Ecological Valuation for Land Use Planning Decision Support in South Florida: The Ecosystem Portfolio Model

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Outline

- Ecosystem Portfolio Model background
- EPM components: ecological value, land price, quality-of-life
- Comparing land use plans with the EPM
- Next steps
EPM Purpose: Incorporating ecosystem values into land use planning decision support

Proposed Developments

Everglades NP

Miami-Dade County Pilot

Biscayne NP
The EPM is an online, updatable tool, not an analysis or report.

- Multi-criteria evaluation of potential land use patterns
  - Criteria: Ecological, economic, and quality-of-life
  - Potential users: Park Service planners, county land use planners, tribes, stakeholders
  - Design protocol: users influence design
  - Everglades NP actively participating on development team
  - Design reflects real-world land use planning
How the EPM works …

1. Multiple land use plans considered
2. Evaluated against multiple criteria
3. Value maps combine user-elicited value judgments and criteria scores

Model-based characterization of outcomes

Land Price Model

Ecological Value Model

Quality-of-Life Value Map

Land Price Map

Ecological Value Map

Multi-attribute utility valuation

Quality-of-Life Indicators

Affordability, Risks, Open space, …

Parcel prices, Price drivers, …

Habitat, Fragmentation Water quality Restoration …
Multi-attribute utility (MAU) valuation

Alternative to cost-benefit analysis

Can be used when outcomes are highly uncertain

Does not require monetization to assign value

Does not require (but can make use of) economic valuation approaches

Used in deliberative decision-making processes involving stakeholders to construct values
EPM components (models)

Ecological Value Model
- Habitat
- Fragmentation
- Water quality
- Restoration

Land Price Model
- Parcel prices
- Price drivers

Quality-of-Life Indicators
- Affordability
- Risks
- Open space
Ecological Value Model

USGS Florida GAP Habitat suitability model

Biodiversity Potential Criterion

Florida Natural Areas Inventory (FNAI)

Rare & Unique Habitats Criterion

MAU Value Map

Cell-wise Aggregate “Ecological Value”

FRAGSTATS metrics

USFWS Multi-Species Recovery Plan model

Threatened & Endangered Species Criterion

Attribute-based Ranking model

Restoration Potential Criterion

Attribute-based Ranking model

Water Quality Buffer Potential Criterion
Land price (hedonic) model

- What drives parcel prices?
- Reveals how environmental and ecological amenities affect land prices

Determined drivers
- Parcel characteristics (zoning, size)
- Development restrictions (environmental, infrastructure, water needs)
- Measured (GIS) distance to amenities
Community Quality-of-Life Indicators

Map-based representations of:
- Community population and development densities
  - Infrastructure inventory, condition, and needs (flood control structures, roads, armoring)
  - Flood/storm surge risks (sea level rise impact scenarios)
- Recreational opportunities, accessibility, use
- Green/open space/natural areas
- Housing price/affordability indices
- Beach/nearshore character (set of indicators)
- Community character (set of indicators)
- Multi-attribute utility function for QOL indicators
Comparing land use plans with the EPM
Inputting land use plans, proposed developments, proposed restoration projects, ...

1) Load LU plan from menu
2) Upload custom LU plan
3) Modify loaded plan through interface

Current land use/cover, county master plan, “Watershed Study” Preferred Scenario for 2050, ...
Using the EPM to compare landscapes: Running the models

Model-based score (characterization)

Outcome

Value

Criteria

Criteria Weights

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

Model-based score (characterization)

EPM Location Selection

- Whole County
- Select Box
- Select Polygon

EPM Criteria

Example

Land Cover: FLUCOS 2004

Parameter of each ecological criterion:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raré &amp; Unique Habitats</td>
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<td>1.0</td>
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<tr>
<td>Waterway Quality Buffer Potential</td>
<td></td>
<td></td>
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<tr>
<td>Landscape Patterns &amp; Fragmentation</td>
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<tr>
<td>Restoration Potential</td>
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</tr>
</tbody>
</table>

Run EPM

Cancel
Ways to evaluate and compare landscapes

- Cell-based value map comparisons
  - Aggregate ecological value maps (MAU)
  - Individual ecological criterion value maps
  - Community Quality-of-Life indicator maps
  - Predicted land price maps (parcels)

- Value map statistics
  - Area of interest
  - User-defined grid
  - Variety of statistics

- Queries
  - Find cells that meet conditions
Example: Comparing current landscape to 2050 Watershed Study Plan

- Land use changes between current use and 2050 Plan
  - Ag and low-density development to higher-density development
  - New parks

- Comparing to current landscape
  - Ag to Ag
  - Commercial to Commercial
Comparing landscapes: Aggregate ecological value maps

Avg, median, Std dev, percentiles

Current | 2050

[Maps of landscapes with circular selections and color-coded values]
Current land use vs. 2050 plan: Biodiversity potential value map
Science tools: Exploring “under the hood”

“DRIs”

Cohesion

Core Area

Shape

Cutler Ridge with DRI #1

Cutler Ridge DRI #1 Cohesion

Cutler Ridge DRI #1 Core Area Mean

Cutler Ridge DRI #1 Fractal Dimension Index Area-weighted Mean

Cutler Ridge with DRI #2

Cutler Ridge DRI #2 Cohesion

Cutler Ridge DRI #2 Core Area Mean

Cutler Ridge DRI #2 Fractal Dimension Index Area-weighted Mean

Cohesion

Core Area

Shape
Decision-making tools: Queries and trade-offs

Find ecological restoration potential > 7 and land price < 10 $/sq_ft
Future work

- Collaborating with Florida International University and Florida Atlantic University to develop Quality-of-Life indicators component
- Evaluating key scenarios with the EPM
  - Detailed sea level rise scenarios being developed
  - Simulated future urbanization under demographic scenarios
EPM contributors

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