Dynamics of bundles of ecosystem services in mountain socio-ecosystems

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Ecosystem service bundles

- “Sets of services that repeatedly appear together across space or time” (Raudsepp-Hearne et al. 2010)
  - Useful for identifying synergies and trade-offs and improving landscape management
- Generally defined through analysis of
  - spatial concordance (Raudsepp-Hearne et al. 2010)
  - social preferences (Martín-López et al. 2012)

- Less attention paid to temporal co-variation of services (Holland et al., 2011)
Objectives

• To develop a typology of temporal trajectories of ecosystem service bundles
  • From published case studies for mountain regions
• To illustrate this typology with a few detailed case studies
  • Example from the French Alps
Methods

• Case studies identified through literature search
  • Mostly in Europe (8) and Asia (5).
  • Few in America (3) and Africa (1)
• Typology of ecosystem dynamics built with cluster analysis
6 types of ecosystem service dynamics

1. Agricultural frontier
   More crops

2. Trees at all costs
   More trees

3. Protected for regulation
   No change in cultural services

4. Human-shaped but decreased management
   Decrease in cultural services

5. Museum and park
   More crops

6. Multifunctional landscape
   More trees

More good production

Less food production

Shifting food production

Less regulation services

More regulation services

More cultural services

More reg/cult services
• Mostly in developing countries
  • Drivers: population growth, demand for food, timber or carbon (but also land abandonment)
• Agricultural frontier: More agricultural products, less regulation services
  • Nepal (Bahadur 2012), Tian Shan in China (Feng et al. 2012)…
• Trees at all costs: Forest expansion is not always associated with increasing services
  ➢ trade-offs between forests and watershed services
  • Ex: Chile (Geneletti, 2013), Ecuador (Farley, 2007), Taihang Mountains in China (Yuan et al., 2012)
Transition towards a landscape not producing any goods but used for recreation and valued for emblematic landscapes and values.

- Drivers: socio-economic and policy changes and new demand for services leading to shift from primary to tertiary activities
- Cantabrian Mountains in Spain (Morán-Ordóñez et al., 2013); several nature-dominated mountain regions of Europe (Haines-Young et al., 2012)
Historical dynamics of land use and ecosystem services at Lautaret, French Alps

Historical trajectory of land use

Ecosystem service models based on plant and microbial traits

Old cadastral maps, aerial photos and ethnobotanical analysis – Girel et al. 2010

Lavorel et al. J.Ecol. 2011,
Grigulis et al. J. Ecol. 2013
Lautaret: Transition to Multifunctionality until the 1970’s

- Emigration to cities. Shift in farming systems from self-sufficiency to livestock production, allowing for more regulation and cultural services of the landscape
- Other examples in Switzerland (future scenarios) (Briner et al. 2013)
Lautaret: Transition to Human-shaped but decreased management since the 1970s

- Mechanisation and continued emigration. Extensification of livestock farming practices:
  - Benefits for regulation services
  - But loss of cultural services produced by traditional management
- Trend exacerbated under scenarios of extreme climate change (Lamarque et al. 2014)
- Other example: in the UK (extensification scenario) (Reed et al., 2013)
From historical trajectories to future scenarios of climate and land use change

1970’s - Multifunctionality

1996-present
Human-shaped, decreased management

Extreme climate change
Loss of production and cultural services
Restriction to regulation services

Present or moderate climate change
Human-shaped, decreased management

Lamarque et al. 2014
Discussion and Conclusion

• Caveats of the typology:
  • Few papers
  • Papers study different sets of services
    • A service may be overlooked because it is not locally relevant, it does not change, or authors are not interested
  • A typology of generic value? Needs to be tested for other socio-ecosystems, especially in naturally constrained biomes (drylands, arctic tundra…)
  • Predictive value for future trajectories in response to climate and socio-economic change
Thank you!

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Lautaret: summary of historical trajectory in ecosystem service bundles

DESCRIBE DRIVERS

1970

“Multifunctional”

1930

1970

2010

2030

“Human-shaped, decreased management”

“Regulating (soils)
Regulating (carbon)
Regulating (water quality)
Provisioning (fodder)
Cultural
Regulating (water quantity/regularity)
Provisioning (crops)”

DESCRIBE DRIVERS

OPERAs