



Ecosystem Science  
for Policy & Practice

# Dynamics of bundles of ecosystem services in mountain socio-ecosystems

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# Ecosystem service bundles

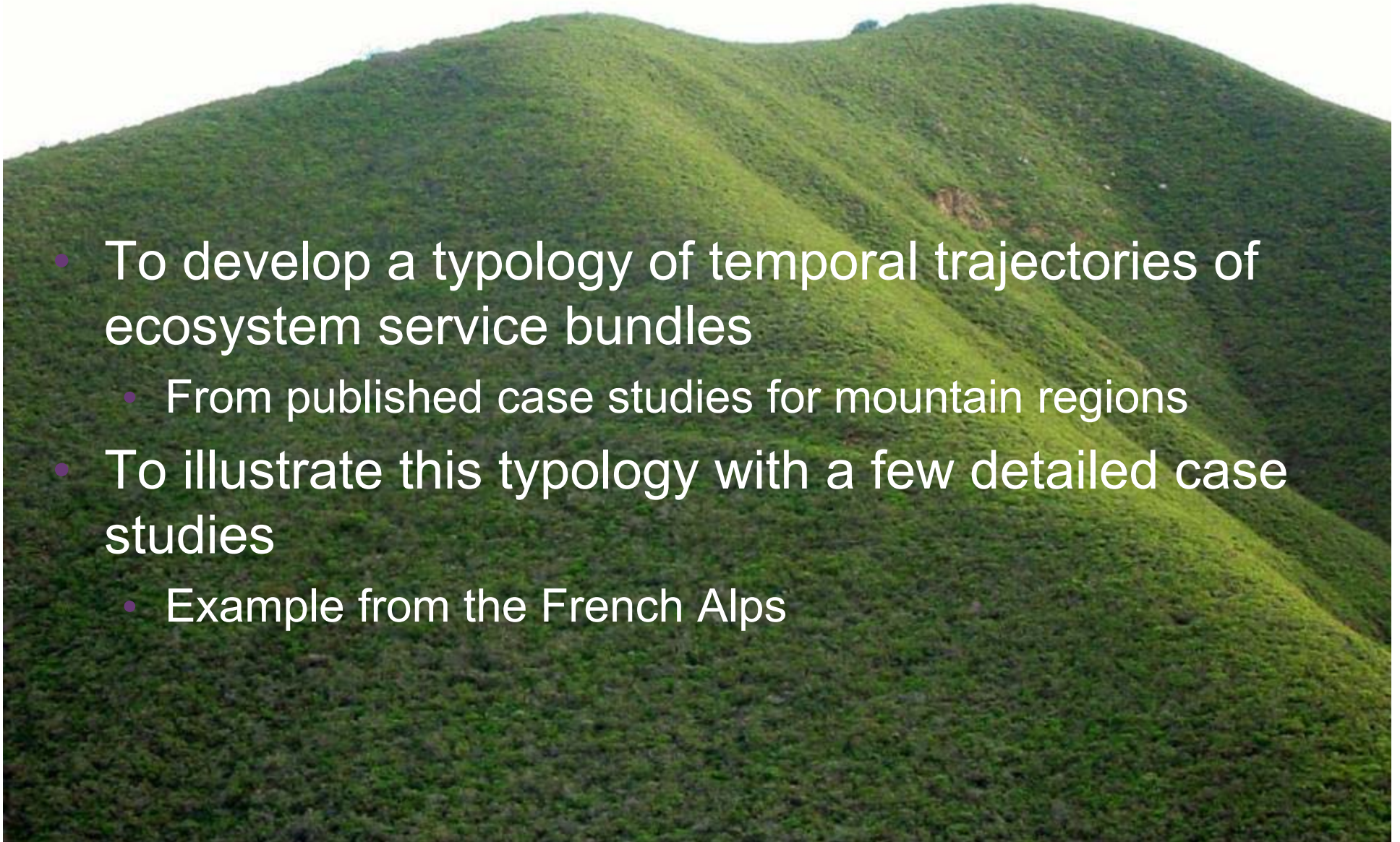
- “Sets of services that repeatedly appear together across space or time” (Raudsepp-Hearne et al. 2010)
    - Useful for identifying synergies and trade-offs and improving landscape management
  - Generally defined through analysis of
    - spatial concordance (Raudsepp-Hearne et al. 2010)
    - social preferences (Martín-López et al. 2012)
- Less attention paid to temporal co-variation of services (Holland et al., 2011)





