Using the Ecosystem Services Approach to Advance Conservation Efforts on Private Lands [1]

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Introduction

Decision-makers in Florida have shown increased interest in using the Ecosystem Services (ES) approach to incentivize or reward ecosystem conservation efforts on private lands (FPRIT 2014). For example, payments for ecosystem services (PES) strategies have been effective in providing landowners with the motivation needed to participate in conservation behaviors (Ferraro and Kiss 2002). Some landowners may find a better understanding of the ES approach to be useful when deciding to participate in a PES program. To support these efforts this document will provide landowners, Extension agents, government and agency leaders, and other stakeholders with a better understanding of the following:

1. how ES are classified,
2. the different ways ES can be valued,
3. how quantifying ES values can help support conservation efforts on private lands in Florida, and,
4. challenges to using the ES approach.

Benefits of the Ecosystem Services Approach

The ES approach is primarily an assessment of how humans benefit from the natural functions of ecosystems (Alcamo and Bennett 2003; Costanza et al. 1998). Understanding how these benefits are valued by humans can allow decision-makers to:

- better assess the impact of different ecosystem management options on human well-being.
- determine the most efficient strategy for achieving a policy goal, such as paying landowners to conserve or provide wildlife habitat.

There are two key reasons why private lands are at a high risk of change in ES benefits: (1) landowners receive little or no external reward for securing certain ecosystem services (e.g., wildlife habitat) through good land stewardship practices; and (2) there is increased pressure on landowners to engage in land uses that are financially profitable, which often leads to changes in environmental quality (Meyer and Turner 1992). The ES approach can help address this problem by associating different types of land uses with the ES benefits generated for humans. *This information can improve the efficiency of conservation policies and programs that seek to protect important ecological services on private lands.*

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Putting the Concept to Use

The ES decision-making approach can best be described in a series of steps (Figure 1):

1. The structure of an ecosystem (e.g., size, diversity, and distribution of plant and animal species) provides a platform on which ecosystem processes occur (e.g., physical, chemical, biological, hydrological), which in turn influences how an ecosystem functions (Fisher et al. 2009). In other words, land management actions that alter the age of plants and types of plant species growing on the landscape influence how organisms interact with each other and with the physical environment.

2. These interactions determine the type, quality, and quantity of ecosystem services produced.

3. Ecosystem services are beneficial to humans in ways that are valuable or important to humans. For example, water-regulating functions of forests help to maintain clean water, which gives rise to a variety of health and recreational benefits for humans.

4. Decision-makers can identify important tradeoffs associated with a range of different land uses by examining which ES benefits are provided by each of the land uses. For example, converting a rangeland to row crop production produces food but may result in reduced soil and water quality and the loss of habitat for native species. Benefits can be discussed in a qualitative sense or quantified in monetary terms to be used in a cost-benefit analysis (Pienaar 2013).

5. The outcomes of these analyses can help inform policies that impact future land use decisions, which in turn impact ecosystem structures and processes. Further explanation regarding these steps is provided in the following sections.

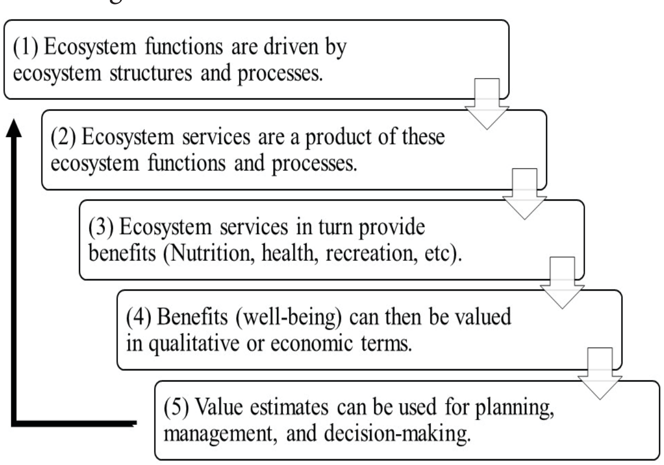

Figure 1. Putting the Ecosystem Services concept to use.

