The Value of Golf in an Urban Ecosystem: A Natural Capital Project case study

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58% of the global population lives in cities.
Challenges of Urban Landscapes

- air pollution
- water pollution
- urban heat
- flooding
- mental & physical health
- energy consumption
- water security
- food security
- biodiversity protection
Planned Urban Landscapes
Urban Ecosystem Services

- Crop pollination
- Stormwater retention
- Carbon sequestration
- Recreation, scenic quality
- Urban cooling
- Air purification, noise attenuation
- Climate change mitigation
- Flood mitigation
- Mental health
- Biodiversity conservation
InVEST translates scenarios into changes in services

MAPS of BENEFITS

InVEST integrates valuation of ecosystem services and tradeoffs

e.g. Heat mitigation, Carbon sequestration ...

e.g. heat reduction, carbon sequestration ...

e.g. mortality reduction, energy savings ...

Input Data (reflect scenarios)

InVEST Models (ecosystem service supply)

Model Outputs (ecosystem services & values)
Urban Integration of Natural Capital

➢ Given growing urban natural capital challenges:
  o Storm water management and pollution
  o Heat island effects
  o Urban pollinators
  o Recreational activities

➢ How can golf courses be managed to contribute natural infrastructure to enhance well-being in urban areas?

➢ How should any urban space be managed for natural capital?
Urban Integration of Natural Capital
Natural Capital Value of Golf Courses
General Approach to Value of Golf Courses

➢ Estimate Marginal Value
  o Estimate baseline value of a golf course for each ecosystem service

➢ Change the golf course
  o Change land use
  o Management practice

➢ Recalculate service value and compute difference
  o Allow model to help determine serviceshed
Minneapolis and St. Paul Metropolitan Area
Wallpapering: A parcel-based approach to simulate land use change

Residential Zoning

Residential Wallpaper

Residential Scenario
Example of Wallpapering Scenarios

- Agriculture
- City Park
- Commercial
- Coniferous Forest
- Deciduous Forest
- Downtown
- Golf Course
- Industrial
- Natural Area
- Neighborhood Office
- Office
- Neighborhood Commercial
- Residential
- Suburban Residential
Results

➢ While the comparison is to golf courses – applies to any land use change scenario
➢ If not a golf course, then what and the concurrent impact on nature
**Single Golf Course: Single ecosystem service, LULC**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline (Bolstad GC)</th>
<th>Poor Soil Golf Course</th>
<th>Low-Density Residential</th>
<th>Urban Core (Downtown)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected Impervious Area</td>
<td>0%</td>
<td>0%</td>
<td>20% (mean for CRWD)</td>
<td>60% (conservative est. for MPRB site)</td>
</tr>
<tr>
<td>Mean Flow Path Length</td>
<td>Longest, by ArcHydro</td>
<td>Longest, by ArcHydro</td>
<td>40 m (typical lot length in Mpls/StP)</td>
<td>61 m (half-length of downtown block)</td>
</tr>
<tr>
<td>Slope</td>
<td>Mean along flow path</td>
<td><strong>2x Bolstad</strong></td>
<td>Unchanged vs. Base</td>
<td>&lt; 3.3% (by DEM)</td>
</tr>
<tr>
<td>Soil Properties</td>
<td>From SSURGO</td>
<td>Clay/Loam</td>
<td>Unchanged vs. Base</td>
<td>Unchanged vs. Base</td>
</tr>
</tbody>
</table>
Single Golf Course: Single ecosystem service, LULC

- **Evaporation**
  - Golf Course (Baseline): 0.4%
  - Golf Course (Poor Soil): 2%
  - Low-Density Residential: 4%
  - Urban Core: 10%

- **Infiltration**
  - Golf Course (Baseline): 98%
  - Golf Course (Poor Soil): 81%
  - Low-Density Residential: 78%
  - Urban Core: 39%

- **Surface Runoff**
  - Golf Course (Baseline): 2%
  - Golf Course (Poor Soil): 17%
  - Low-Density Residential: 19%
  - Urban Core: 51%
What is the effect of land cover on UH?

Determine how change in LU from GC would impact UH?
Focal Point
Marginal Value of a Golf Course?

- Use UHI model
- Convert golf course into a housing development
- Compare UHI before and after
There is a 0.17 degree C increase per night for areas near the change.
Golf Facilities’ Impact on UHI

SCENARIO
1. 135 golf facilities
2. Convert all golf courses to urban residential neighborhoods
3. Impact 907 km$^2$
4. Maximum temperature increase of 0.83 degrees C per night
UHI and Socioeconomic Factors
Tokyo: Single ecosystem service – pollinator habitat
Classify photo into basic land cover types
Select golf course area for development

Before development

After development
Run pollinator model before and after development
By developing the golf course, pollinator habitat became fragmented with reduced forage quality.

Golf courses are engaged stewards within the community and provide critical habitat for pollinators.
Future Work

➢ Expand to: San Francisco, Phoenix, Dallas, Atlanta, Philadelphia and Chicago
➢ Connect natural capital metrics with demographic and socio-economic attributes
➢ Add economic and non-economic value
➢ Collaborate with urban planners to integrate natural capital assessments into existing tools
➢ Build dashboard to allow golf industry to determine their community value (social and economic)
Thank you!

5th Golf Innovation Symposium