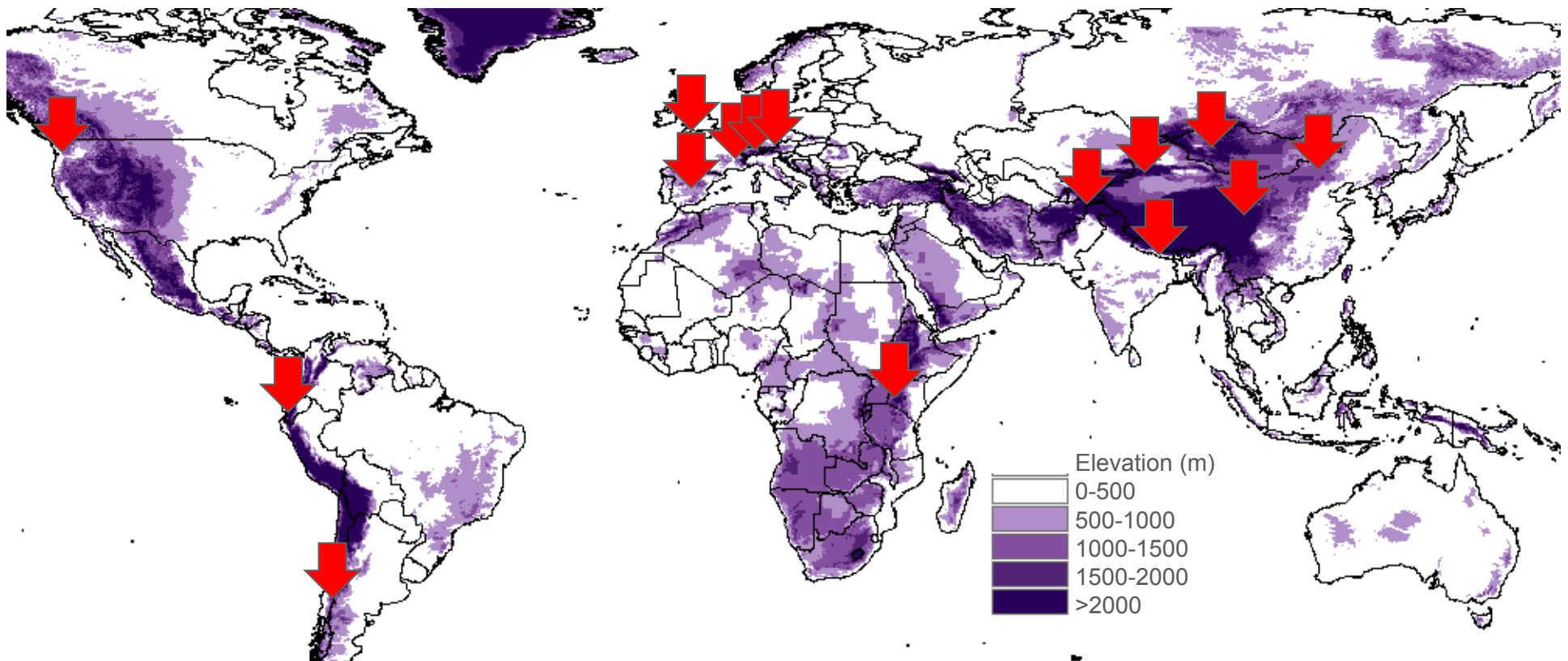
# Objectives

- 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

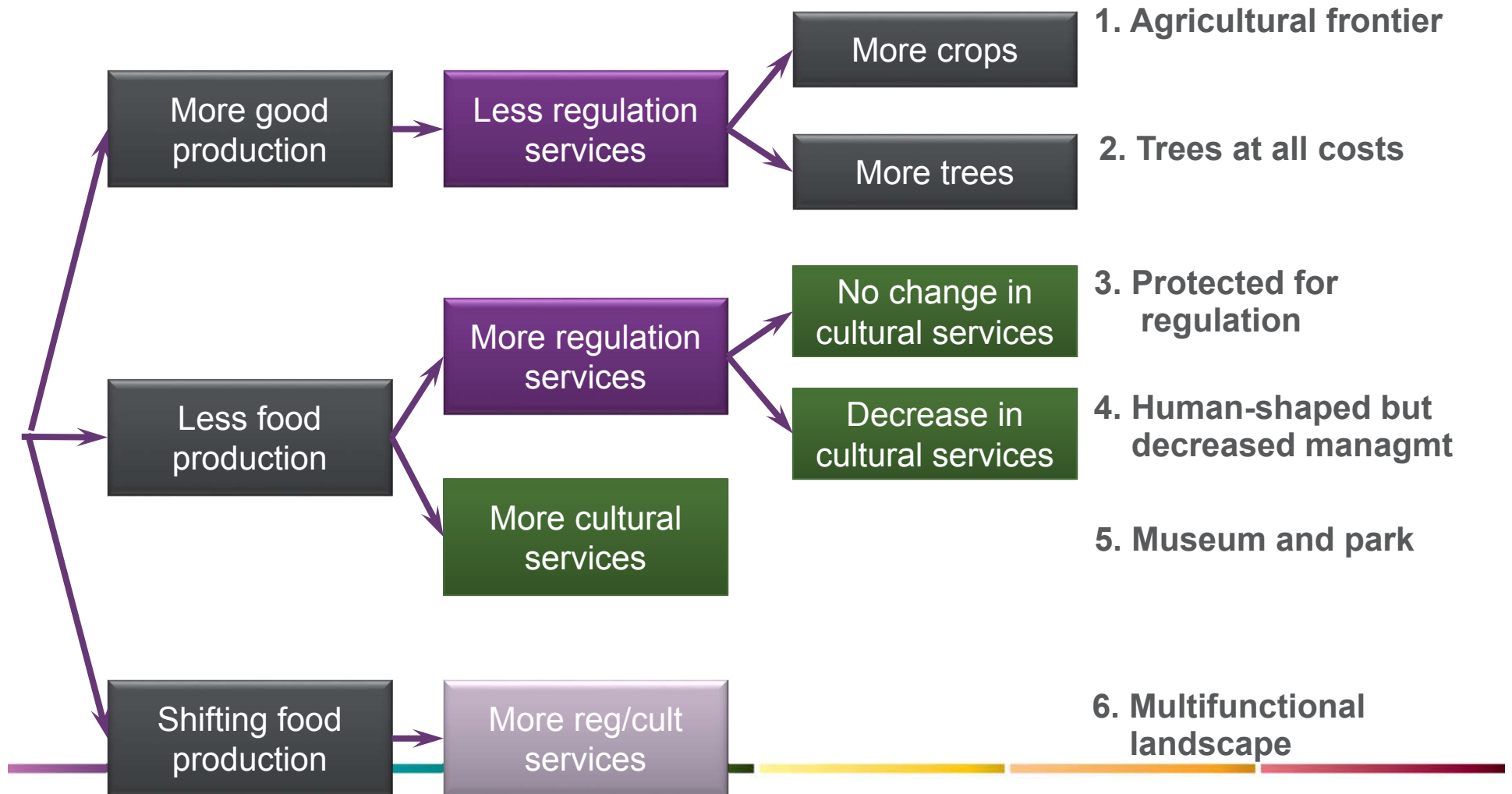


# Methods

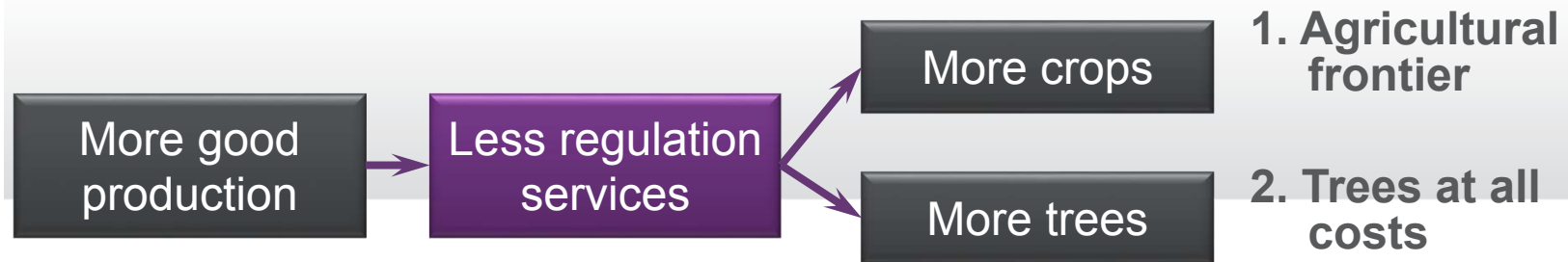