Ecosystem Functions and Structure

Ecosystems around the world have been classified into several main biomes including marine and coastal systems, wetlands, lakes and rivers, forests, woodlands and shrub lands, grass and rangelands, desert, tundra, cultivated areas, and urban areas (de Groot 2010). Ecosystem functions that occur within these biomes include regulation functions, habitat functions, production functions, and cultural functions (United Nations Millennium Ecosystem Assessment 2005). Land management activities modify ecosystem structures so that they function better in providing one type of service over another (Table 1).

For example, natural areas are managed for regulation and habitat functions, which help maintain biological and genetic diversity services. Comparatively, agricultural lands are managed to better function in the provision of raw organic materials.

Ecosystem Service Benefits

Ecosystem functions give rise to intermediate and final services which benefit humans in many ways. The direct benefits for humans include material inputs for production (e.g., timber), life support (e.g., clean water and water), and amenity values (e.g., recreation) (Champ et al. 2003). Figure 2 illustrates how direct benefits can rise from the intermediate and final services associated with a forest ecosystem.

Ecosystems can also benefit humans even when humans are not using a particular service. These benefits are known as "nonuse values." For example, "existence value" is the satisfaction that a person derives from knowing that something (e.g. a rare species) exists, even though that person might never see that species. "Option value" is the benefit people derive from simply knowing they have the option to use ecosystem services in the future.

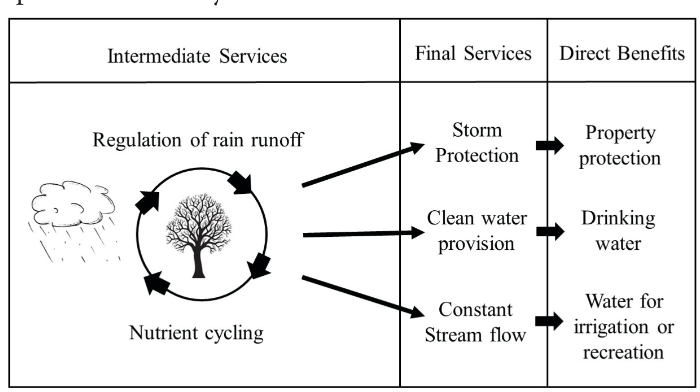

Figure 2. Conceptual relationship between final and intermediate services and direct benefits for humans of a forest ecosystem (based on Fisher et al. 2009)

It is also important to recognize that ecosystems can also provide disservices that are not beneficial to humans. For example, bees provide pollination services that allow plants to fruit and be eaten by humans, but bee stings can also seriously harm some humans by causing an extreme allergic reaction (i.e., anaphylactic shock).

Valuing Ecosystem Services

Humans value ecosystems based on the benefits they derive from ecosystems (e.g. clean air, clean water, recreational opportunities, food, timber, and species conservation). Social-cultural values related to diversity and identity, human health, education, freedom, and spirituality influence these values because they inform individuals about which end-states or qualities they want in an ecosystem (Farber et al. 2002). In other words, the personal and cultural values of individuals influence their decisions about how ecosystems should be conserved or managed.

Loss of forest land and environmental pollution has long been recognized as an issue of societal importance. To address public concerns, US government agencies frequently use economic analyses (e.g., cost-benefit analysis) to understand how environmental policies impact human well-being. When generating estimates of economic value, it is assumed that the values held by the public are reflected in the economic choices people make, or their willingness to pay for a good or service (i.e., assessed monetary value) (Just et al. 2004). Value is easily measured in existing markets where the purchasing behaviors of buyers informs sellers and producers how much of the good or service should be produced to meet demand and how much money people are willing to pay for goods and services. Unfortunately, demand for ecosystem conservation is not well understood because many of the benefits associated with conservation (e.g., clean water and air) are not traded in an existing market.

