Assessment of Ecosystem Services Values for the Central Everglades

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Everglades Restoration

- The Comprehensive Everglades Restoration Plan (CERP) was approved in 2000.
- Provides a framework to restore, protect and preserve the water resources of central and southern Florida, including the Everglades.
- U.S. Army Corps of Engineers (USACE) is the lead agency overseeing this restoration effort.
- This is the nation’s most comprehensive and costly restoration project to date.
Central Everglades Planning Project

- A biennial review of CERP found that little progress was being made in restoring the core of the Everglades ecosystem

- Restoring a more natural quantity, quality, timing and distribution of water to the remaining portions of the “River of Grass” is a key component of Everglades restoration

- The Central Everglades Planning Project (CEPP) will deliver a finalized plan for a suite of restoration projects in the central Everglades as part of CERP
Central Everglades Planning Project

Pre-drainage Flows

Current Flows

Restored Flows

HISTORIC FLOW

CURRENT FLOW

RESTORED FLOW
Central Everglades Planning Project

- The current USACE planning process takes 6+ years
- CEPP is included in the USACE’s National Pilot Program for feasibility studies, so the schedule for CEPP will utilize the Planning Transformation pilot process (new 18 month timeframe)
Central Everglades Planning Project

PROVISIONING SERVICES
- Products obtained from ecosystems
  - Food
  - Freshwater
  - Fuelwood
  - Fibre
  - Biochemicals
  - Genetic resources
  -...

REGULATING SERVICES
- Benefits obtained from regulation of ecosystem processes
  - Climate regulation
  - Disease regulation
  - Water regulation
  - Water purification
  - Pollination
  -...

CULTURAL SERVICES
- Non-material benefits obtained from ecosystems
  - Spiritual and religious
  - Recreation and ecotourism
  - Aesthetic
  - Inspirational
  - Educational
  - Sense of place
  - Cultural heritage
  -...

SUPPORTING SERVICES
- Services necessary for the production of all other ecosystem services
  - Soil formation
  - Nutrient cycling
  - Primary production

LIFE ON EARTH – BIODIVERSITY

FAO, 2007
Central Everglades Planning Project

- CEPP’s Tentatively Selected Plan (TSP) for restoration is anticipated to impact a range of ecosystem services – defined as the services from ecosystems that are integral to human well-being.
**Central Everglades Planning Project**

<table>
<thead>
<tr>
<th>Ecosystem Services Likely to be Impacted by CEPP</th>
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<tbody>
<tr>
<td><strong>Water Quality</strong></td>
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<tr>
<td>Reduction in nutrients/phosphorus</td>
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<tr>
<td><strong>Water Quality</strong></td>
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<tr>
<td>Estuary salinity and aquatic habitat improvements</td>
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<tr>
<td><strong>Water distribution throughout Everglades habitats</strong></td>
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<td><strong>Water Supply</strong></td>
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<tr>
<td>Aquifer recharge and prevention of salt water intrusion</td>
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<tr>
<td><strong>Reduce invasive plant species</strong></td>
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<tr>
<td><strong>Threatened, endangered and rare species</strong></td>
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<tr>
<td><strong>Recreation</strong></td>
</tr>
<tr>
<td>May include fishing, hunting, boating, off-road vehicle use, bird watching, wildlife viewing, canoeing, kayaking, biking</td>
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<tr>
<td><strong>Commercial Fishing</strong></td>
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<tr>
<td>Sea trout, pink shrimp</td>
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<tr>
<td><strong>Carbon sequestration</strong></td>
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<td><strong>Wildfire mitigation</strong></td>
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The Role of Economics

- Land and water resources provide a wide range of ecosystem services that have considerable social and economic value to local communities and society as a whole.

- Tradeoffs have to be made to balance shifting and often competing demands placed on land and water resources.

- “Economics is the science which studies human behavior as a relationship between ends and scarce means which have alternative uses” (Robbins, 1935)

- Understanding the public’s values for scarce resources can help inform decisions involving their allocation.

- One often cited role of government is to promote economic efficiency in the use of resources to obtain maximal benefit for society. 
  ~Musgrave (1959)
The Role of Economics

Regional Economic Impact Analysis
- Focuses on local income and employment changes
- Reflects direct spending and public use and indirect or multiplier effects
- From a national viewpoint, a transfer of economic activity: gains (losses) in one county offset by losses (gains) in other counties

Benefit-Cost Analysis
- Takes a national perspective
- Focuses on what the user would pay for a resource
- Benefits to users (consumer and producer surplus)
- Costs are spending and opportunity costs
- Economic efficiency goal is to maximize net benefits (TB-TC)
The Role of Economics in CEPP

- To ensure continued provision of the ecosystem services upon which we rely for our well-being, it is important to improve our understanding of the monetary value of ecosystem services, which can then play a role in decision-making processes that affect ecosystem service quality and quantity.