- Case studies identified through literature search
  - Mostly in Europe (8) and Asia (5).
  - Few in America (3) and Africa (1)
- Typology of ecosystem dynamics built with cluster analysis



# 6 types of ecosystem service dynamics







- 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)

Less food  
production



More cultural  
services

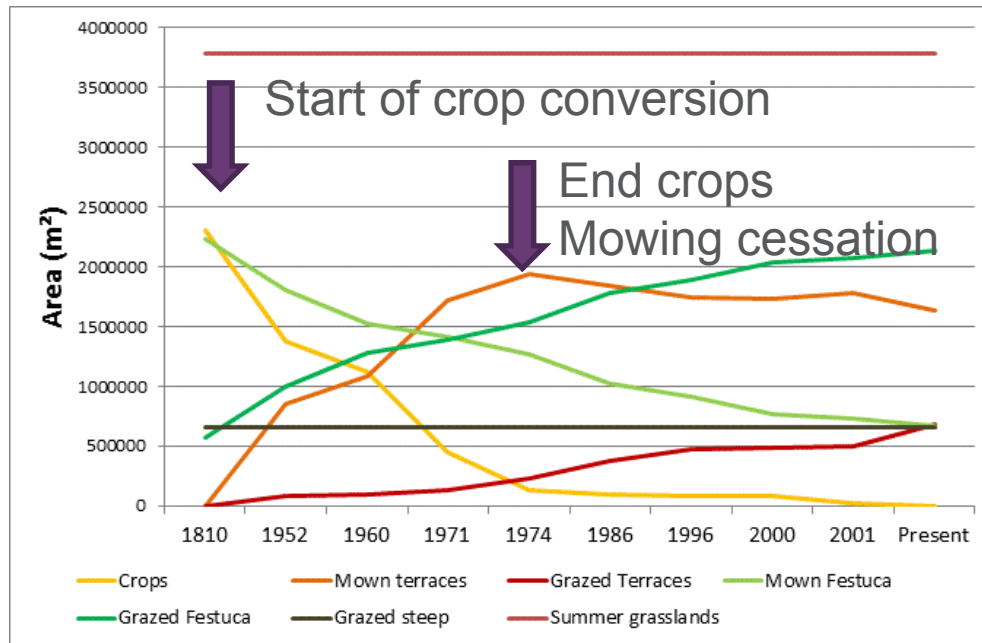
## 5. Museum and park

- 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)