To help inform policy decisions, economists use several different types of valuation methods to estimate the value of ES (King and Mazzotta 2000). Surveys are used to assess people's willingness to pay (WTP) for ES, which are not traded in the market. The survey method is particularly useful for assessing the value of the existence of species (Champ et al. 2003). Other methods examine the prices paid for goods that are related to ES in order to approximate the value of the ES that support these goods. For example, a person's willingness to pay more for a house next to a state park can reflect the value the person places on certain environmental amenities (e.g., nature, observation of wildlife, open space) generated by the park. Monetary value can also be described using costs-avoided approaches, where the quantification of costs avoided is used to determine the cost-effectiveness of natural ecosystems over man-made technologies. For example, a 10% increase in forest land in a groundwater recharge area has been found to reduce the chemical and treatment costs of drinking water facilities by up to 20% (Ernst et al. 2004).

Incorporating Services and Values into Decision-Making

Understanding the value associated with different ES can allow decision-makers to make better-informed decisions about different land use options. In many cases, a mix of biophysical and economic measures is used to express changes in benefits and services. For example, the value of a forest wetland ecosystem can be expressed using the value of fish harvested ($), the spatial concentration of recreation boaters (m^2) and concentration (g/m^3) of fecal coliform bacteria in the water (Guerry et al. 2012). Deciding which measure is used to express changes in human well-being depends on the context in which the decision is made and stakeholder needs.

Sometimes when human well-being has already been significantly impacted, decision-makers will intervene using laws and regulations. The Clean Water Act is a good example. This Act seeks to control pollution in navigable waterways. Practitioners who use the ES approach can use predictive modeling tools to quantify how changes in ecosystem structure (e.g., different types of forest management) may result in changes in water quality (e.g., lbs. of sediment). Simple spatially explicit modeling tools are already available to help planners identify scenarios where conservation actions will be most effective. For example, the InVEST program by the Natural Capital Project is a suite of free, open-source software models that can be used to map and value the goods and services from nature. This information can help decision-makers and stakeholders work together to develop policies or programs to help meet landowner needs and societal objectives.

One policy strategy is to use financial incentives to encourage changes in landowner behaviors and ecosystem service outcomes. The payment for ecosystem services (PES) strategy pays private landowners to provide public benefits through ecosystem management. A PES program does this by facilitating negotiations between ecosystem service providers (i.e., landowners) and buyers (e.g., a government agency representing public demand) (Ferraro and Kiss 2002). In some cases, economic valuation methods can help decision-makers design more efficient incentive programs because landowner payments can be directly linked to quantified estimates of public demand for ES.

Challenges to Using the Ecosystem Services Approach

While there is great potential for using the ecosystem services approach in a variety of decision contexts, there are a number of challenges (Ruckelshaus et al. 2013). The primary challenge is a poor understanding of how changes in ecosystem structure impact the production of key services and benefits. Spatial models often require certain kinds of data that may not always be available to practitioners. Simple spatial models are also limited in predictive power, especially at smaller spatial scales. Adding to this are science gaps in understanding how changes in ES impact broader measures of human well-being such as livelihoods and community health. Another challenge is engaging leaders and stakeholders. An interactive and iterative approach to decision-making is often time consuming but necessary for building trust and ensuring success in subsequent negotiations and agreements about proposed policy actions.

Suggested Websites and Readings

Integrating Ecosystem Services Into Federal Resource Management https://nespguidebook.com/introduction/integrating-ecosystem-services-into-federal-resource-management-a-guidebook/

InVEST by the Natural Capital Project http://www.naturalcapitalproject.org/invest/

Ecosystem Valuation http://www.ecosystemvaluation.org/

References

Alcamo, J., and E. M. Bennett, Eds. 2003. *Ecosystems and human well-being: a framework for assessment*. Island Press. New York, NY.

