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Analysis

Assessing the value of the Central Everglades Planning Project (CEPP) in Everglades restoration: An ecosystem service approach

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ABSTRACT

This study identifies a full range of ecosystem services that could be affected by a restoration project in the central Everglades and monetizes the economic value of a subset of these services using existing data. Findings suggest that the project will potentially increase many ecosystem services that have considerable economic value to society. The ecosystem services monetized within the scope of this study are a subset of the difference between the future-with the Central Everglades Planning Project (CEPP) and the future-without CEPP, and they totaled ~ $1.8 billion USD at a 2.5% discount rate. Findings suggest that the use of ecosystem services in project planning and communications may require acknowledgment of the difficulty of monetizing important services and the limitations associated with using only existing data and models. Results of this study highlight the need for additional valuation efforts in this region, focused on those services that are likely to be impacted by restoration activities but were notably challenging to value in this assessment due to shortages of data.

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1. Introduction

South Florida's Everglades are a unique and complex system of interdependent ecosystems, a region of subtropical wetlands that has historically provided a wide range of direct and indirect benefits to human beings. Human uses of the Everglades and the beneficial services provided by it have changed over time, reflecting the shifting demands placed on a region that has been significantly altered from its natural state over the course of more than a century. The Everglades, now considered one of the most threatened ecosystems in the nation (Light and Dineen, 1994), have undergone immense changes since the mid to late 1800s, a time when drainage and hydraulic changes became a priority to encourage agricultural settlement and develop a viable economic base for the state (Anderson and Rosendahl, 1998; McVoy et al., 2011; Snyder and Davidson, 1994). Throughout the 20th century, the construction of canals, levees, and water control structures used to manage flood protection and divert water for agriculture and development affected the natural flow and quality of water in this region. The Everglades watershed is now a degraded and highly managed system that provides water supply throughout south Florida, adheres to flood protection protocols, and contains approximately 6900 mi^2 in State and National parks and natural management areas (Barnes, 2005; Davis and Ogden, 1994; Doering et al., 2002; FNAI, 2013; Holling et al., 1994; Kushlan, 1989; McVoy et al., 2011; NRC, 2012, 2007; Parker et al., 2013; Sime, 2005; Tropical BioIndustries, 1990; Walters and Gunderson, 1994). The overall spatial extent of conservation areas in the Everglades is not expected to decline, as these areas are publicly-owned and protected from development; however, without intervention, loss of ecological functions and characteristics is expected to continue.

Despite these alterations, the Everglades continues to significantly contribute to the quality of life of Florida residents, visitors, and consumers who depend on these ecosystems for drinking water, recreational opportunities, agriculture, seafood, and much more. Everglades National Park has gained global recognition as a World Heritage Site, an International Biosphere Reserve, as well as a Wetland of International Importance under the terms of the Ramsar Convention (Maltby and Dugan, 1994). As the largest designated sub-tropical wilderness reserve in North America, the Park supports a high diversity of flora and fauna,

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and its national and international significance is evidenced by the number of visitors that come from locations outside of Florida to experience it (Papadogiannaki et al., 2008).

This study assesses the economic value of ecosystem services that will be affected by a large-scale ecosystem restoration project being implemented by the South Florida Water Management District (SFWMD) and the U.S. Army Corps of Engineers (USACE). The Central Everglades Planning Project's (CEPP) plan for restoration proposes hydrologic restoration in a swath of Florida that stretches from Lake Okeechobee to the southern end of the Florida peninsula (Fig. 1). CEPP is the most recent portion undertaken of the Comprehensive Everglades Restoration Plan (CERP) (USACE, 1998). Specifically, this study evaluates the forecasted change in the value of ecosystem services between the future with the project and the future without the project (FWO), and demonstrates the type of practical analysis that can be conducted with existing data. Due to article length considerations, a step-by-step, detailed description of processes followed to conduct this CEPP ecosystem services evaluation is available upon request, as is a qualitative description of services that could not be monetized using available ecological and economic data.

2. Methods

2.1. Theoretical Framework

Ecosystem services can be broadly defined as "… socially valued aspects or outputs of ecosystems that depend on self-regulating or managed ecosystem structures and processes" (Murray et al., 2013). Ecosystem services can directly and indirectly affect human well-being and ecosystem services themselves are interconnected. The economic value that individuals receive from ecosystem services can be described in a total economic value (TEV) framework, where TEV is comprised of both use value and non-use, or passive use, value (NRC, 2005; Freeman, 2003). Use values include those derived from direct uses of a resource, such as recreation, as well as indirect uses of a resource, such as flood control provided by a wetland. Both consumers and producers can derive economic value from the use of a resource. Non-use values include those held for leaving an ecosystem service in a particular condition for future generations (bequest value), or the value of simply knowing that an ecosystem or service provided by it exists in a particular condition (existence value). The concept of TEV is at the core of definitions of sustainability.

