meaningful only to experts (EPA-SAB-09-012, May 2009). For example, critical loads are designed to provide information about when deposition causes ecosystem harm, not to determine when effects are necessarily adverse to human well-being. In order to help bridge this gap, scientists from government agencies, NGOs, universities, and the private sector participated in a workshop in February 2015. Experts in ecology, economics, natural resource management, and air pollution policy were represented, with the goal of identifying links between atmospheric deposition effects on sensitive natural resources and the ecosystem services they provide by determining specific linkages from critical loads endpoints to ecosystem services and the human beneficiaries who use them directly. While substantial information on the effects of acidification and eutrophication in aquatic and terrestrial ecosystems has been published, little work had previously been done in establishing how specific air quality effects on plants, animals, soils, algae, and water are linked to the humans who use or enjoy them. By better elucidating the effects that degraded air quality can have on nature's benefits, NPS can better integrate air quality considerations into park management and planning processes while highlighting the many benefits the average person derives from these ecosystems and the important benefits of air pollution mitigation measures.

Decision Context

The EPA is charged with setting National Ambient Air Quality Standards (NAAQS) for several pollutants, including NO_x and SO_x. A primary standard is set for the purpose of protecting human health from direct effects of a pollutant, while a secondary standard is set to protect public welfare derived from components of nature such as soils, water, crops, vegetation, and wildlife, as well as to address their economic values. During the review process, EPA evaluates the science since the last review of the standards, generally every five years, to determine the level at which the standard should be set. Products from the workshop may be useful during this review process and may help inform the risk assessment with regard to the links between critical loads and public welfare. The linking of a change to a biological indicator via an ecological production function directly to human beneficiaries can provide important indications of the many ways humans depend on the natural world for their well-being and how appropriate air quality standards are crucial for ensuring those benefits.

Links between atmospheric deposition and ecosystem services developed during the workshop can also inform public and private land managers about how excess nitrogen and sulfur can affect those who use and depend on the landscapes they manage. For example, a result of this

workshop was the identification of a chain whereby nitrogen deposition above a critical load can alter phytoplankton communities in lakes and streams. This then causes declines in small fish and macroinvertebrates, which results in decreased piscivorous wildlife such as large fish and birds. Eleven separate human beneficiaries were identified who use this final ecosystem good, including anglers, resource-dependent businesses, and people who care about wildlife for its existence value. Illustrating the chain from atmospheric pollution to human beneficiaries can help build grassroots support for better controls on excess nitrogen emissions and inform which mitigation strategies could help the most beneficiaries. This information could then be integrated within planning and adaptation frameworks at both the park and agency level.

Location

The ecosystems covered in this workshop included any natural landscape that is adversely affected by nitrogen or sulfur deposition, including both aquatic and terrestrial ecosystems. A majority of NPS units exceed a critical load for at least one indicator, and many parks, such as Rocky Mountain National Park and Shenandoah National Park, are experiencing significant adverse effects from nitrogen and/or sulfur deposition. A critical load must have been identified in the scientific literature for a given ecosystem to have been considered in this workshop, but most ecosystems in the contiguous United States have had at least one critical load determined for a component of the ecosystem. Critical loads used as starting points varied in scale, from a single species such as balsam fir, to ecosystem-wide indicators such as changes to herbaceous cover in western coastal sage scrub. Because an objective of the workshop was to identify as many chains as possible linking critical loads to social benefits, groups were encouraged to explore any nitrogen- or sulfur-based critical load published in the scientific literature for any region of the lower 48 states.

Key Players, Existing Resources, and Organizational Capacity

The workshop was organized and run through a collaboration of the National Park Service, the U.S. Forest Service, the Environmental Protection Agency, and the Research Coordination Network on Reactive Nitrogen. In addition, experts with backgrounds in ecology and air pollution, economics, air quality policy, and natural resource management from the federal government, universities, nonprofits, and private consultancies played important roles. The National Science Foundation Research Coordination Network on Reactive Nitrogen in the Environment (under award DEB-1049744) sponsored the workshop.

The Final Ecosystem Goods and Services Classification System (FEGS-CS), developed by the EPA, was selected to identify the ecosystem services and beneficiaries affected by exceedance of critical loads. The FEGS-CS framework provided an existing resource that has been vetted and peer reviewed. It was also a desirable framework because it “provides simple guidelines for identifying ecosystem services” and is designed to reduce or eliminate many of the stumbling blocks encountered when using an ecosystem services framework, such as double counting. The straightforwardness of the system made it easier for participants with less experience using ecosystem services to get up to speed, an important consideration for getting the most production out of a short workshop.

Alone, none of the organizing groups possessed the expertise and capacity to fulfill the workshop’s goals of linking atmospheric deposition and critical loads to ecosystem services and human beneficiaries. The collaboration between groups with ecological and economic expertise was crucial to the success of the workshop; indeed it was designed so that each work group had a mix of the two.

Analysis

Experts were split into four groups according to their expertise, with each group including at least one economist. The groups were assembled based on broad effects of nitrogen and sulfur deposition on ecosystems: aquatic and terrestrial eutrophication (fertilization) and aquatic and terrestrial acidification. Starting with critical loads data for biological indicators from peer-reviewed literature, each group worked through the ecological effects of exceedance of a critical load. They identified as many ecological links as necessary until the final product produced by nature and directly used by humans—the Final Ecosystem Goods and Service (FEGS)—was identified. These ecosystem response links are known as the ecological production function and represent the supply side of ecosystem services.