- Currently several stakeholders and agencies in Florida, as well as USACE leadership, have asked for such an assessment of Everglades restoration.

- The CEPP team will therefore conduct an assessment of the ecosystem services value of their restoration plan (the TSP).

- This assessment will not be used to select the TSP, but rather to show societal benefits resulting from it.
The Role of Economics in CEPP

“Federal agencies with responsibilities relating to ecosystems and their services (e.g., EPA, NOAA, DOI, USDA) should be tasked with using best available techniques to develop valuations for the ecosystem services affected by their decision-making and factoring the results into analyses that inform their major planning and management decisions.”

President’s Council of Advisors on Science and Technology (PCAST) report on Sustaining Environmental Capital: Protecting Society and the Economy. 2011
The Role of Economics in CEPP

- The USGS and UF will provide technical assistance for an assessment of the value of ecosystem services associated with the CEPP TSP.

- USGS and UF will coordinate with USACE to determine which methods and tools will be used, calculate the dollar values of ecosystem services that will be gained by CEPP over those that would be available if CEPP were not implemented, qualitatively discuss those services that cannot be valued monetarily, and provide documentation of the methods and results in a peer-reviewed written report.
**The Role of Economics: Economic Impact Analysis**

- Can illustrate the contribution of Everglades restoration to the local economy
- Economic input-output models can be used to determine how various economic sectors will be impacted under the future with and without CEPP restoration activities

1. **What are the economic impacts of the actual restoration activities (construction, planting, etc.) associated with CEPP?**

2. **What are the economic impacts of changes in services such as recreation activities associated with CEPP?**
The Role of Economics: Non-market Valuation

- In 2009, NOAA convened a blue ribbon panel of economists to consider approaches for collecting and analyzing data on the economic outcomes of restoration projects.
- The panel was asked to provide recommendations on what aspects of economic outcomes could be measured to best capture the economic effects of restoration projects.
- The panel notes that measures of economic impact do not accurately reflect economic value.
The Role of Economics: Non-market Valuation

- Public values for ecosystem services are not generally expressed in the marketplace.
- Non-market valuation methods are used to quantify the economic value (\$’s) that members of society receive from non-marketed resources.
- Total Economic Value = \text{use value} + \text{non-use (passive use) value}
The Role of Economics: Non-market Valuation

- This is measured as *net willingness to pay*, also referred to as *consumer surplus*. This is the standard measure of benefits in a benefit-cost analysis.
- The process of ecosystem service valuation.

National Research Council, Valuing Ecosystem Services: Toward Better Environmental Decision-Making, 2004
Economic Valuation Methods

- **Stated Preference Methods**
  - Rely on answers to carefully worded survey questions. Those answers—in the form of monetary amounts, choices, ratings, or other indications of preference—are scaled following an appropriate model of preference to yield a measure of economic value.
  - Ex: Contingent Valuation Method; Attribute-Based Methods

- **Revealed Preference Methods**
  - Draw statistical inferences on values based on actual choices people make within markets.
  - Ex: Travel Cost Method; Hedonic Pricing Method; Defensive Behavior Method
Economic Valuation Methods

- Benefit Transfer Methods
  - The use of existing value estimates (secondary data) to monetize the value of an ecosystem service of interest
  - Application of a value per unit estimate (per visitor day, per household, per acre) from an existing study site to an unstudied site for which such a benefit per unit value is needed, called the policy site
Economic Valuation Methods

- Benefit Transfer Methods – criteria for a valid transfer (Boyle and Bergstrom, 1992)

1) The nonmarket commodity valued at the study site must be identical to the nonmarket commodity to be valued at the policy site.

2) The human populations affected by the nonmarket commodity at the study site and the policy site have identical characteristics.

