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# Managing natural wealth: Research and implementation of ecosystem services in the United States and Canada

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ABSTRACT

The United States and Canada have vast stores of ecological wealth that provide often unseen but critical benefits to the people and economy of each country. The close ties between ecology and the economy make it urgent that action is taken to address the risks of ecosystem degradation, but these close ties also present opportunities to develop new incentives for ecosystem conservation. To highlight the diversity of approaches being implemented in the US and Canada, we describe examples of programs seeking to maintain ecosystem services from wetlands, agricultural lands, forests, and water quality. Corporations are also beginning to account for ecosystem service values. Innovative solutions are being developed mostly within existing government and corporate policies that allow for ecosystem service accounting. To further mainstream ecosystem service values into broader economic decisions, new policies are necessary that not only allow but mandate their inclusion in decisions and reporting.


**Contents**



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## 1. Introduction

The United States and Canada are both rich in natural capital—with expansive forests, rivers, prairies, lakes, agricultural land, and other ecosystems. Canada contains 25% of the world's wetlands and 20% of the world's freshwater; the two countries are ranked third and fourth in forest cover (Canada has 7.9% of global, US 7.7%) (Alvarez, 2007; Dufour, 2007). Both countries contain large expanses of natural areas, playing a critical role for local, regional, and national economies. With a wide variety of human activities threatening these ecosystems, the impacts will not only be felt by wildlife, but can lead to declines in human health and well-being as well as economies (The President's Council of Advisors on Science and Technology (PCAST), 2011).

While the two countries are roughly equal in land area, the US supports a population approximately 10 times greater (Statistics Canada, 2007; Mackun and Wilson, 2011). In the US, the utilization of market-based ecosystem services has increased over the last half century, including agriculture products, forest products, and freshwater withdrawal. Agriculture has increased at a rate greater than population growth, bringing its own costs and benefits to the ecosystem and humans. Surface and groundwater use has increased 46% (1960–2000). Commercial fish and shellfish landings have increased 90% (1950–2005); however, since 1978, only Alaska has experienced increases, while other regions have declined (The H. John Heinz III Center for Science Economics and the Environment, 2008). In Canada, logging harvest rates have increased substantially since the start of cumulative data collection in 1920, with a 60% increase in harvest rates between 1975 and 1988 (Global Forest Watch, 2000). The extent of agricultural lands only slightly increased between 1921 and 2011, and in recent years there has been a shift from livestock to crops (Statistics Canada, 2011b). But the average annual yield of water has declined between 1971 and 2004 in the regions where populations are concentrated, in Southern Canada (Bemrose et al., 2010). Other critical ecosystem services are less apparent and more challenging to assess, but no less important. These include "natural processes as purification of air and water, regulation of climate and floodwaters, erosion control, pollination, seed dispersal, carbon storage, and renewal of soil fertility" (The H. John Heinz III Center for Science Economics and the Environment, 2008).

In both countries, significant efforts have been made to protect natural resources, whether through public and private networks of protected areas or environmental regulations that limit threats like pollution or habitat conversion. But ecosystems are still at risk, and threats are increasing with rising populations, expanded exploitation of resources, and climate change (Millennium Ecosystem Assessment, 2005b). The links between ecosystem health and economies make action urgent, but also present opportunities to develop new incentives and institutions for ecosystem conservation.

In order to both address these risks and take advantage of the opportunities, the connections between ecosystem health and the benefits that ecosystems provide diverse stakeholders need to be understood. Otherwise decisions and actions – whether by a government, company, or individual – often do not recognize the value of ecosystem services to them and others. "A major part of our 'balance sheet' (representing nature's value) is missing, leading us to use nature's resources wastefully and unsustainably— much as a tenant who does not pay for electricity tends to leave the lights on" (Sustainable Prosperity, 2011). Dollars are a common metric that can be useful in making those values tangible to some audiences, but other quantitative and qualitative measures can be effective or even preferable for other audiences (Cowling et al., 2008).

In this paper, we provide an overview of research, implementation, and industry actions related to ecosystem services in the United States and Canada ("North America" in this paper; Mexico is excluded in this analysis as it is covered in a separate article in this journal). We use a broad definition of ecosystem services, the benefits that nature provides to people (Costanza et al., 1997; Millennium Ecosystem Assessment, 2005b). We do not limit this paper to ecosystem service markets or services that can be valued monetarily.

## 2. Ecosystem services research

### 2.1. Research publication trends

Research around ecosystem services began in 1977 with the introduction of the idea as "nature's services" in a paper published in *Science* by Westman (1977). The first publication to use the term "ecosystem services" was written in 1981 by Ehrlich and Ehrlich entitled *Extinction: The causes and consequences of the disappearance of species* (Ehrlich and Ehrlich, 1981). No additional papers were published with the term until 1991. Since then, however, a total of 3770 papers have been published internationally; 1848 (49.0%) of those have had at least one author from United States or Canada.

The publication data used in this paper was collected on August 28, 2012 from the Institute for Scientific Information's (ISI) Web of Science for the analysis of the topic area of "ecosystem services" (papers were included if the term appeared in the title, abstract, or keywords of the paper). The term also had to be in English to be included. ISI Web of Science defines papers as being published in North America if one of the authors on the paper is from the United States or Canada. ISI provides data for a large subset of peer-reviewed journal articles. Different subscription levels are available. The one used in this paper is through University of Maryland, College Park, which includes articles published beginning in 1945. Unlike Google Scholar, it does not include books, book chapters, magazine articles, or other forms of publications. However, ISI does contain the majority of, although not all, peer-reviewed journal articles within the topic area.

While research in this field has increased exponentially, it is unevenly distributed across the different ecosystem services categories, as defined by Millennium Ecosystem Assessment (2005b) (Fig. 1). Within the 3770 published ecosystem service papers, we used the ISI Web of Science to tabulate the number of papers with topic areas for each of these categories, and found that the distribution of categories in the papers with North American authors was similar to the distribution of all ecosystem service literature, with an almost even number of publication between provisioning and regulating services (37% and 38%, respectively) and cultural services accounting for 6%. Most publications within provisioning services were related to food (20% of total North American publications), especially crops (11%) and capture fisheries (8%). Freshwater (6%) and timber (4%) were also represented well. Under regulating services, almost half of the publications included climate regulation (18%), with a more even spread across other services: water purification and waste treatment (8%), natural hazard regulation (6%), pollination (5%), erosion regulation (4%), and pest regulation (4%). Recreation (5%) was included in three-quarters of cultural services publications.

### 2.2. Valuation research

Recent national assessments of ecosystems in the US and Canada have begun to describe the status and trends of ecosystems (The H. John Heinz III Center for Science Economics and the Environment, 2008; Federal Provincial and Territorial Governments of Canada, 2010). Because data only exist for a subset of ecosystems, these assessments were unable to quantify the effects of the delivery of