Costanza, R., R. d'Arge, R. D. Groot, S. Farber, M. Grasso, B. Hannon, et al. 1997. "The value of the world's ecosystem services and natural capital." *Nature* 387 253–260.

Champ, P.A., K. J. Boyle, T. C. Brown, Eds. 2003. *A Primer on Nonmarket Valuation*, Volume 3. Springer: New York, NY, USA.

De Groot, R. S., R. Alkemade, L. Braat, L. Hein, and L. Willemen. 2010. "Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making." *Ecological Complexity* 7(3), 260–272.

Ernst, C., R. Gullick, and K. Nixon. 2004. "Conserving Forests to Protect Water." *American Water Works Association* 30(5), 1–7.

Farber, S. C., R. Costanza, and M. A. Wilson. 2002. "Economic and ecological concepts for valuing ecosystem services." *Ecological Economics* 41(3), 375–392.

Ferraro, P. J., and A. Kiss. 2002. "Direct payments to conserve biodiversity." *Science* 298(5599), 1718–1719.

Fisher, B., R. K. Turner, and P. Morling. 2009. "Defining and classifying ecosystem services for decision making." *Ecological Economics* 68.3: 643–653.

Florida Panther Recovery and Implementation Team (FPRIT). 2014. *Partners for fish and wildlife program proposal for managing native landscapes on private lands in the Florida Panther Focus Area*. Vero Beach, Florida. Downloaded on January 1, 2015 from https://www.fws.gov/verobeach/FloridaPantherRIT/20140324_PESConceptPaperDRAFT.pdf

Guerry, A. D., M. H. Ruckelshaus, K. K. Arkema, J. R. Bernhardt, G. Guannel, C. K. Kim, and S. A. Wood. 2012. "Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning." *International Journal of Biodiversity Science, Ecosystem Services & Management* 8(1–2), 107–121.

Just, R. E., D. L. Hueth, and S. Andrew. 2004. *The Welfare Economics of Public Policy: A Practical Approach to Project and Policy Evaluation*. Edward Elgar Publishing: North-Hampton, England, UK.

King, D. M. and M. J. Mazzotta. 2000. *Ecosystem Valuation*. US Department of Agriculture Natural Resources Conservation Service and National Oceanographic and Atmospheric Administration.

Meyer, W. B., and B. L. Turner. 1992. "Human population growth and global land-use/cover change." *Annual Review of Ecology and Systematics* 39–61.

Millennium Ecosystem Assessment 2005. *Ecosystems and human well-being: Synthesis*. Washington (DC): Island Press.

Pienaar, E. 2013. *The Use of Cost-Benefit Analysis in Environmental Policy*. Gainesville: University of Florida Institute of Food and Agricultural Sciences. Retrieved April 14, 2015 from http://edis.ifas.ufl.edu/UW383.

Ruckelshaus, M. E., McKenzie, H. Tallis, A. Guerry, G. Daily, P. Kareiva, S. Polasky, et al. 2013. "Notes from the Field: Lessons Learned from Using Ecosystem Services to Inform Real-World Decisions." *Ecological Economics*. doi: 10.1016/j.ecolecon.2013.07.009.

Table 1. Examples of ecosystem functions and services.

Function	Intermediate Services	Final Goods and Services
Regulation	Land cover features that regulate rain runoff.	Water provision in local watersheds and aquifers.
	Breakdown of nutrients and compounds (by plants and biota).	Nutrient control, waste treatment, and pollution control.
Habitat	Wild plants and animals.	Maintenance of biological and genetic diversity.
	Nurseries that support reproduction.	Maintenance of commercially harvested species.
Production	Raw organic materials (e.g., vegetables/meat, lumber, litter).	Physical health and vitality, building and manufacturing, fuel and energy, fodder and fertilizer.
Cultural	Varied landscapes.	Aesthetic, artistic, educational, and spiritual services.