

# Ecological effects of land-use change in the European Alps

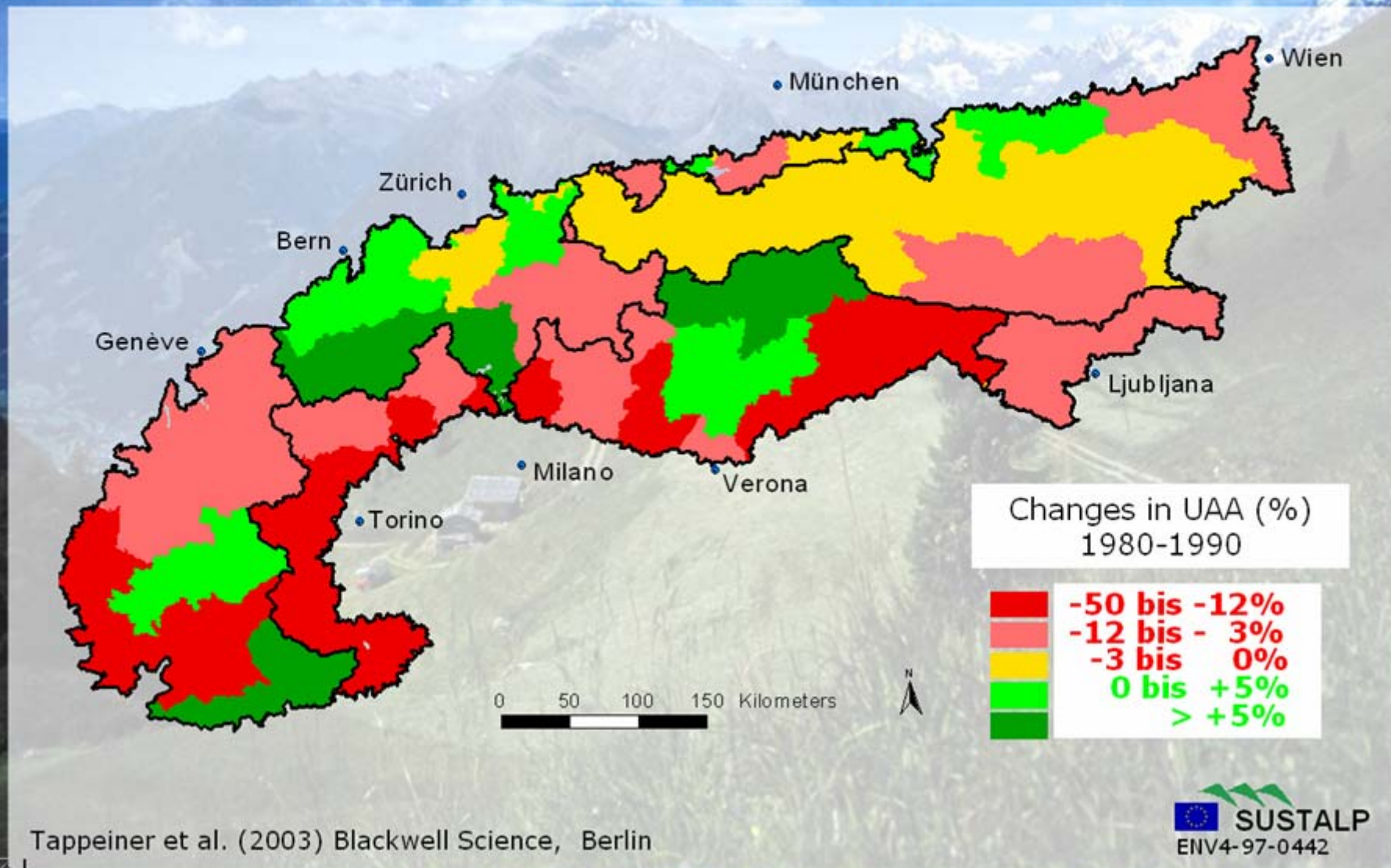
U. Tappeiner, E. Tasser, M. Bahn, A. Cernusca  
...and many others

# Problem



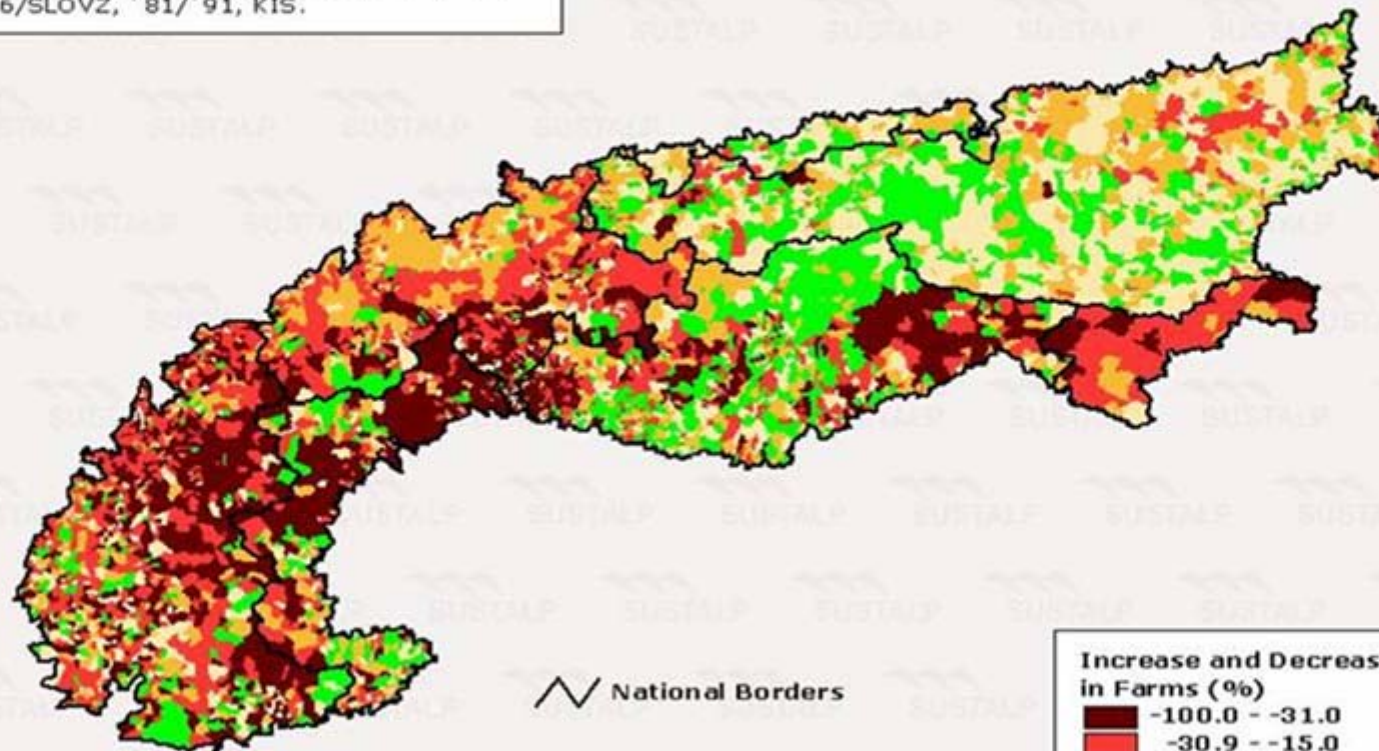
- 1. Rapid land-use changes in the European Alps**
- 2. What are the main consequences of these agro-economic developments on ecosystems and the landscape?**

# Change in utilised agricultural area in the Alps in 10 years



# Farm abandonment in the Alps in 10 years

ÖSTAT, BNE, '83/AS, '95; BASTAT, LBS, '85/'96;  
LASTAD, BGS, '83/'95; MinAP, Rgagr, '79/'88;  
AVW, LLWZ, '80/'90; ISTAT, Cgagr, '82/'90;  
SY, '96/SLOVZ, '81/'91, KIS.

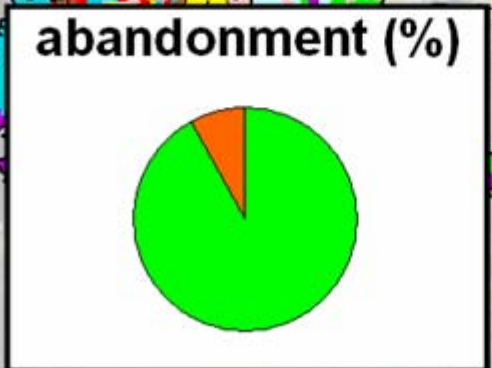
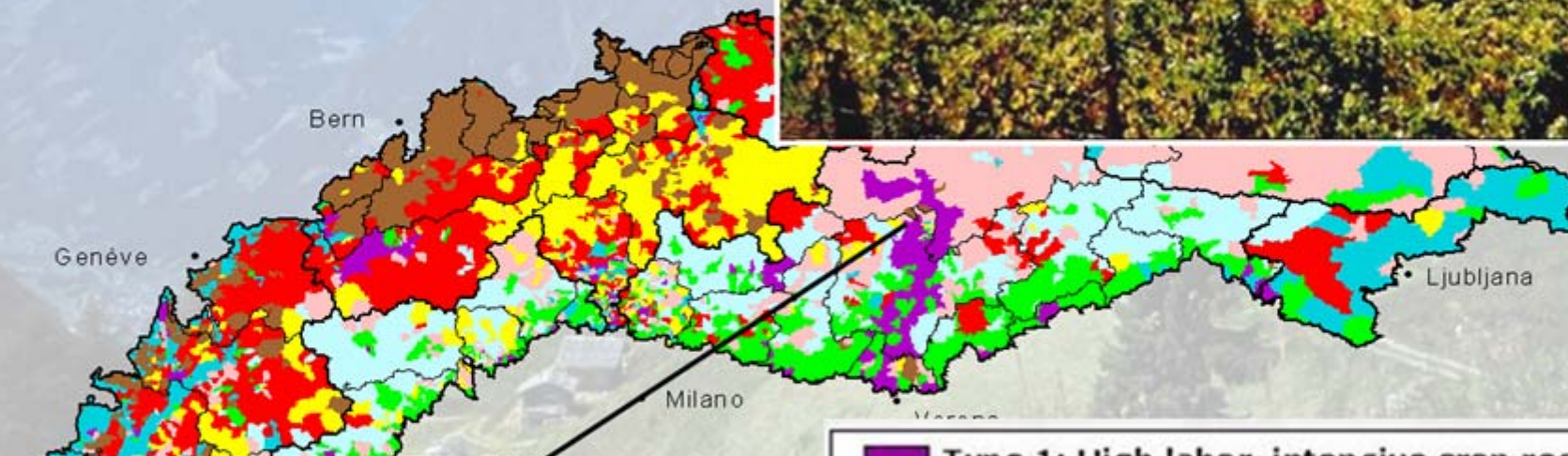


