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Short communication

Protecting our life support systems: An inventory of U.S. federal research on ecosystem services

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ABSTRACT

In the United States, a broad range of federal resource management and environmental agencies are conducting research related to ecosystem goods and services (EGS), and government agencies at all levels are increasingly interested in measuring the outcomes of proposed decisions in terms of ecosystem service benefits. The United States Environmental Protection Agency's (USEPA) Ecosystem Services Research Program responded to the need for increased awareness of EGS efforts across agencies by conducting a web-based inventory of U.S. federal ecosystem services research. This characterization describes the breadth and focus of ecosystem services programs and projects that were ongoing or completed between April 2010 and May 2012 at nine federal agencies: the Department of Defense (DOD), Department of Energy (DOE), Department of the Interior (DOI), Department of Transportation (DOT), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), United States Army Corps of Engineers (USACE), United States Department of Agriculture (USDA), and USEPA. This paper discusses the progress, gaps, and opportunities revealed and will increase awareness of current efforts, enhance opportunities for the public and private sector to collaborate on ecosystem services work, identify high priority research areas, and help avoid duplication.

1. Introduction

Publication of the Millennium Ecosystem Assessment (2005) greatly increased global awareness of the worldwide threats to ecosystems, the benefits of ecosystem goods and services (EGS) to humans, and the decisions that impact EGS. Since then, there has been a significant increase in public and private sector attention to EGS from a research and policy perspective. An increasing number of U.S. Federal agencies with natural resource protection mandates are conducting research, managing land and water, implementing markets, and developing tools in support of conserving EGS. Federal agencies are being called upon to take action to conserve EGS. In 2009 the U.S. President issued Executive Order 13514 (The President, 2009), calling on all executive agencies and departments to "safeguard the health of our environment" and "prioritize actions based on a full accounting of both economic and social benefits and costs". A draft version of this inventory was cited in the President's Council of Advisors on Science and Technology (PCAST) (2011) report on "Sustaining Environmental Capital". The Committee on Environment, Natural Resources and Sustainability (CENRS) has asked its Subcommittee on Ecological Systems (SES) to take steps to implement the PCAST call for an inventory of federal monitoring of biodiversity and EGS. To achieve the goals outlined by PCAST, an assessment of the current state of federal EGS work is needed. This inventory will increase awareness of current efforts and enhance opportunities for the public and private sector to collaborate, leverage existing EGS work, identify high priority research areas, apply findings, and avoid duplication.[1] The full database showing all listings and a complete methodology is available online at the Ecosystem Commons website, where researchers are invited to add to what was captured through our methodology.[2]

2. Methods

We used public websites and interagency dialogs to create an inventory of federal research that specifically addresses EGS. The inventory includes programs and projects that were ongoing or completed between April 2010 and May 2012 at the following nine agencies. These agencies were also the primary invitees to dialogs

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[1] The authority for this research and the resulting analysis is contained in the Clean Water Act, Section 104, 33 U.S.C. 1254 and the Clean Air Act, Section 103, 42 U.S.C. 7403.
[2] http://ecosystemcommons.org/content/draft-federal-inventory-ecosystem-services-research-and-policy.

on EGS organized in 2010 by the Office of Management and Budget (OMB) and the Council on Environmental Quality (CEQ):

Department of Defense (DOD),
Department of Energy (DOE),
Department of the Interior (DOI),
Department of Transportation (DOT),
National Aeronautics and Space Administration (NASA),
National Oceanic and Atmospheric Administration (NOAA),
United States Army Corps of Engineers (USACE),
United States Department of Agriculture (USDA), and
United States Environmental Protection Agency (USEPA).

We performed internet searches for programs and projects using a variety of relevant search terms and investigated each agency's website for potential listings the search may have missed. This information was occasionally supplemented by follow-up conversations with the listed agency contacts. We also collaborated with the National Ecosystem Services Partnership to host two interagency exchanges between USDA, USEPA, NOAA, and DOI, which provided review of the listings that had been found to date (NESP, 2010).

In order to capture the breadth of federal EGS research, we defined ecosystem goods and services as simply "the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005). Provided there was no explicit mention of EGS, we excluded efforts with a primary focus on habitat conservation, ecosystem structure and function, production of commercial goods, and risk assessment.

This methodology created certain limitations. Programs and projects without public web pages could not be identified for inclusion. In addition, since a standardized classification system for EGS does not yet exist, our EGS classification builds upon the Millennium Ecosystem Assessment categories (Millennium Ecosystem Assessment, 2005), breaking them down into more detail. Our classification is ad hoc and we made subjective judgments based on the information available.

Fig. 1 summarizes the classifications used to characterize each listing by primary type of research (Fig. 1, column A), the ecological system type (column B), the services being assessed (column C), and type of products (column D). All relevant codes were assigned (codes not shown in figures), and a primary focus was chosen for each listing. The inventory also includes a category for grant programs; it is not shown in Fig. 1, since it was never selected as a primary type. To help prevent coding bias, two independent analysts assessed the same source websites to ensure the codes were applied consistently. Additional review was provided by principal investigators and at least two senior staff at each agency. We received reviewer feedback on 50% of the entries; only five suggested changes to the primary codes we had assigned. As a result, we have confidence in the characterization of the listings.

While we counted the number of listings to give a general sense of the work being done in a given area, what constitutes a single listing varies widely in scope and size. To provide a sense of relative size, we have classified each listing as either a program or a project (see Fig. 2). Programs contain multiple projects, at multiple sites, with many researchers engaged, over an indefinite time range. Projects are smaller, often were completed in several years, with few researchers, and existed within a larger program. Grant-making programs are listed as a single program, however only those where the majority of grants support EGS topics are included. We did not include both the umbrella program and the subprojects; only one or the other. Fig. 2 shows the relative contribution of programs and projects to each agency's total count.

A Primary Type of Research	B Ecological System Type	C Ecosystem Service Focus	D Anticipated Products
Biophysical	Agriculture	Air quality	Case studies
Market implementation and PES	Air	Climate regulation	Educational or outreach materials
Monitoring	Coast	Cultural	Journal article
Policy research and evaluation	Desert	Fiber	Original data
Resource management	Forests	Fire management	Policy support
Social research	Grasslands	Flood mitigation	Resource management practices
Valuation and market research	Green space	Food	Tools, models, or metrics
	Ground water	Freshwater provision	
	Lake	Habitat or biodiversity	
	Ocean	Human health and disease	
	Rangelands	Multiple or bundling	
	Riparian buffer	Nutrient cycling	
	Soil	Other natural hazard mitigation	
	Streams and rivers	Primary production	
	Urban	Soil quality	
	Wetlands	Timber	
		Water quality	

Fig. 1. Coding options for each inventory listing. Each listing characterized by the variables in columns A–D.