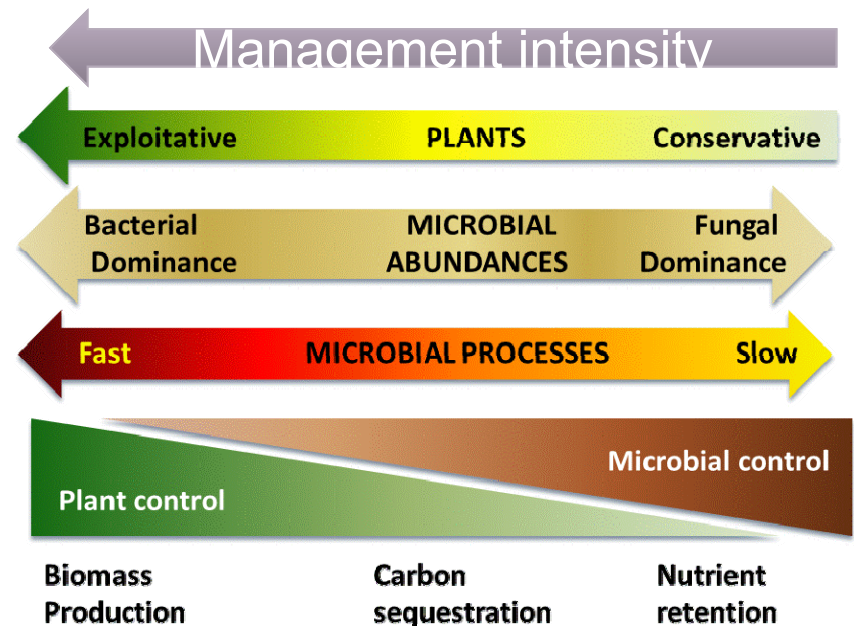
# Historical dynamics of land use and ecosystem services at Lautaret, French Alps

## Historical trajectory of land use

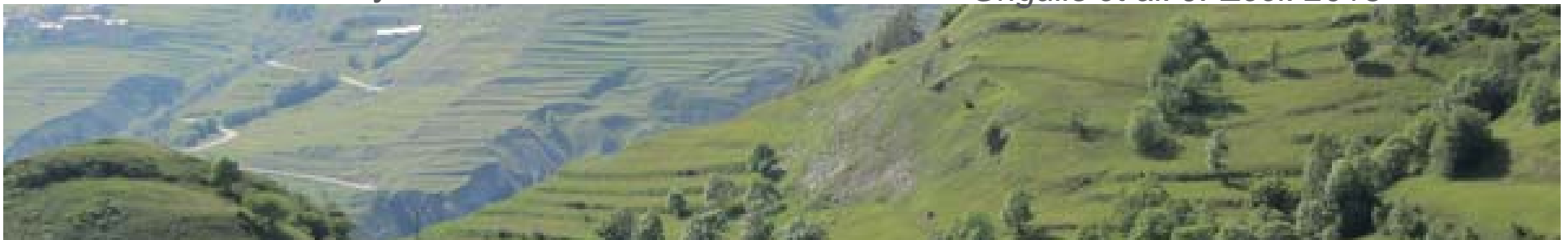


Old cadastral maps, aerial photos and ethnobotanical analysis – *Girel et al. 2010*