Monetizing the total economic value of ecosystem services is a means of accounting for the importance of ecosystems and the services they provide for human well-being, and can be used to demonstrate the value of a natural or restored ecosystem. Most economists would not say that these values should be the sole basis for public policy decisions, but almost all would recognize that they should be included as inputs to policy-making processes (Arrow et al., 1996; Polasky and Segerson, 2009). Ecosystem service valuation contributes to a more comprehensive accounting of the economic benefits provided by ecosystems, information that can be used to evaluate tradeoffs in the use of scarce resources and is being promoted in federal decision-making (see PCAST, 2011).

2.2. Valuation Process

Ecosystem service valuation includes three basic steps that require extensive communication among ecologists and economists. In addition, since this assessment compares alternative future scenarios, the discussions included an advanced team of modelers. The steps are: 1) identification of the services that are, or will be, affected by a specific policy action; 2) determination of how ecosystem services will change under the policy action; and 3) evaluation of the importance of these changes in ecosystem services to the public (NRC, 2005). Of course, some degree of uncertainty surrounds each of these components.

To identify the services that would change with CEPP, information was gathered through a facilitated process from Federal and State agencies involved in CEPP and in Everglades land management, from literature review, and from ongoing Everglades ecosystem services efforts such as the Marine and Estuarine Goal Setting for South Florida (MARES, http://sofla-mares.org/), the Synthesis of Everglades Research and Ecosystem Services (SERES, http://everglades-seres.org/Welcome.html), the South Florida Water, Sustainability and Climate Project (http://sfwsc.fiu.edu/index.html), and work being conducted at The Center for Urban and Environmental Studies at Florida Atlantic University (Alpert and Stronge, 2009) (Table 1, columns 1 and 2). Changes that are expected to take place due to complementary ecosystem restoration and water management projects in the region were accounted for in the modeling, per USACE policies and planning procedures; those with the most certainty of being completed were included in the modeling (projects that are in construction or have obtained necessary authorizations to proceed into construction). The others will be required to show that they align with and promote the region's restoration and watershed objectives, including supporting projects such as CEPP, in order to obtain their authorizations to proceed. Therefore, it is likely that in the future the combined ecological benefits of several projects will be greater than those reported here, but it is very unlikely that future projects will detract from the benefits reported here. Next, an array of models was employed to forecast how ecosystem services would change in the future with CEPP. Sub-teams of modelers and scientists documented the expected changes qualitatively and quantitatively. As with any modeling procedure, there is some level of error and uncertainty associated with model output. To help address this uncertainty, the planning models used in CEPP are kept current with best available science per Programmatic Regulation guidance (DOD, 2003) and were reviewed and validated by USACE for use in CEPP planning per USACE policy. Discussion of uncertainties inherent in these models is summarized in Section 6.10 in the CEPP Project Implementation Report (PIR), and more detail about the models and reviews are provided in CEPP PIR Appendices A and G (USACE, 2014). Additional model uncertainty is described in detail in this article where information was available.

A critical component of successful ecosystem service valuation is connecting an ecological process to a clearly defined endpoint that can be valued through economic approaches; in some cases in this assessment, best professional judgment indicated that services would change with CEPP but the changes could not be quantified (Table 1, column 3). In these cases monetization could not be completed since the endpoint could not be sufficiently estimated. Due to article length considerations, detailed descriptions of these services are available upon request.

Monetary values of CEPP ecosystem services were estimated using existing data rather than conducting original nonmarket valuation studies, given scope limits of this study. Three economic approaches were employed: (i) market-based approaches, i.e., the use of existing market prices and other data where available; (ii) benefit transfer, i.e., the use of existing nonmarket valuation data; and (iii) cost-based approaches (Table 1, column 5). It should be noted that benefit transfer, based entirely on existing data, should be used only if appropriate guidelines are followed (NRC, 2005). The ability of this method to produce valid and reliable ecosystem service value estimates depends on the availability of existing data that match the characteristics of the policy site being evaluated (see Boyle and Bergstrom, 1992; Rosenberger and Loomis, 2003). In addition, cost-based approaches focus on ecosystem service supply rather than demand, and as a result, provide only an approximation of economic value rather than a true measure of consumer surplus. That said, cost-based methods are relatively straightforward, can provide an approximate estimate of economic value, and are useful in cases where resource constraints rule out more rigorous nonmarket valuation approaches; monetizing costs is often easier than monetizing benefits for a particular ecosystem service.

A surprisingly limited number of published studies quantifying the monetary value of ecosystem services in Florida or the Everglades