Mapping ecosystem services trade-offs and synergies in a pioneer front context (Brazil)

Solen Le Clec’h, Johan Oszwald, Thibaud Decaens, Simon Dufour, Michel Grimaldi, Nicolas Jégou, and Patrick Lavelle
Ecosystem Services (ES):

Benefits people obtain from ecosystems (MEA, 2005)

Underlines societal dependency towards the ecosystems (Daily, 1997)
Ecosystem Services (ES):

- Considered in an operational way
- Operationalized through the maps
- In interrelations

How to map ecosystem services trade-offs and synergies and what for?
Realized by J. Oszwald
## Service écosystémique

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Regulation du climat</th>
<th>Regulation du cycle de l'eau</th>
<th>Control of soil erosion</th>
<th>Production</th>
<th>Maintenance of the trophic chain</th>
<th>Value of existence</th>
<th>Pollination</th>
<th>Nutrient cycle</th>
<th>Soil formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks de carbone de la végétation</td>
<td>X</td>
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<tr>
<td>Stocks de carbone du sol</td>
<td>X</td>
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<tr>
<td>Infiltrability of soil</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Water biodisponible</td>
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<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Chemical quality of soil</td>
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<td></td>
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<tr>
<td>Index of biodiversity</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Pollinators</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Soil engineers</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
How to map ecosystem services trade-offs and synergies and what for?

1. Combinaison of single ES maps:
   1. Map from a scoring
   2. Map from a PCA

2. Map from landscape units
**SCORING**

Maps for each ES - Le Clec’h et al., 2013

Statistical models linking sampling and remote sensing data.

Scoring classes

Scoring map

*Sum of all the scores*

**PCA**

Trade-offs map

*On the synthetic variables*

**LANDSCAPE UNITS**

Landscape units map

Mean value of ES by landscape units

Distance matrix

Land cover map (6 types)

Landscape units

Results
## Unequal capacity to modeled ES

<table>
<thead>
<tr>
<th>Proxy</th>
<th>$R^2$ (decision tree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon stocks in vegetation</td>
<td>0.74</td>
</tr>
<tr>
<td>Biodiversity index</td>
<td>0.65</td>
</tr>
<tr>
<td>Available water for plants</td>
<td>0.39</td>
</tr>
</tbody>
</table>
Richness in ecosystem services in Pacaja in 2007

Proxies: Biodiversity’s index, pollinators, carbon stored in vegetation and in soil, soil water infiltration rates into soil and soil chemical quality.

8 9 10 11 12 13
14 15 16 17 18 19
20 21

Land cover in 2007

Forest
Burned forest
Juquira-Capoera
Pasture with tree
Clean pasture
Bare soils

Discussion
Sensitivity to modelized indicators
PCA

Very synthetic but less explicit
Results: Maps based on single analysis.
Results: Map based on landscape units
Mapping ES trade-offs rises technical questions

There is no one single way to map ES and trade-offs.

Methodological questions: uncertainty, site effect, choice of ES, scale change.

Undeniable questions but questions that exist in all mapping practices.
<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PCA</strong></td>
<td>Explanatory tool to understand the correlations between the indicators;</td>
<td>Difficulties to interpret and explain in terms of the original data (landscape characteristics); Based on monothematic maps (uncertainty); Difficulties to take the interrelationships into account.</td>
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<tr>
<td></td>
<td>Data driven mapping tool.</td>
<td></td>
</tr>
<tr>
<td><strong>Scoring</strong></td>
<td>Overview of ES hotspots; Opportunity of scoring particular indicators; Easy to implement.</td>
<td>Non data driven; Failure to address the relations between the ES; Limited by the impact of the subjective discretization choice; Based on monothematic maps (uncertainty).</td>
</tr>
<tr>
<td><strong>Landscape units</strong></td>
<td>Very simple method; Very easy map to interpret; Overview of the roles played by the different areas in the ES providing.</td>
<td>Limitation in the remote sensing data use to map (simplification); Limitation of studied indicators; The interrelationships are not taken into account.</td>
</tr>
</tbody>
</table>
Mapping ES trade-offs rises questions about the uses

Several uses of the notion of ES. Necessity to adapt the maps and their methods to these uses.

<table>
<thead>
<tr>
<th>Pedagogical</th>
<th>Heuristic</th>
<th>Policies / political</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding of social dependance to ecosystems</td>
<td>Reflexion on the exercise of mapping</td>
<td>Quantitativist approach: tool to evaluate policies</td>
</tr>
<tr>
<td>Landscape units method: Easy to explain Landscape easily monitored and affected</td>
<td>Reflexion on the notion itself</td>
<td>Qualitative approach: tool to bring and lead public debate.</td>
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<tr>
<td></td>
<td></td>
<td>PCA and scoring methods Flexible concerning the choice of ES</td>
</tr>
</tbody>
</table>

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Merci pour votre attention