## Ecosystem service models based on plant and microbial traits

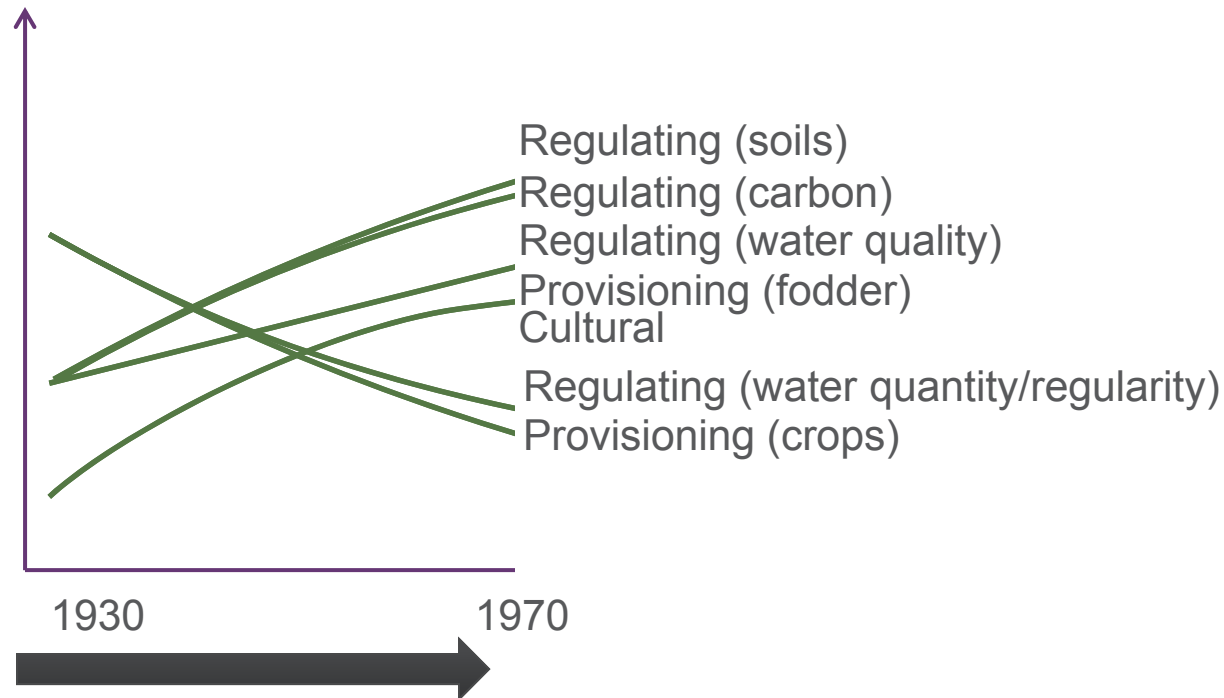


*Lavorel et al. J.Ecol. 2011,*  
*Grigulis et al. J. Ecol. 2013*



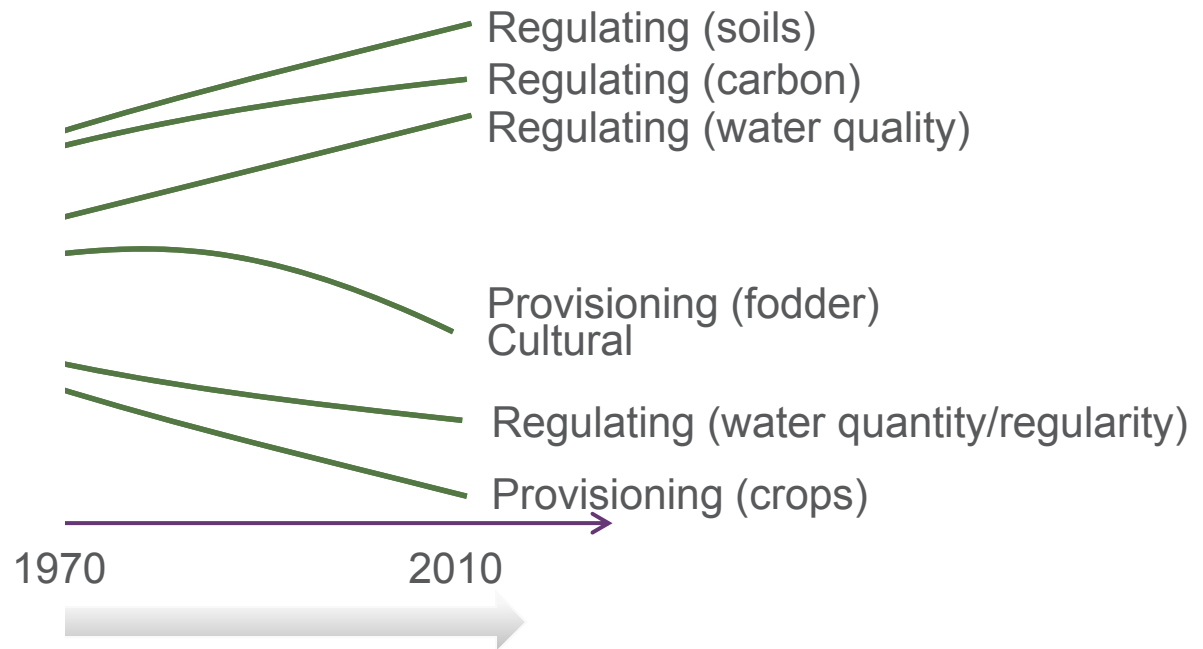