# Abandoned areas in the last 150 years

8 agrarian structure regions  
In the European Alps



Unterland/Überetsch

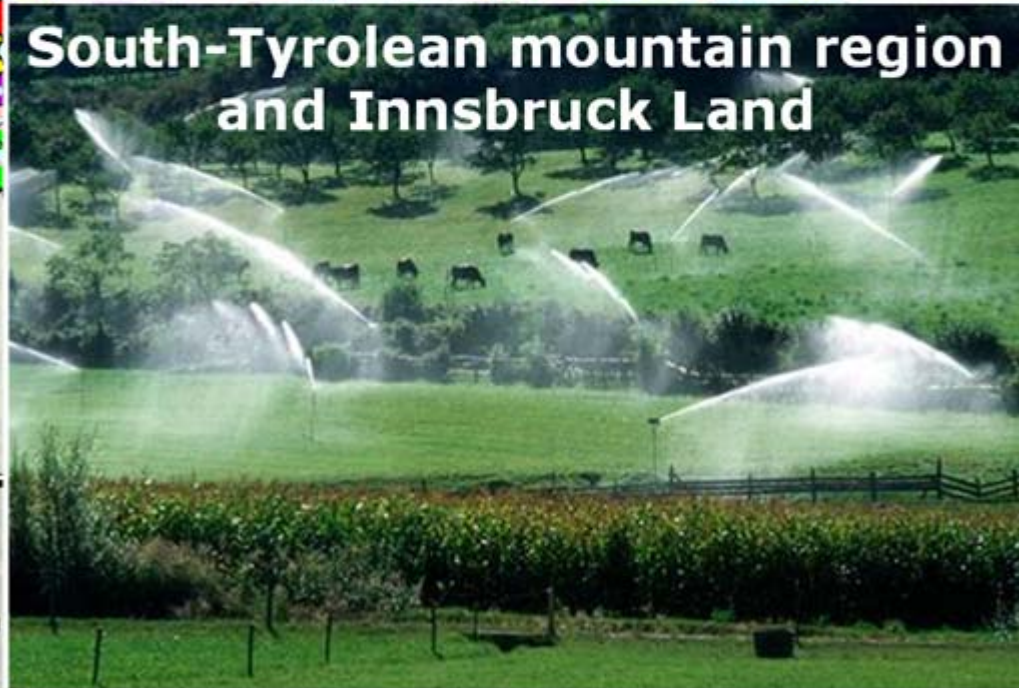
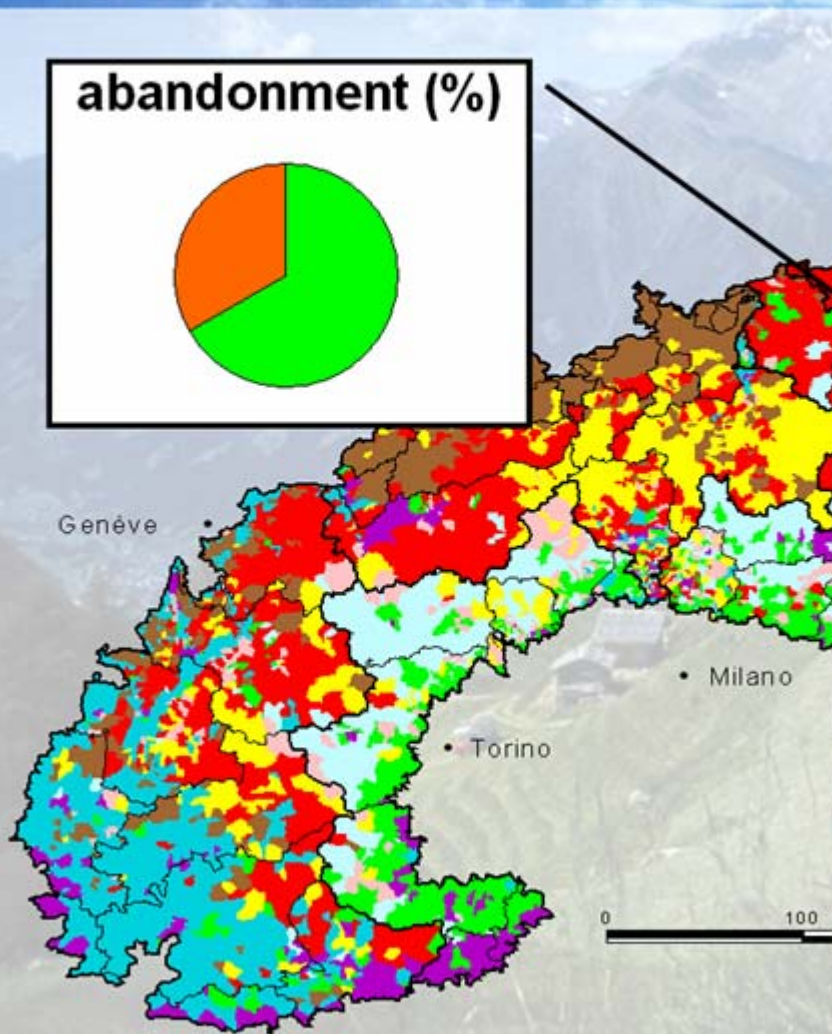
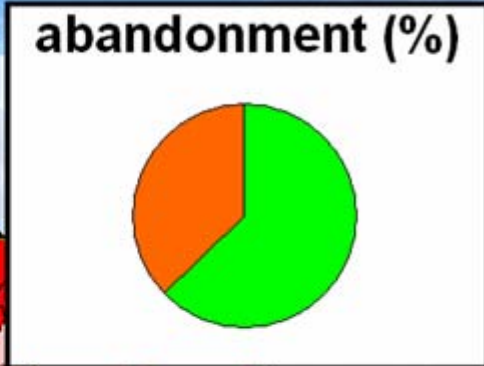
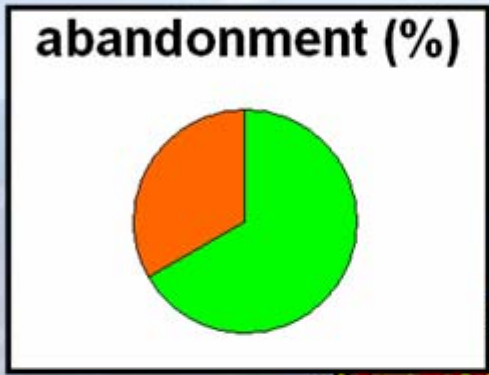


- Type 1: High labor, intensive crop region
- Type 2: Labor-extensive arable land region
- Type 3: Grassland region
- Type 4: Small-scale grassland farms
- Type 5: Area of high farmland abandonment
- Type 6: Structured, full-time farming
- Type 7: Alpine 'standard region'
- Type 8: Large-scale cattle breeding

SUSTALP  
ENV4-97-0442

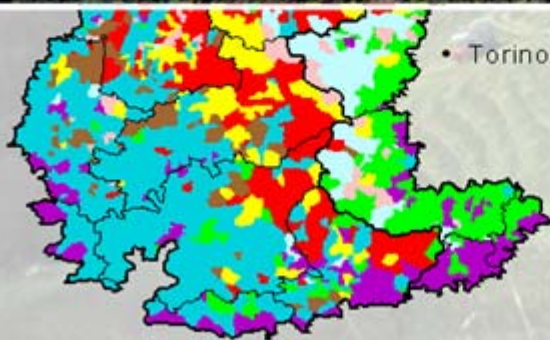
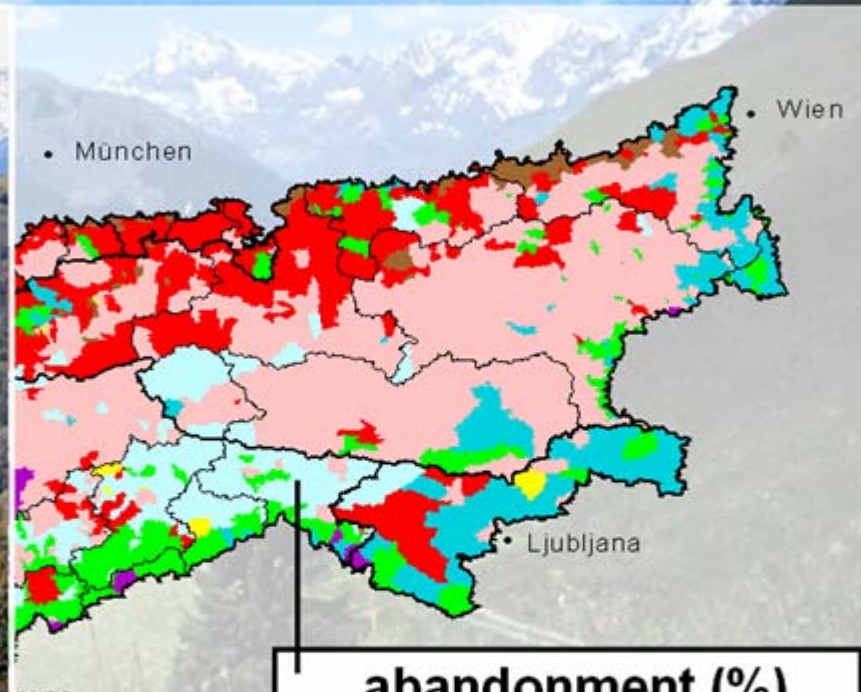
Coopr. 2002 Tappeiner U., Tappeiner G., Hilbert A., Mattanovich E. (eds.),  
European Academy of Bolzano/Bozen,  
Development within the EU-project SUSTALP (ENV4-CT-97-0442).