The groups theorized as many chains as possible, entering each into a preformatted spreadsheet. A key task in this section was the identification of a “strength of science” score for each link of a chain to express the confidence in the scientific backing for an ecological linkage. For example, the terrestrial eutrophication team started with an identified critical load for the sagebrush-steppe ecosystem. Exceedance of this critical load has been shown to result in increased invasive grass cover. The group then brainstormed a chain (consisting of the critical load, the ecological production function, and the beneficiary) whereby this change in cover leads to an increased grass-to-forb ratio, which could in turn lead to decreased forage quality. Decreased forage quality could then lead to a shift in wildlife composition, with the FEGS being wildlife. From this FEGS, all possible beneficiaries that could be affected were identified, such as hunters or experiencers and viewers. Over all of the groups combined, 1,045 unique chains were identified, with 66 unique FEGS and 26 separate beneficiaries.

The report identified areas for possible follow-up work, such as further elucidation of chains with high strength of science scores where the ecological relationships are well documented. Additional work could also better quantify each link of the ecological production function using empirical data or focus on the demand (beneficiary) side of the equation, with the end goal in some cases being an economic valuation.

Figure 22. Example of chain linking critical load for changes in stream water nitrogen to decline in piscivorous wildlife and identifying parties potentially affected by loss of that wildlife



Implications

Often people perceive that air pollution affects only “unimportant” facets of an ecosystem such as phytoplankton or grass cover. But the participants in this workshop demonstrated how these seemingly benign changes can reverberate through an ecosystem until they affect human welfare in important ways. The sheer number of FEGS and beneficiaries affected shows the significant impacts that damage to ecosystems from air pollution can have on social and economic benefits. This includes those used directly by the beneficiary such as fish in the case of anglers, as well as nonuse services such as intrinsic or spiritual values. Brainstorming and diagramming links between changes in biological indicators and FEGS also served to identify chains where more analysis will have the greatest payoff, such as strong chains with one weak link or chains having many important beneficiaries. In addition, better knowledge of links between biological indicators and beneficiaries can inform and improve NPS management decisions and research priorities by highlighting vital hotspots of ecosystem provision that are degraded by air pollution.

This analysis may also be used by the EPA in the setting of a NO_x and SO_x secondary air quality standard. The identification of linkages between nitrogen deposition, with its effects on natural resources and ecosystems, and effects on human welfare was an important product of this workshop. The identification of so many chains and beneficiaries that are affected demonstrates the adverse effects this pollution can have on the public welfare and may help “inform the science and risk assessments with regard to the relationships between critical loads, and effects on ecosystem services.” This will help provide a public welfare context for the costs of nitrogen and sulfur pollution on the environment.

A final workshop report has been published by NPS, and a series of journal articles are planned. Now that chains and beneficiaries have been identified, it is envisioned that next steps could

involve valuation by economists of these degraded ecosystem services. The insights gained from this workshop will also allow ARD to raise awareness of the less well-known ways in which air pollution affects park ecosystems, those who enjoy them, and those who depend on the benefits they produce. Through a better understanding of the links from air pollution effects on ecosystems to effects on human well-being, NPS can better recognize all of the implications of degraded air quality, more strongly influence efforts for air pollution mitigation, and better protect the resources it manages.

Acknowledgments

The author would like to thank Maura Flight of Industrial Economics, Incorporated, for her valuable support and assistance in the development of this case study, as well as NESP and Katie Locklier, who also provided helpful guidance and input.

How to cite:

Bingham, A. 2015. "Determining Links to the Human Beneficiary: Report from the Air Quality and Ecosystem Services Workshop." In *Federal Resource Management and Ecosystem Services Guidebook*. Durham: National Ecosystem Services Partnership, Duke University, www.nespguidebook.com.

About the National Ecosystem Services Partnership

The National Ecosystem Services Partnership (NESP) engages both public and private individuals and organizations to enhance collaboration within the ecosystem services community and to strengthen coordination of policy and market implementation and research at the national level. The partnership is an initiative of Duke University's Nicholas Institute for Environmental Policy Solutions and was developed with support from the U.S. Environmental Protection Agency and with donations of expertise and time from many public and private institutions. The partnership is led by Lydia Olander, director of the Ecosystem Services Program at the Nicholas Institute, and draws on the expertise of federal agency staff, academics, NGO leaders, and ecosystem services management practitioners.

About the Nicholas Institute for Environmental Policy Solutions

Established in 2015, the Nicholas Institute for Environmental Policy Solutions at Duke University improves environmental policymaking worldwide through objective, fact-based research in the areas of climate change, economics of limiting carbon pollution, emerging environmental markets, oceans governance and coastal management, and freshwater management. The Nicholas Institute is part of Duke University and its wider community of world-class scholars. This unique resource allows the Nicholas Institute's team of economists, scientists, lawyers, and policy experts not only to deliver timely, credible analyses to a wide variety of decision makers, but also to convene decision makers to reach a shared understanding of the century's most pressing environmental problems.

The content contained in this PDF came from our online guidebook in February 2016. For the most up-to-date information, please visit nespguidebook.com.