# Lautaret: Transition to Multifunctionality until the 1970's



- 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)

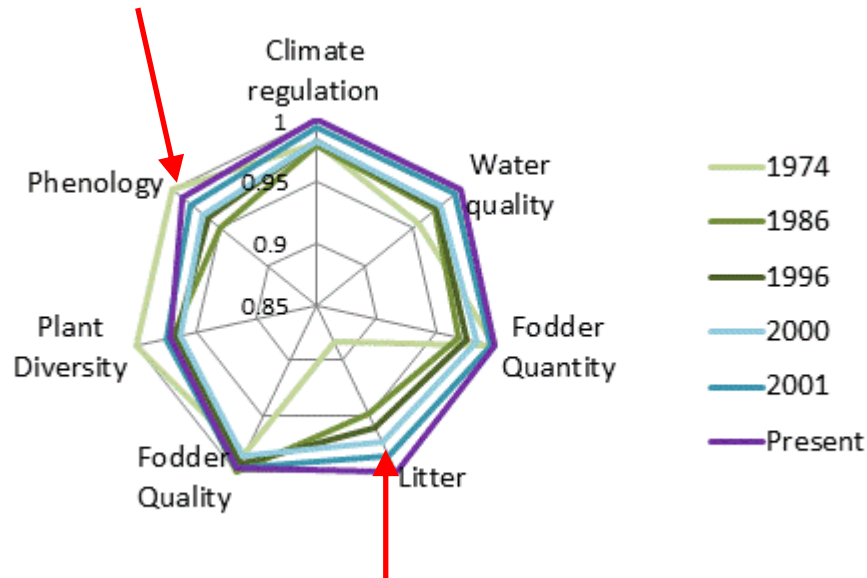
# Lautaret : Transition to Human-shaped but decreased management since the 1970s