# Abandoned areas in the last 150 years



Tappeiner et al. (2003) Blackwell Science, Berlin

# Abandoned areas in the last 150 years



0 100 200 Kilometers



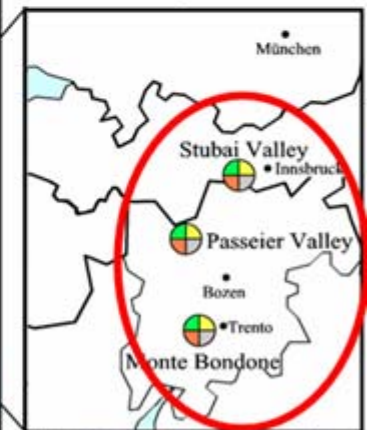
Tappeiner et al. (2003) Blackwell Science, Berlin



- Results from several FP4, FP5 and INTERREG projects



- Investigations in Mountain areas along European transects
- SFT Studies





# Research topics

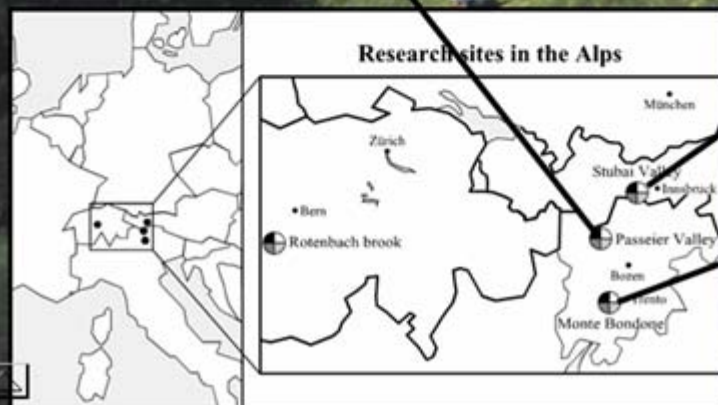
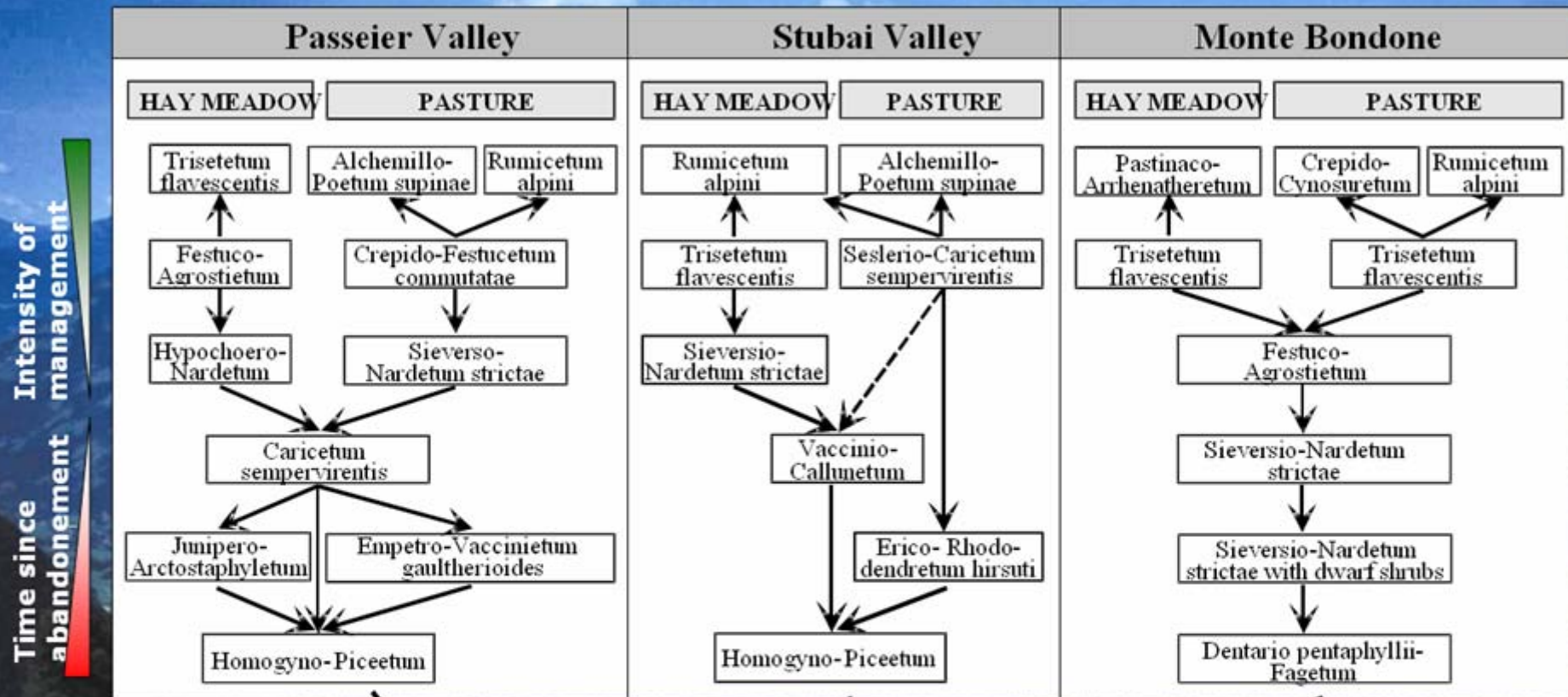
Land use



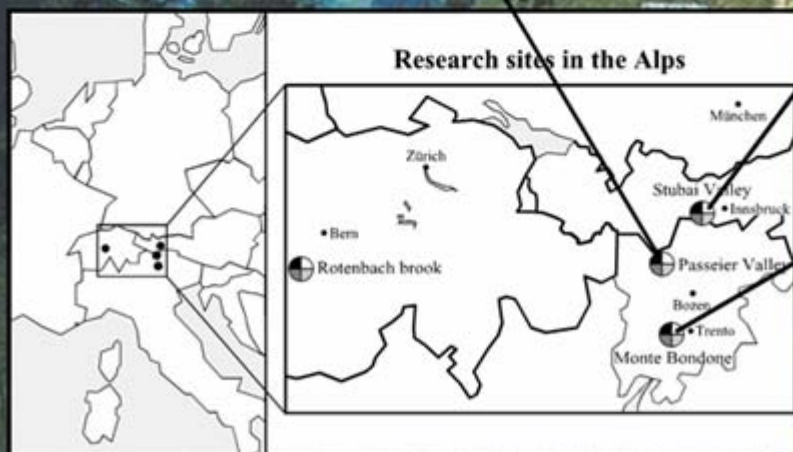
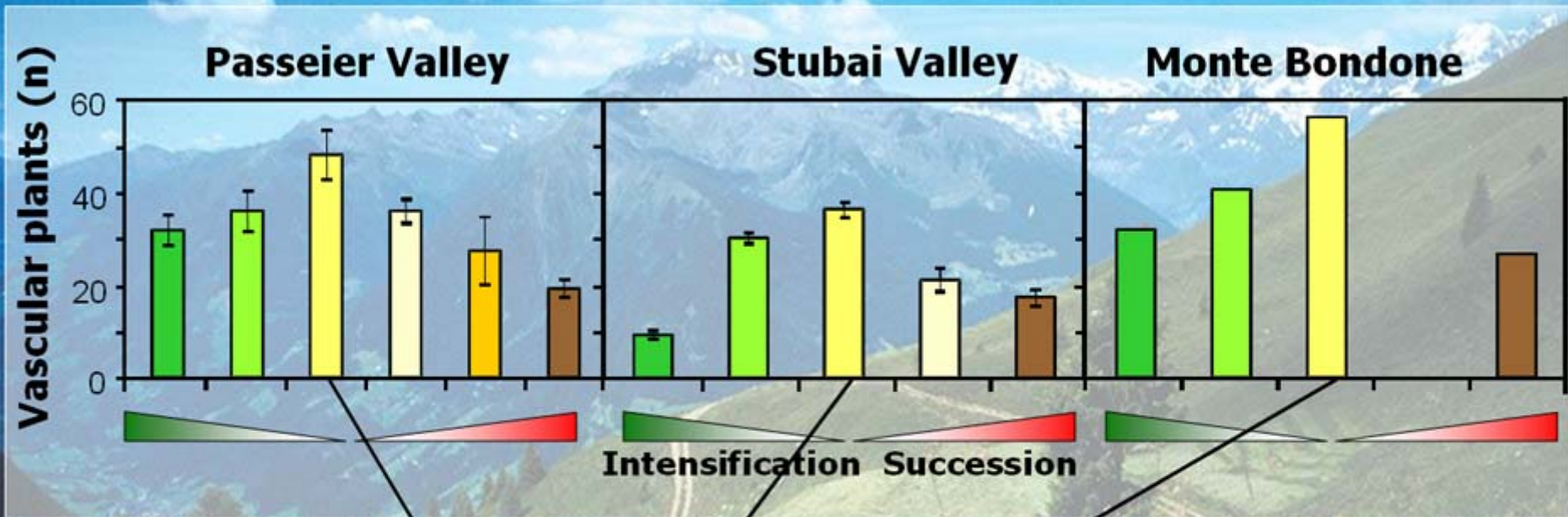
Effects on species,  
ecosystem and  
landscape processes :

- **Diversity**
- Bio-geochemical and hydrological cycles
- Potential risks – natural hazards