3) The assignment of property rights at both sites must lead to the same theoretically appropriate benefit measure (e.g. original study uses WTP and a measure of WTP is desired for the policy site).
Economic Valuation Methods

- **Benefit Transfer Toolkit** – provides resource managers/planners with a web-based tool to estimate the economic value of:
  - Fishing ($/day)
  - Hunting ($/day)
  - Wildlife viewing ($/day)
  - T&E species ($/HH)
  - Wetlands ($/acre)
  - Aquatic and terrestrial habitats ($/acre)
  - Open space ($ property premium)

- [http://dare.colostate.edu/tools/benefittransfer.aspx](http://dare.colostate.edu/tools/benefittransfer.aspx) - John Loomis, Leslie Richardson, Frank Casey & Timm Kroeger
Economic Valuation Methods

- **Cost-Based and Other Approaches**
  - Replacement Cost Method - estimates the value of an ecosystem service based on the cost of replacing that service.
  - Substitute (Alternative/Avoided) Cost Method - estimates the value of an ecosystem service based on the cost of providing substitute services.
  - Damage Cost Avoided Method - often applied to value an improvement in some ecosystem service which prevents damages.
  - Net Factor Income/Production Function Method - market based valuation technique that can be used to value ecosystem services that are inputs to the production of a final good.
  - Market/Transactions Evidence - involves observation of similar sales of resources in competitive markets to infer a value for the resource of interest.
Our Process for Valuing Ecosystem Services for CEPP

- Calls with CEPP team members
- Present economic methodologies for ES valuation
- UF/USGS draft methods document
- Address comments on draft to achieve acceptance of methodology
- Calculate monetized ES values (and non $) associated with the CEPP TSP
- Draft report on ES values, including qualitative discussion of ES values that could not be monetized

Understand/document how various ecosystem services are expected to be impacted under CEPP

Select ecosystem services to be valued monetarily and acquire needed data
For the first ecosystem service valuation component of CEPP, time and budget constraints rule out conducting any original studies based on stated or revealed preference approaches.

Benefit transfer methods and possibly regional economic impact analysis and cost-based approaches will be used for the first valuation component.

This effort will highlight gaps in the existing literature to efficiently guide future ecosystem service valuation research in the central Everglades.

Future opportunities may lead to original, survey-based stated and revealed preference studies being conducted.
Our Process for Valuing Ecosystem Services for CEPP

- Extensive literature review to pull together studies relevant to the CEPP study area, and studies valuing relevant ecosystem services in other locations.

- Web-based tools help identify gaps in the existing literature for particular locations or ecosystem services and identify those services that can be valued with existing data.
Our Process for Valuing Ecosystem Services for CEPP

- Qualitatively documenting expected impacts to all ecosystem services under CEPP TSP
- Ecosystem services report card example

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<table>
<thead>
<tr>
<th>Ecosystem Service (ES)</th>
<th>ES Type</th>
<th>Why important to ecosystem and people of south FL</th>
<th>Existing Condition</th>
<th>Future w/TSP¹</th>
<th>Future w/o TSP²</th>
<th>Component of Total Economic Value³</th>
<th>Possible Valuation Method⁴</th>
<th>Availability of ecosystem indicators, data sources; appropriateness to be evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality</td>
<td>P, R</td>
<td>Important for natural systems of ENP; downstream residents e.g., Keys; affects water quality of coastal resources</td>
<td>High nutrient loads in certain areas...</td>
<td>D, I, O, B</td>
<td>CVM, CE, BT</td>
<td>USACE, SFVMD, SWFWMD, MARES, others??</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estuarine salinity and aquatic habitat improvements</td>
<td>P, R</td>
<td>Important for health of estuaries, their associated habitats and recreational and commercial activities</td>
<td>Salinity imbalances causing declines in estuarine health...</td>
<td></td>
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<tr>
<td>Water distribution throughout Everglades habitats</td>
<td>P, R</td>
<td>Restoration of natural flow patterns important for healthy tree islands, ridge and slough landscapes</td>
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<td></td>
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<tr>
<td>Water supply</td>
<td>P, R</td>
<td>All residents depend on a water recharge and prevention of saltwater intrusion</td>
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<tr>
<td>Reduce invasive plant species</td>
<td>Important to natural and human systems, may affect some homeowners and landowners</td>
<td></td>
<td></td>
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<tr>
<td>Threatened, endangered and rare species</td>
<td>Important for healthy ecosystems; may be important as resistance value or wildlife viewing</td>
<td></td>
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<tr>
<td>Recreation</td>
<td>Fishing, hunting</td>
<td>Many residents and visitors participate in recreational</td>
<td></td>
<td></td>
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</tbody>
</table>
Lessons Learned….