- 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



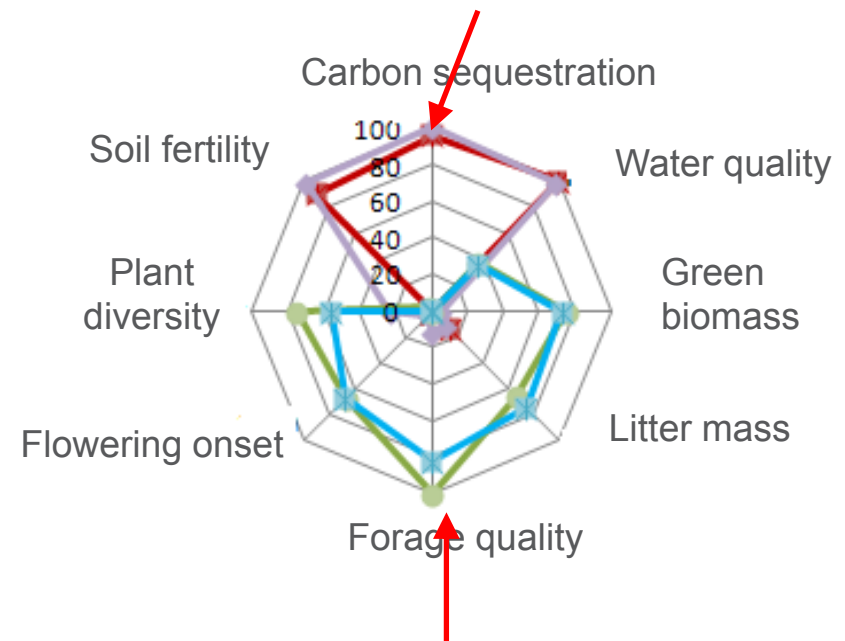
1996-present

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

# 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





# Ecosystem Science for Policy & Practice



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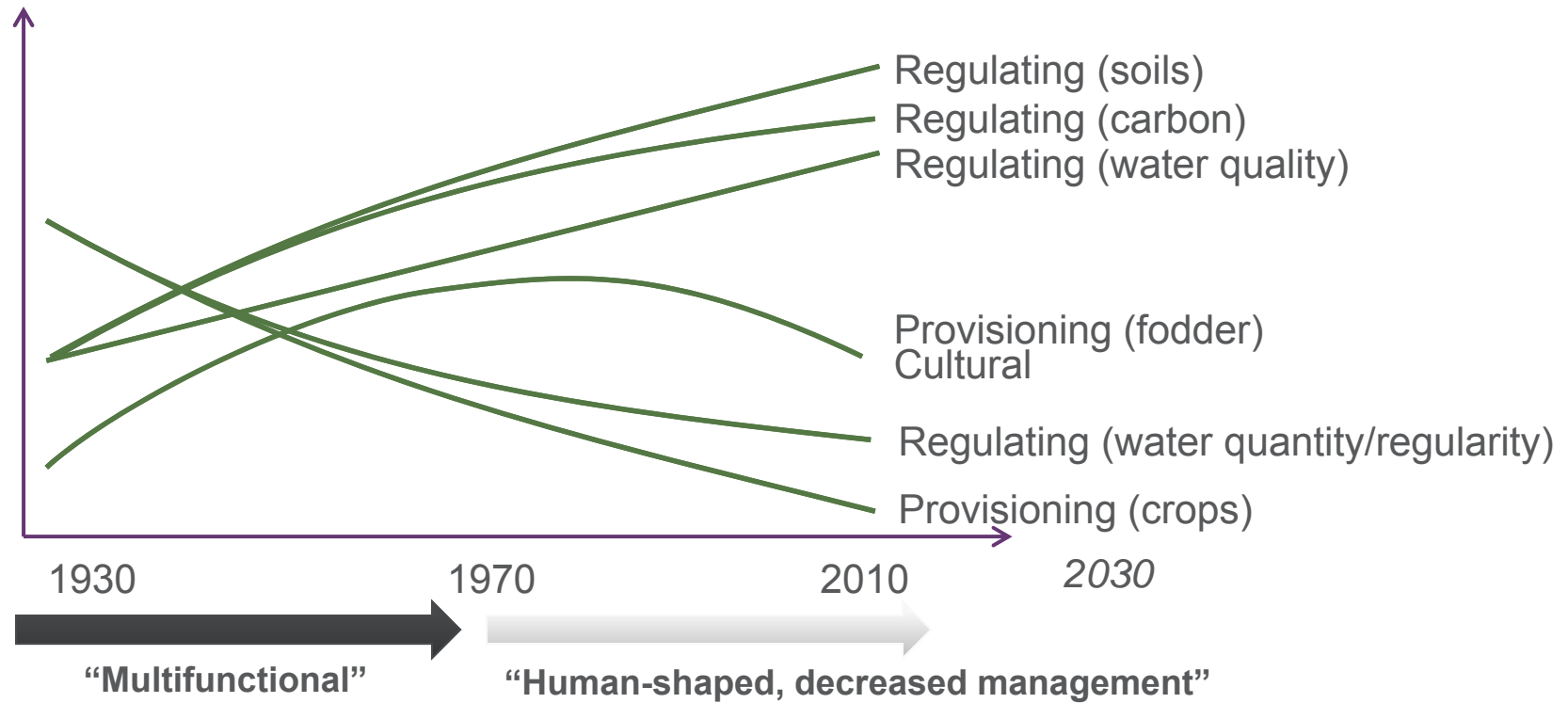
## Thank you!

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# Lautaret : summary of historical trajectory in ecosystem service bundles



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