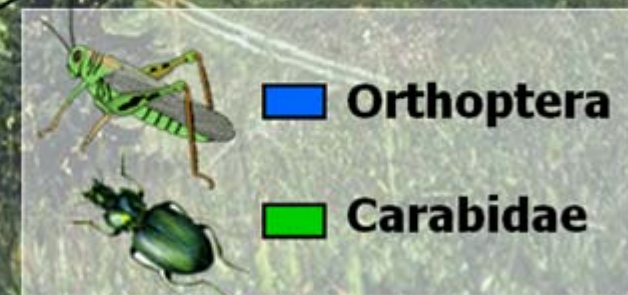
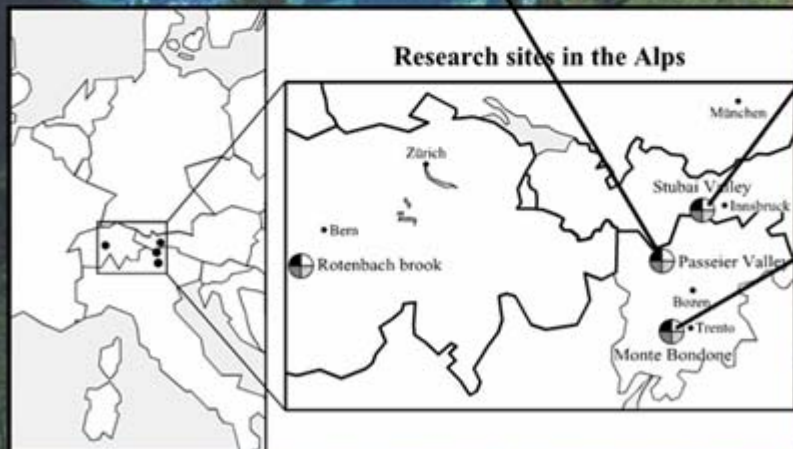
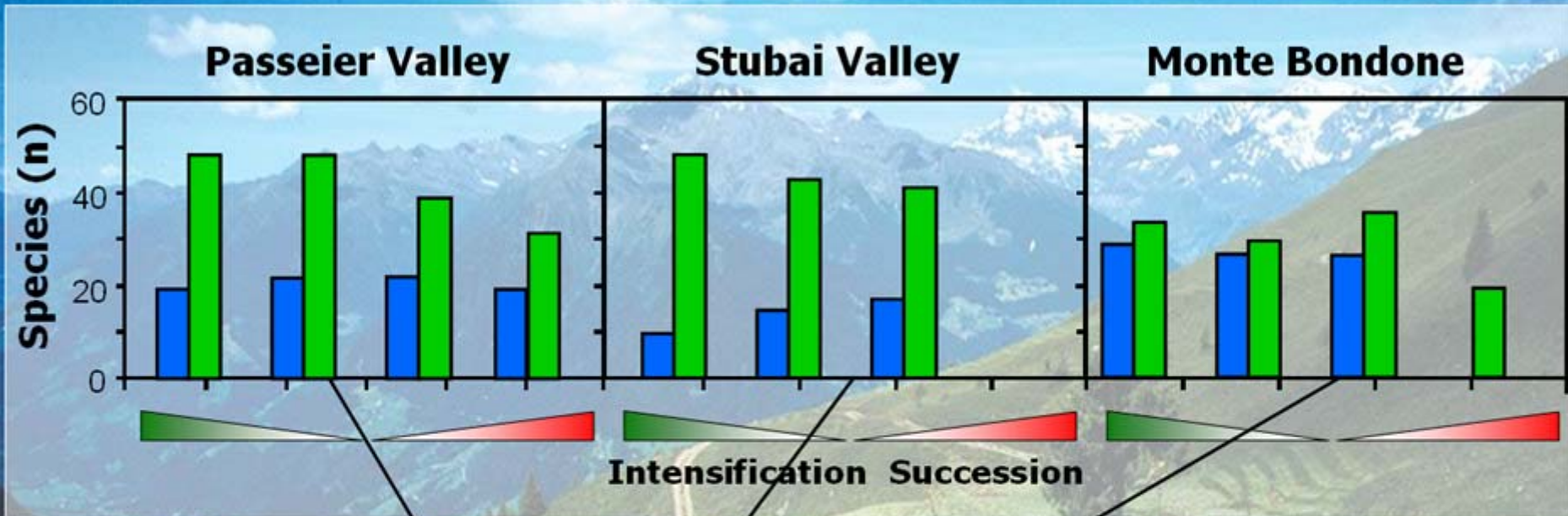
# Succession