- Importance of engagement with other team members, stakeholders, and scientists throughout the process.
- Importance of effective communication across disciplines.
- Making clear from the beginning exactly what data, i.e., ecological endpoints, are needed to value a particular ecosystem service.
- Recognition that the use of existing data will limit the ecosystem services that can be monetarily valued in a particular study area—especially in a unique ecosystem such as the Everglades.
Questions?
References


• Picture Citation: Florida Panther (Puma concolor coryi) resting among Everglades saw grass, endangered species, Florida. Copyright ©Tom & Pat Leeson.
Additional Slides
CEPP Study Area
CEPP Study Area

The study area for the CEPP encompasses the Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), Lake Okeechobee, a portion of the Everglades Agricultural Area, the Water Conservation Areas, Everglades National Park, the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast. The following describes the existing physical, ecological, and socioeconomic conditions within this large study area. The existing conditions are presented in either a regional or area specific content depending on the nature of the resource or the anticipated effect of that resource. TABLE 2-1 presents a compilation of many ecological and economic characteristics of the study area.
Central Everglades Planning Project

CENTRAL EVERGLADES PROCESS

TARGET - 18 MONTHS

3 MONTHS

SCOPING

Decision Point 1
Determine Study Direction

IPR 1

EXECUTION

Decision Point 2
Tentatively Selected Plan

IPR 2
IPR 3
IPR 4

REVIEW

Decision Point 3
Civil Works Review Board

IPR 5
IPR 6

CONFIRMATION

Decision Point 4
Final Chief’s Report

IPR 7

IPR: In-Progress Review with Corps Leadership
Economic Valuation Methods

- **Stated Preference Methods**
  - Contingent Valuation Method example

Loomis et al., 2000
"The purchase of water and 300,000 acres of conservation easements along 45 miles of the South Platte river from willing farmers as well as restoring these areas in natural vegetation costs a great deal of money. To fund these actions a South Platte river restoration fund has been proposed. All citizens along the front range from Denver to Fort Collins would be asked to pay an increased water bill (or rent if water is included in your rent) to: (1) purchase water from farmers to increase water for fish and wildlife from 17% and (2) to manage the South Platte river as shown in the increased ecosystem services along the 45 miles of the South Platte river. The funds collected can only be used to restore natural vegetation along 45 miles of the South Platte river and purchase water from willing farmers to increase instream flow to improve habitat for six native fish so they are not in danger of extinction."

• If the South Platte river restoration fund was on the ballot in the next election and it cost your household $_ each month in a higher water bill would you vote in favor or against?
• _I would vote Yes _I would vote No”
• The $_ was randomly filled in with one of 12 dollar amounts ($1, 2, 3, 5, 8, 10, 12, 20, 30, 40, 50, 100).
Economic Valuation Methods

- **Stated Preference Methods**
  - Attribute-based Method example

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Choice Scenario 1

Please vote for the plan that you prefer:

| Environmental Response | Option A | Option B | Option C
|------------------------|----------|----------|----------
| Water Quality Improvement (reduction of phosphorus runoff) | 31 - 60% | 61 - 90% | No change |
| Air Quality Improvement (absorption of CO₂) | No change | high | No change |
| Wildlife habitat Improvement (better habitat for wildlife) | Moderate | No change | No change |
| Annual Tax Increase (per year for 5 years) | $40 | $120 | $0 |

If the above plans are in a referendum, which one would you vote for?

☐ Option A  ☐ Option B  ☐ Option C

Please circle one number to indicate how certain you are with the choice you have just made:

Not certain 1  2  3  4  5  Very certain

Shrestha and Alavalapati, 2004
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The Role of Economics

- One often cited role of government is to promote economic efficiency in the use of resources to obtain maximal benefit for society
  ~Musgrave (1959)

- Similarly, the Office of Management and Budget tells us that:

  Government programs may be justified on efficiency grounds where they address market failures, such as public goods and externalities

  Benefit-cost, or economic efficiency, analysis is the recommended technique to use when conducting an economic analysis of government programs

  Social net benefits, and not the benefits and costs to the Federal Government, should be the basis for evaluating government programs that have effects on private citizens or other levels of government

  Consumer surplus provides the best measure of the total benefit to society from a government program

  ~OMB Circular A-94
The Role of Economics in CEPP

“Such undervaluation of ecosystem services inevitably leads over time to deterioration of ecosystems and their services through exploitation without compensatory maintenance.”

“The issue is not perfection but usefulness; and continuing to improve the techniques for valuation of ecosystem services and applying those techniques in ways that incorporate the values derived into public and private decision-making affecting ecosystems can be very useful indeed in ensuring the preservation of this valuable environmental capital and the sustainability of the services flowing from it”

President’s Council of Advisors on Science and Technology (PCAST) report on Sustaining Environmental Capital: Protecting Society and the Economy. 2011
Economic Valuation Methods – Benefit Transfer

**Value Transfer**
- Single point estimate
- Average or median value
- Administratively approved
- Use estimate at policy site

**Function Transfer**
- Benefit/demand function
- Meta-regression analysis function
- Adapt function to policy site
- Use tailored estimate at policy site

Source: Rosenberger and Loomis (2001)