# Biodiversity

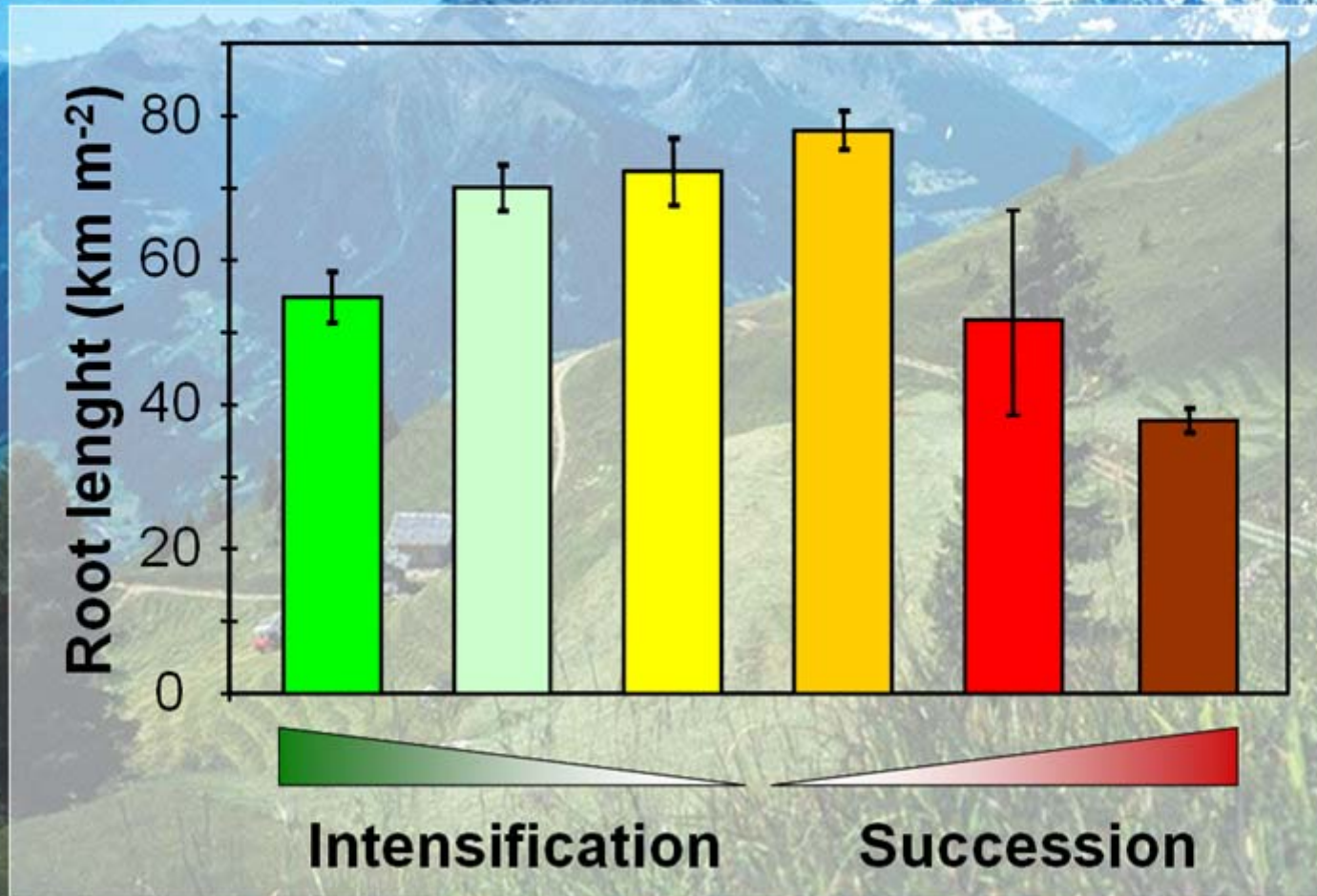


# Biodiversity

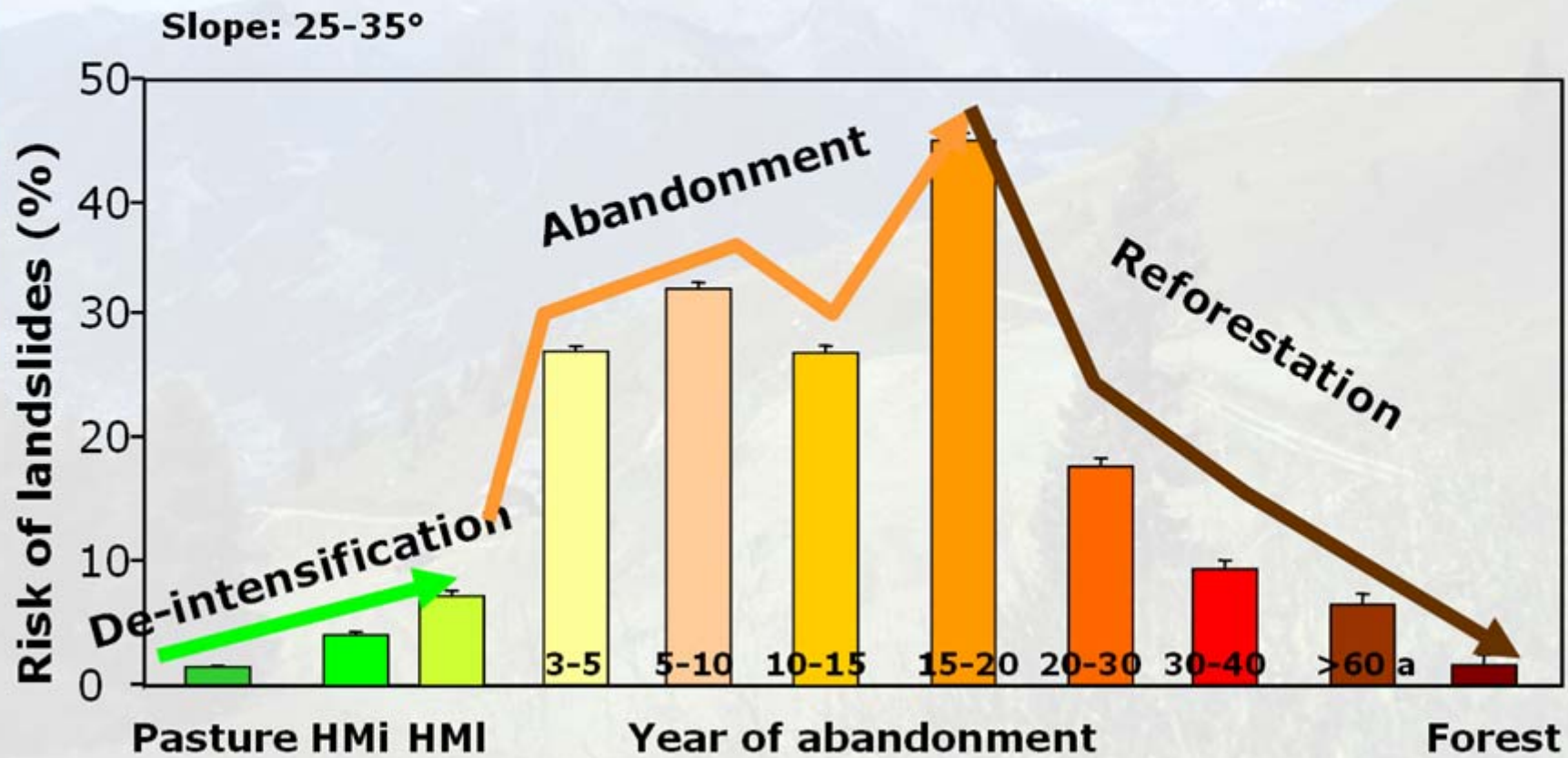


# Root diversity and density

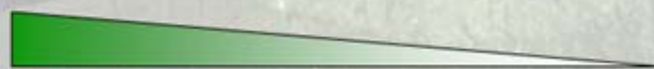
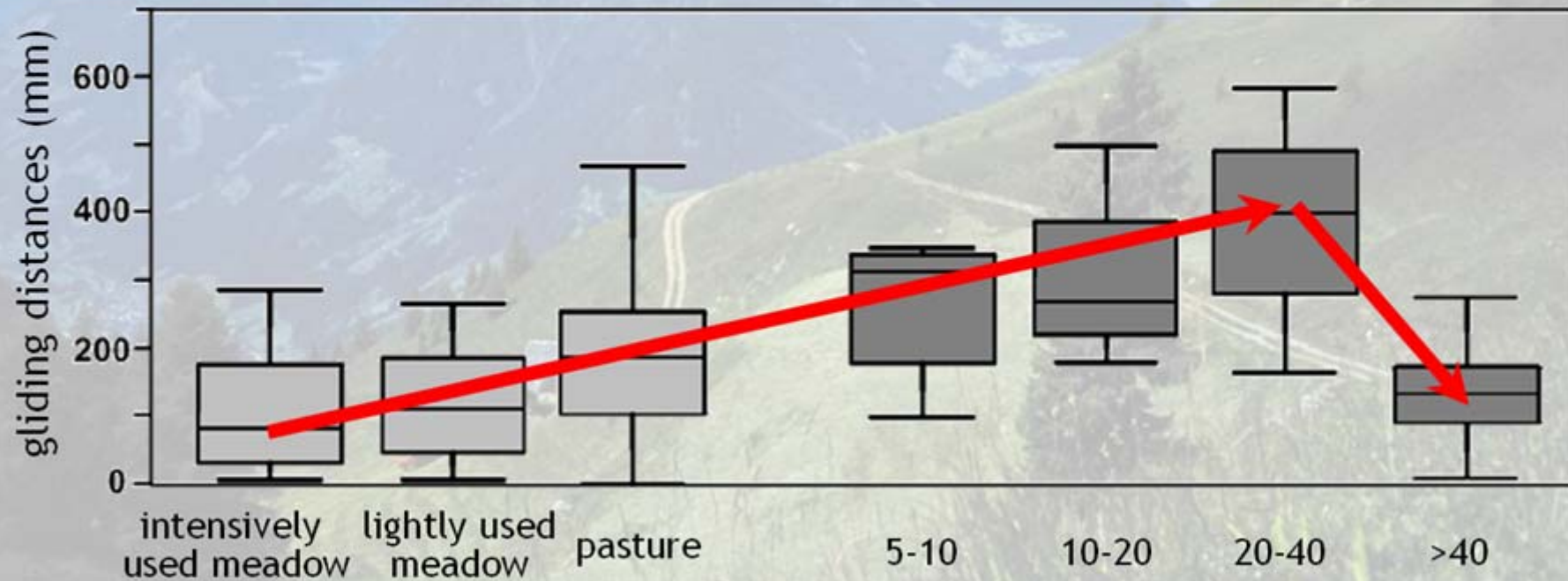
= > Stability?



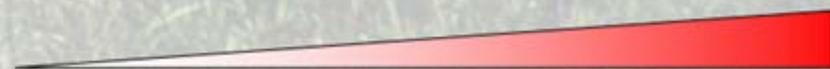
# Hillslope erosion



# Snow gliding



**Intensification**



**Year of abandonment**

# Research topics

Land use

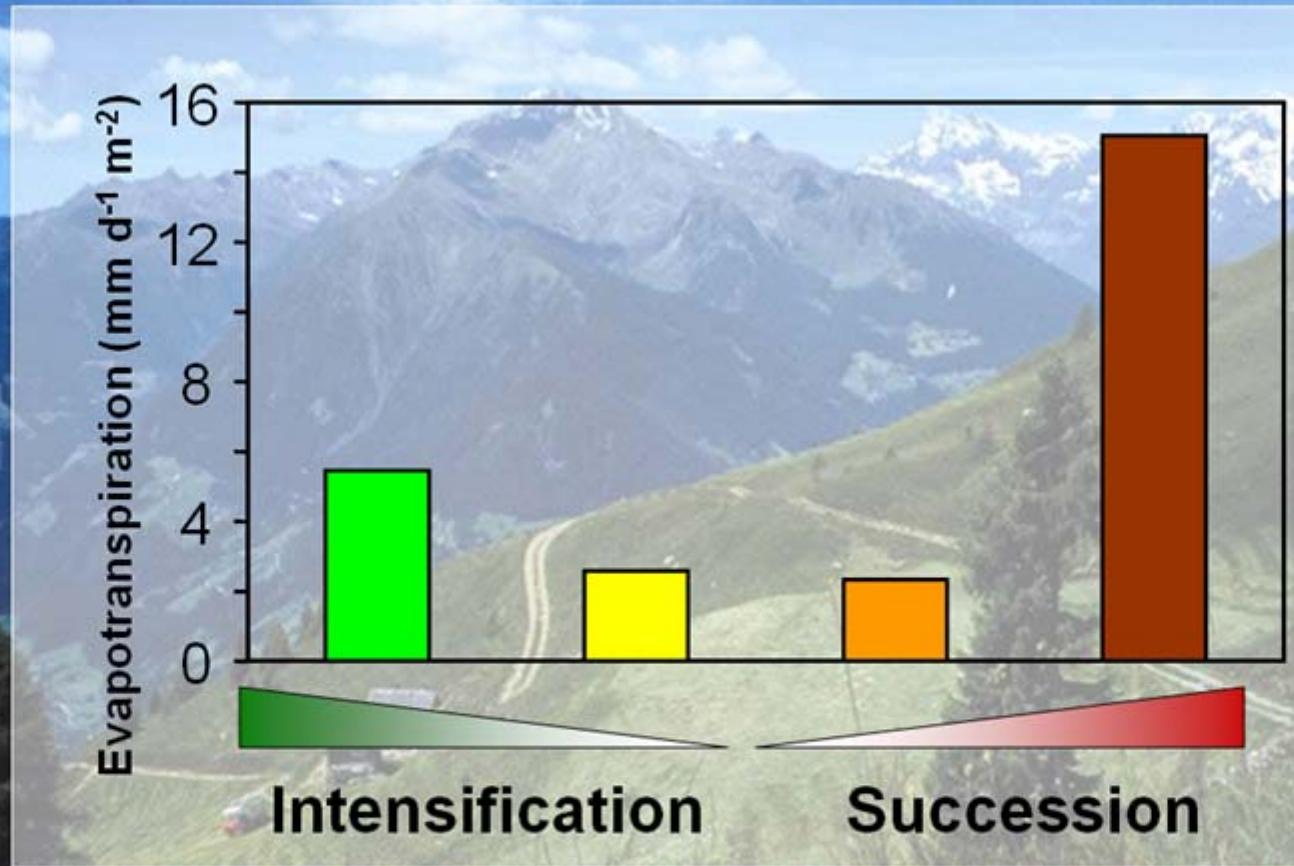


Effects on species,  
ecosystem and  
landscape processes :

- Diversity
- Bio-geochemical and hydrological cycles
- Potential risks – natural hazards

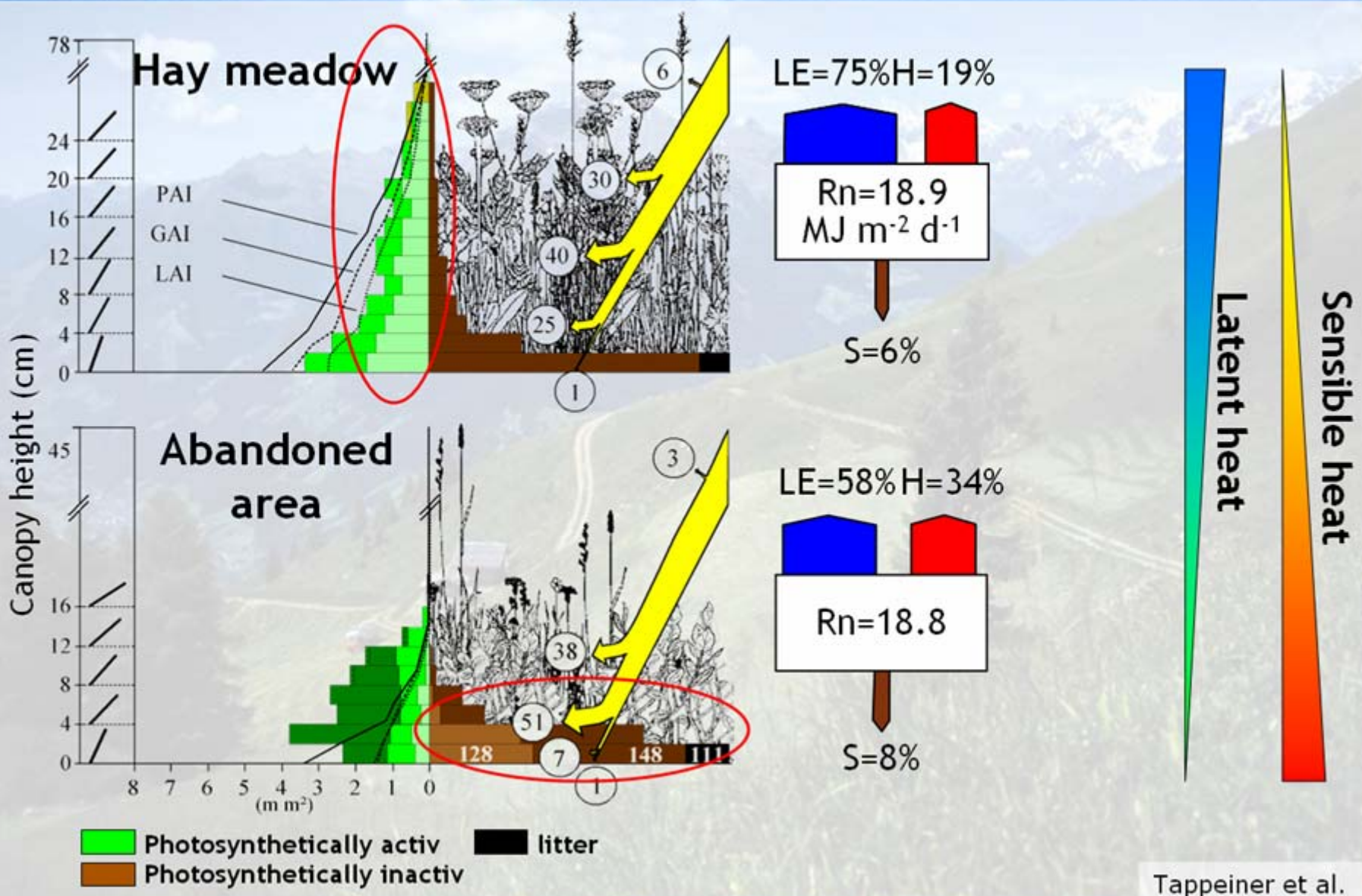


# Water balance



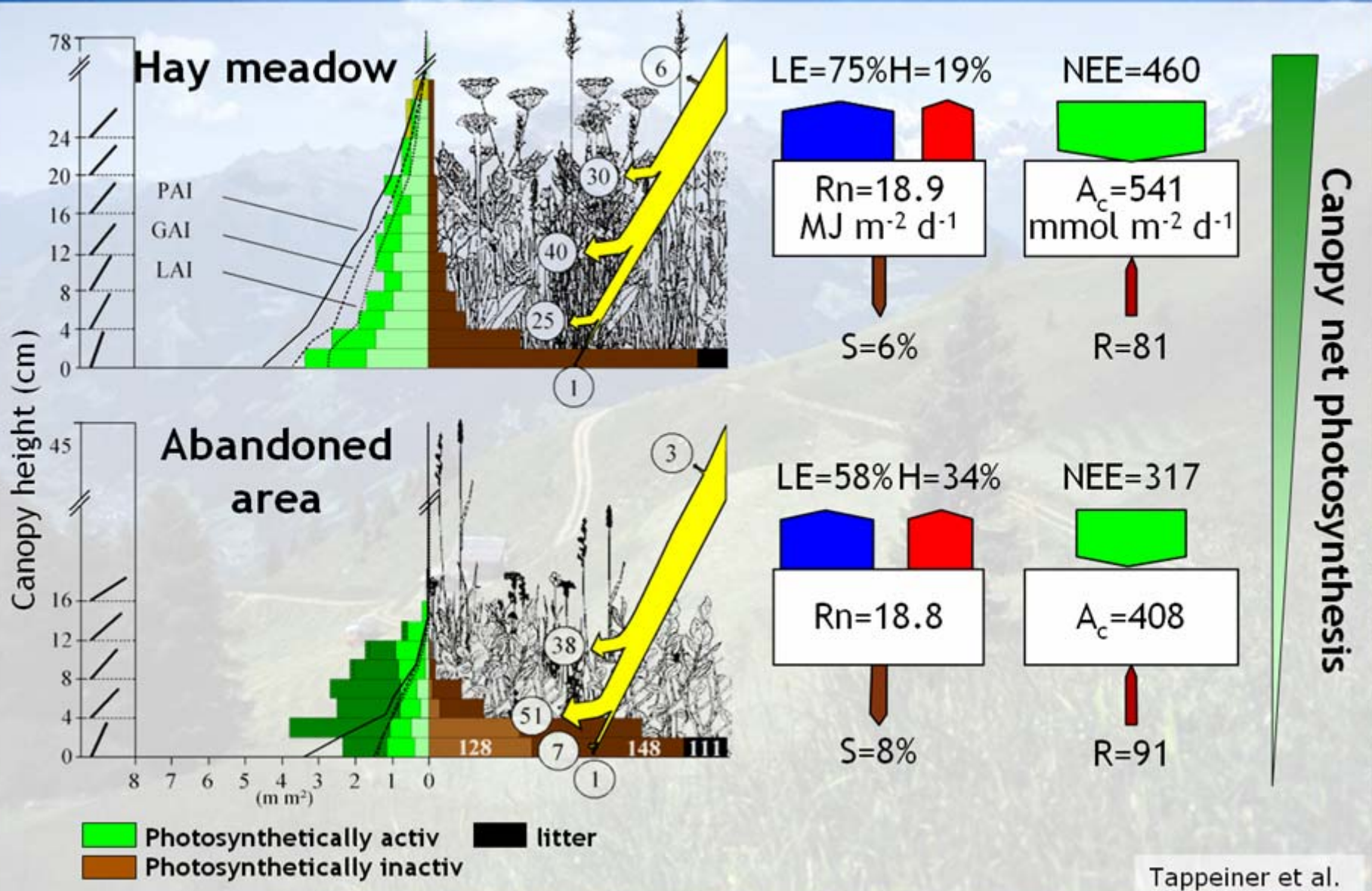
- Reforestation: 7 - 50% reduction of discharge in single creeks
- Lower gain in hydroelectric energy?

# Canopy structure and energy budget

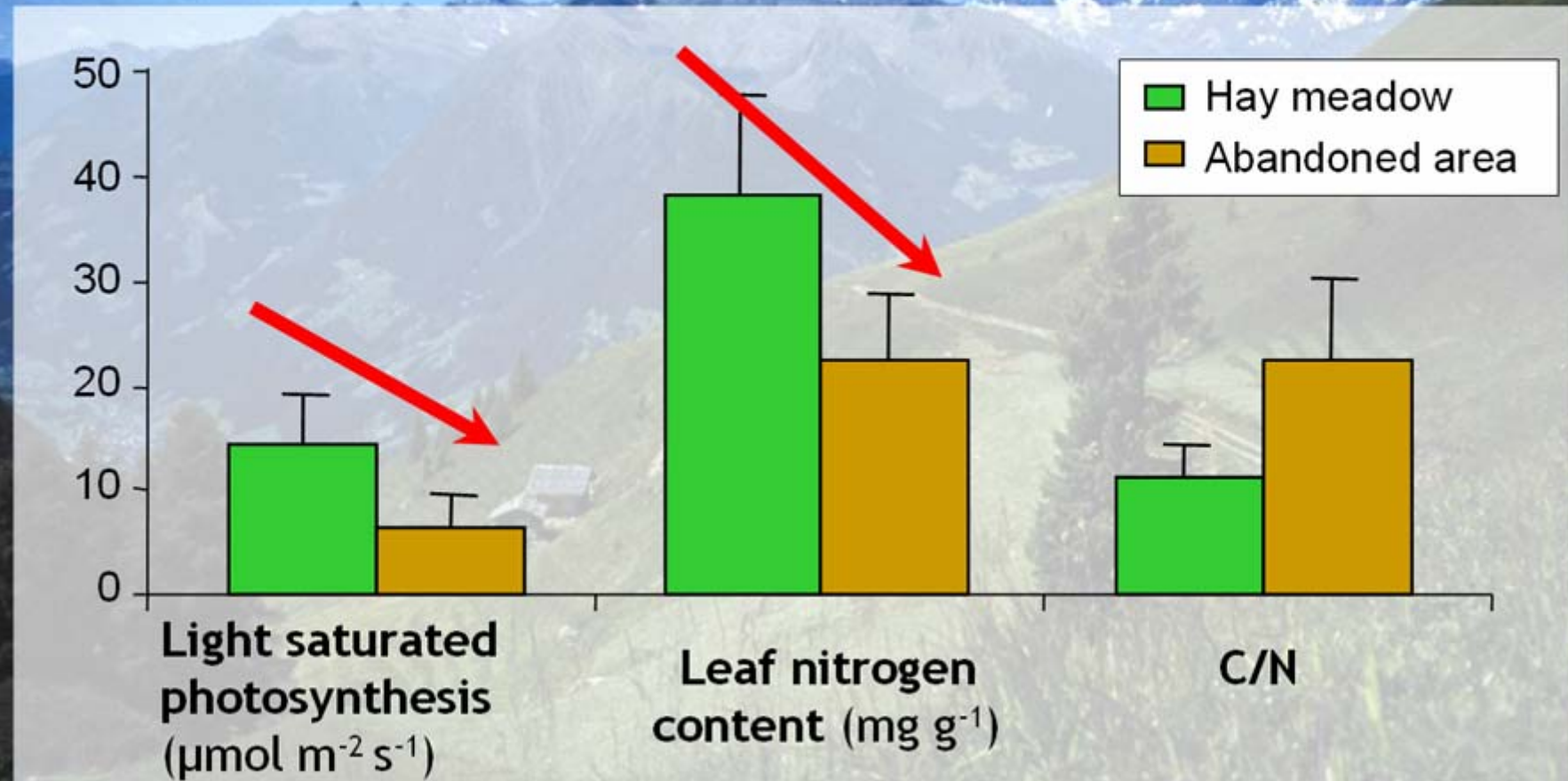


Tappeiner et al.

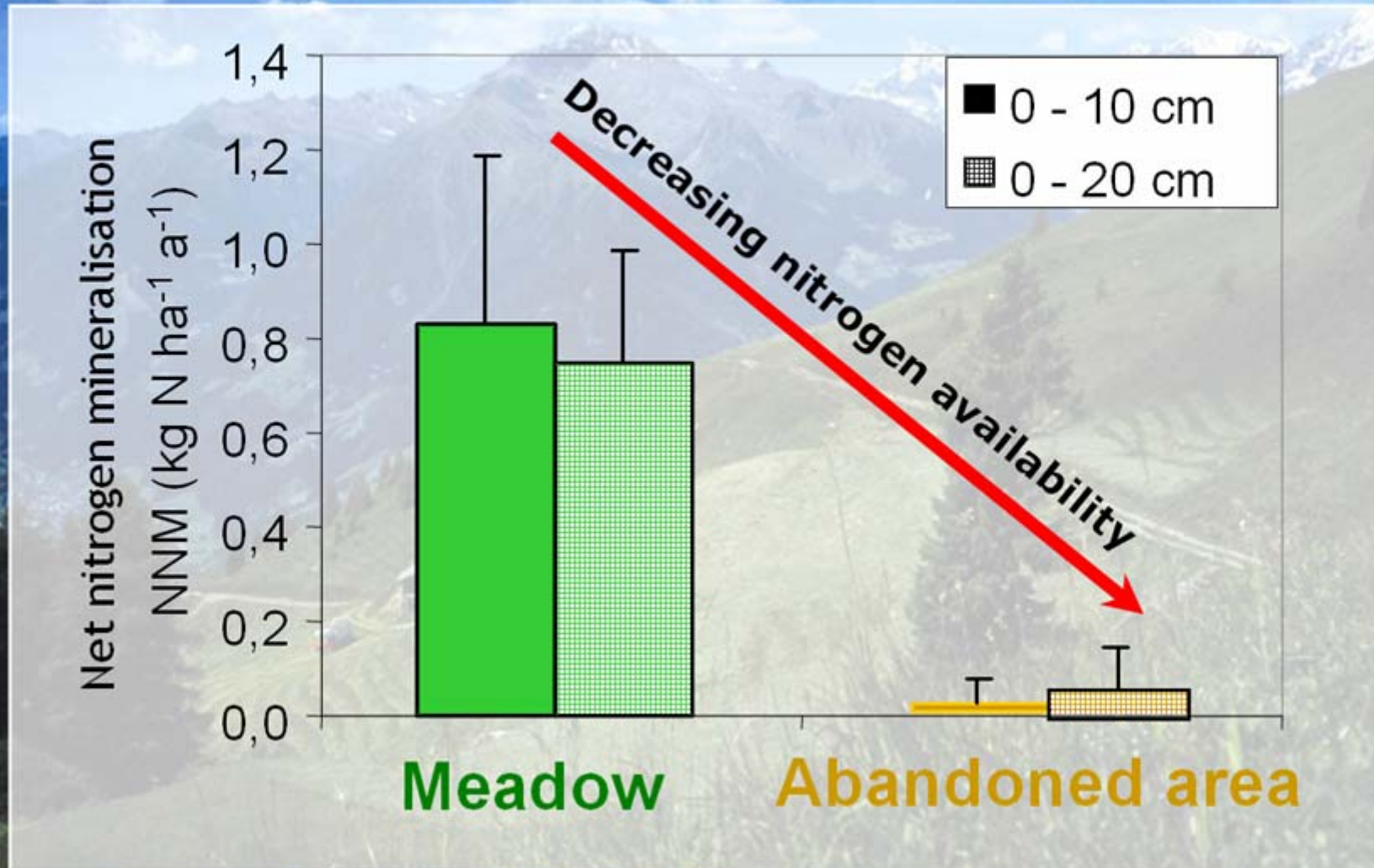
# Energy budget and CO<sub>2</sub> exchange



# Leaf photosynthesis and nitrogen content



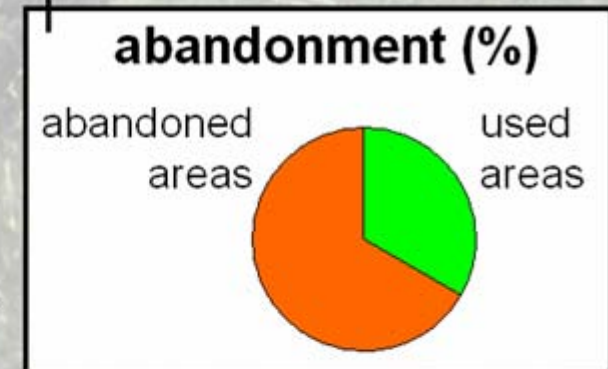
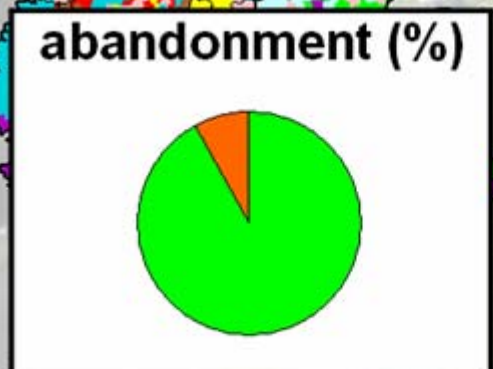
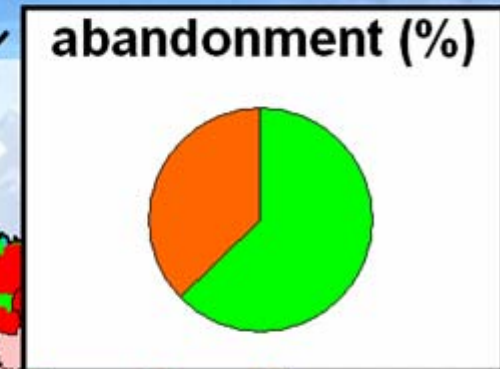
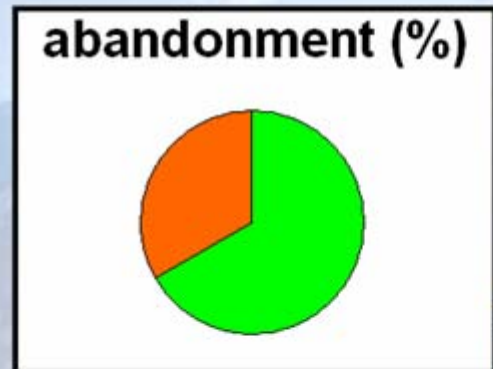
# Nutrient supply



Zeller, Tappeiner et al. (2000), Biol Fertil Soil

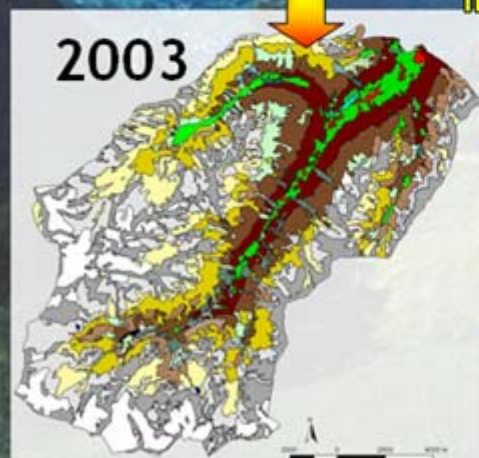
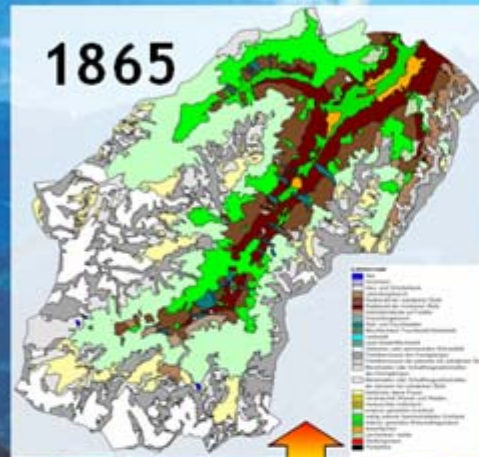


# Landscape development and ecosystem services at the landscape level



Tasser, Tappeiner et al.

# Landscape development and ecosystem services at the landscape level

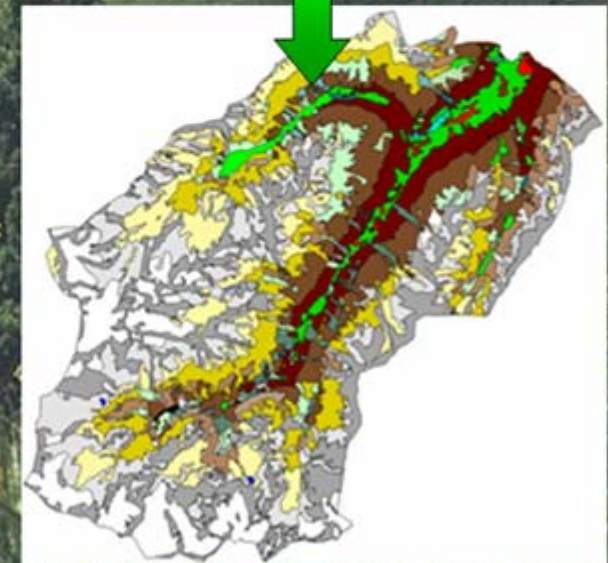
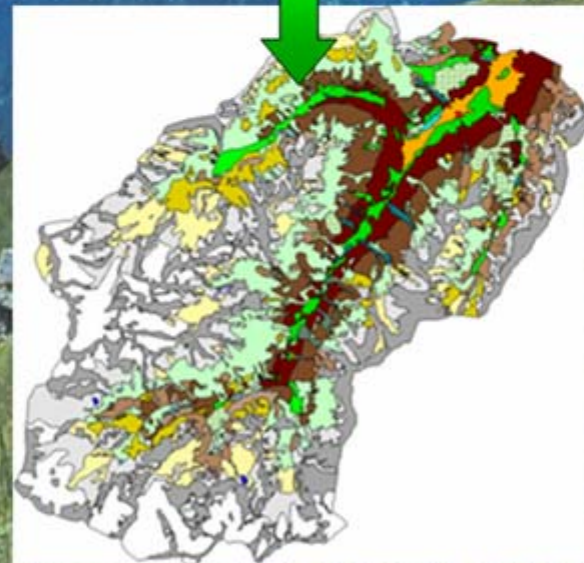
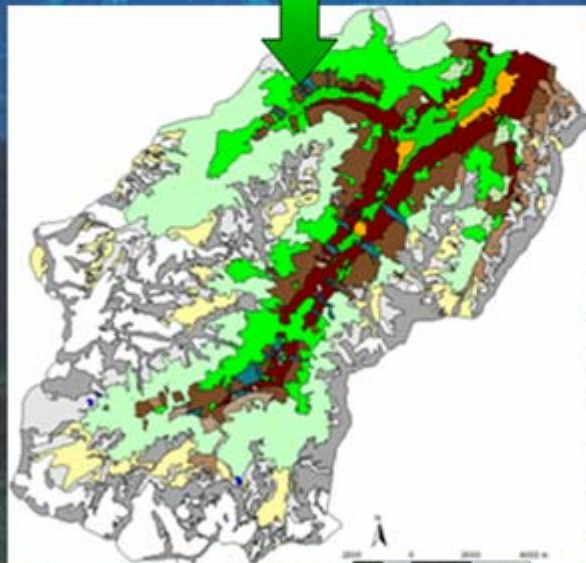
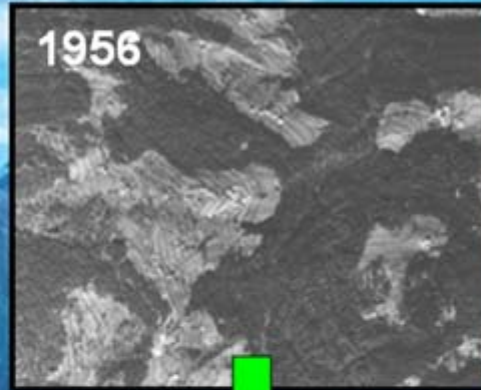


2030 ?  
Scenarios of  
land-use change  
+  
GIS-based  
Ecosystem models

- C-fluxes
- C / N-pools
- Biodiversity



# Historical development



- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"> <li> lake</li> <li> moor</li> <li> pebble and gravel bank</li> <li> dwarf-pines</li> <li> coniferous forest at the subalpine level</li> <li> coniferous forest at the montane level</li> <li> block forest</li> <li> mountain alder shrubs (<i>Alnetum viridis</i>)</li> <li> damp forest</li> <li> mixed forest: coniferous forest-damp forest</li> </ul> | <ul style="list-style-type: none"> <li> deciduous forest</li> <li> mixed forest: coniferous forest-deciduous forest</li> <li> glacier</li> <li> rock habitat at the high mountain level</li> <li> rock habitat at the colline - montane level</li> <li> waste dump communities at the high mountain level</li> <li> waste dump communities at the colline - montane level</li> <li> natural alpine grasslands</li> </ul> | <ul style="list-style-type: none"> <li> grasslands with dwarf shrubs</li> <li> communities of abandoned areas with shrubs</li> <li> communities of extensively used hay meadows</li> <li> communities of moderately used hay meadows</li> <li> communities of highly used hay meadows</li> <li> fields</li> <li> larch meadows</li> <li> settlements</li> <li> parking lots</li> </ul> |
|---|--|--|

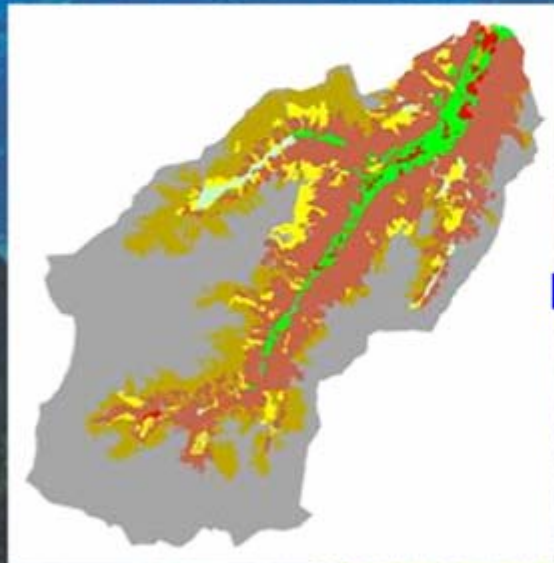
Tappeiner, Tasser et al.



# Land-use scenarios

2000

2030



	1	2	3	4	5	6	7	8
1	*	0	0	0	0	0	0	0
2	*	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	*	0	0	0	0
5	0	0	0	*	0	0	0	0
6	0	0	0	*	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

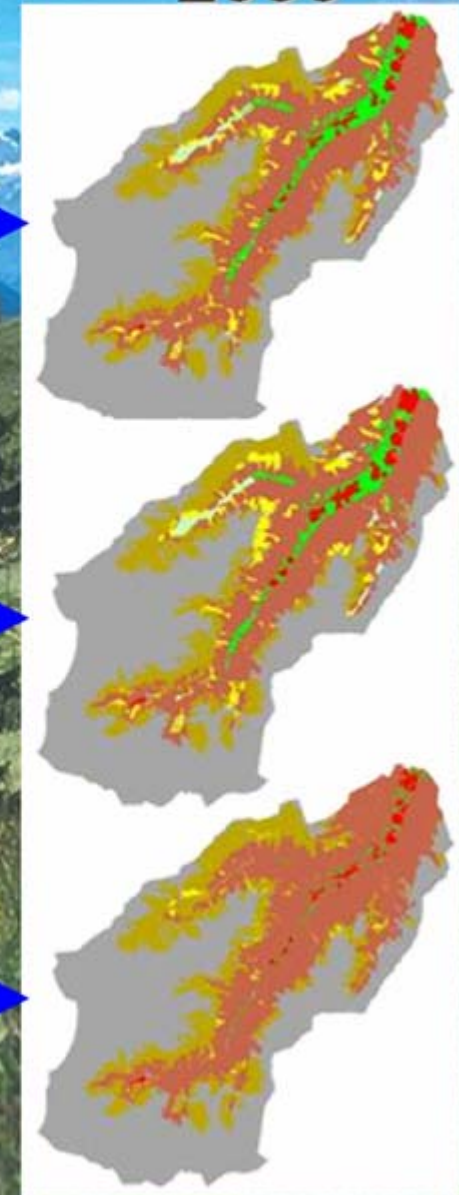
Transition matrices



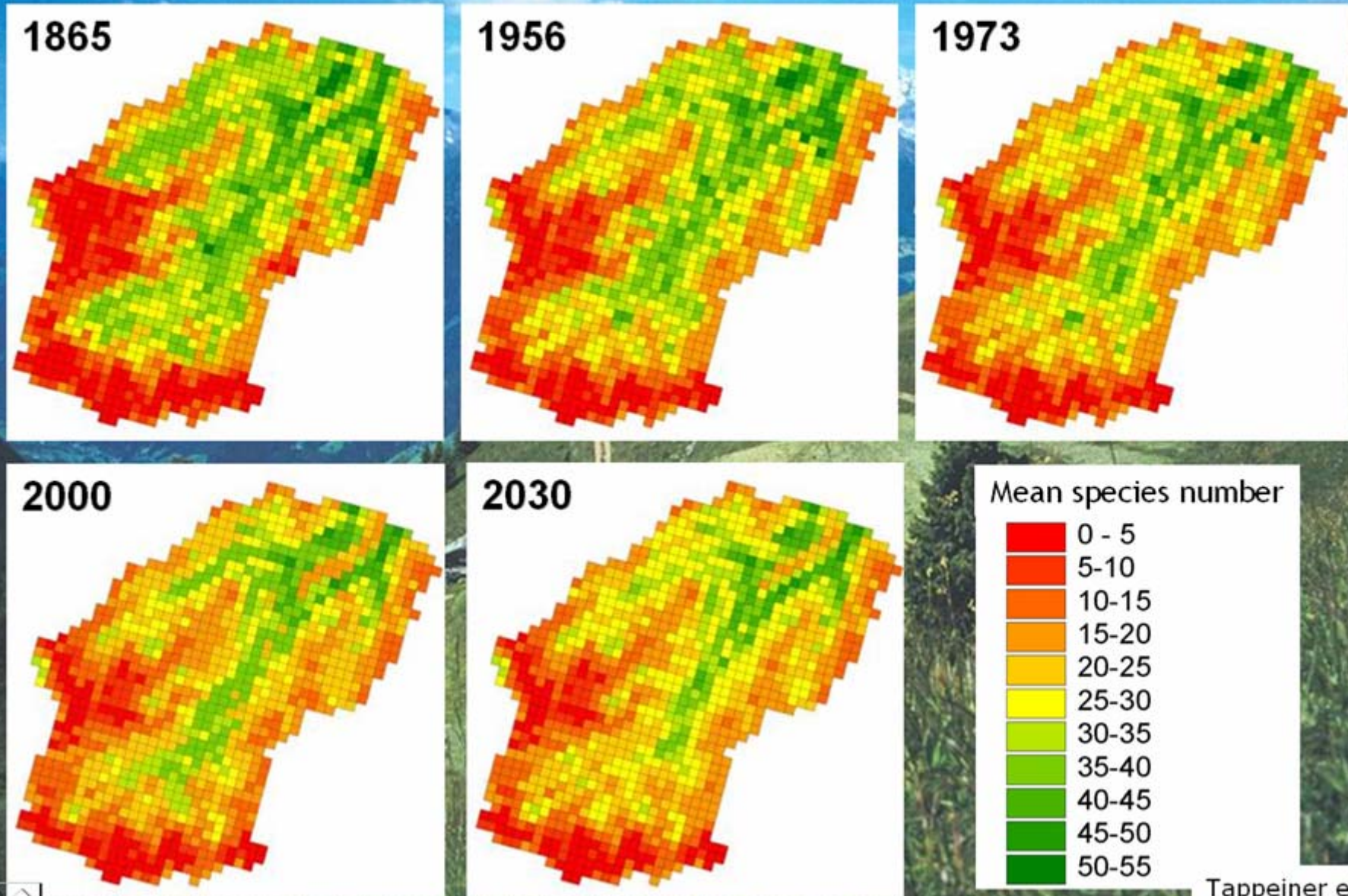
Stakeholder workshop



Agro-economic model

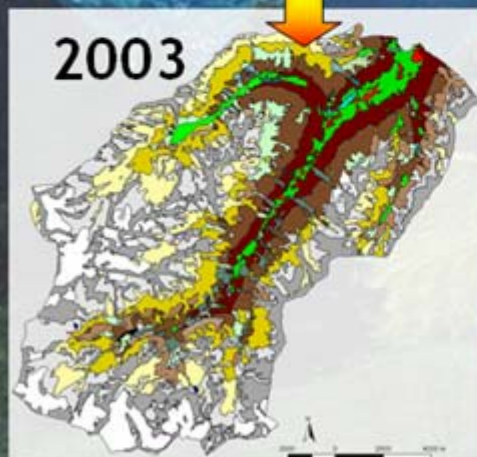
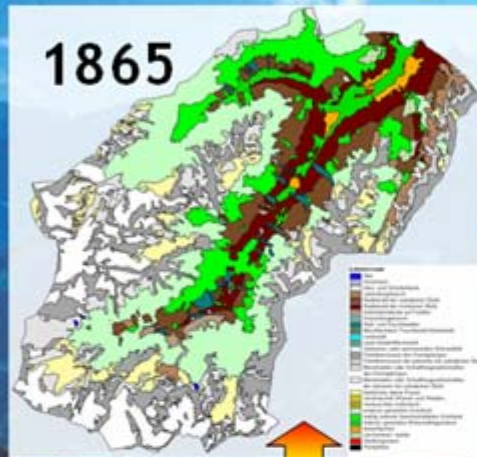


# Changes of biodiversity



# Landscape development and ecosystem services at the landscape level

## Land-use changes

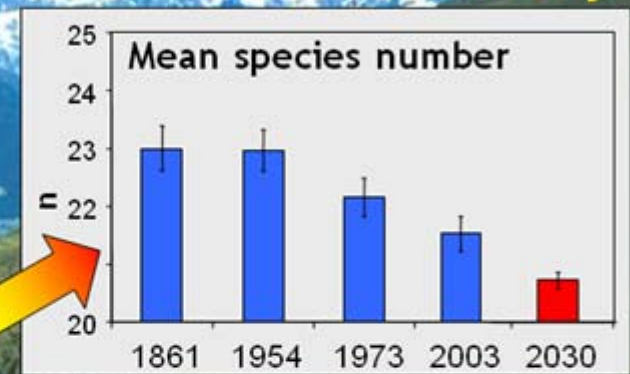


2030 ?  
Scenarios of land-use changes

GIS-based ecosystem models

A central box containing a map of 2030 scenarios. The map shows various land-use patterns, including agricultural fields, forests, and infrastructure. The text '2030 ? Scenarios of land-use changes' is at the top, and 'GIS-based ecosystem models' is at the bottom. A scale bar is also present.

## Biodiversity



## C-Sequestration

