Long term ecological research in the European Alps to uncover effects of Global Change (especially climate change and biological invasions)

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Integrated European Long-Term Ecosystem, critical zone & socio-ecological Research

**SUPPORT**

Political: 20 countries (EoS)

Institutional:
- Financial: 78 [21 countries]
- Scientific: 161 [27 countries]

2018 → ESFRI Roadmap
2020 → EU Preparatory Phase Project
2020 → EU Advanced Community Project

Biogeographical regions

- Alpine
- Atlantico-Atlantique
- Atlantic
- Alboran
- Boreal
- Continental
- Mediterranean
- Transpontine
- Mediterranean

UFZ
„Whole System“-approach & cross-disciplinarity

eLTER WILL SERVE MANY RESEARCH COMMUNITIES

LTSER Eisenwurzen: Zöbelboden © LTER Austria
Example for eLTER Site design, activities and co-location

Observed and investigated:
- System structure & functions
- Main drivers of change
- Interactions of slow/fast disturbance effects
Overview of long term research sites in the Alps

LTSER Platform
Eisenwurzen

LTSER Platform
Tyrolian Alps

OZCAR-RI
CRYOBSCLIM
Meta-analysis of long-term biodiversity trends in Europe

Accelerated increase in plant species richness on mountain summits is linked to warming

High altitude habitats suffer from Climate Change (CC) while low altitude habitats may benefit

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Shift of vegetation belts in the future?

(Thurillat & Schönborn 2000)
Shift of vegetation belts in the future?

Current +3°C Future

Modelling species co-occurrence under Climate Change

(Theurillat & Schönborn 2000)

See also Pompe et al. 2010, Basic Appl Ecol 11: 603-611

→ Species co-occurrence in Alpine communities and their areas decrease
Shift of vegetation belts in the future?

- Neither belts, nor communities or species shift!
- Individuals disperse
  → Change in community composition
  → Future communities may look different

→ Species co-occurrence in Alpine communities and their areas decrease

(Theurillat & Schönborn 2000)

Modelling species co-occurrence under Climate Change

See also Pompe et al. 2010, Basic Appl Ecol 11: 603-611
Can topographically controlled thermal-habitat differentiation buffers against climate warming?

Day time → heterogeneity
Night time ~ homogenous

Complex interplay of micro, meso and macro climate on species performance and species interactions

→ long-term cross-scale studies needed
Biological invasions & costs

- *Alien* species are (accidentally or deliberately) *introduced* by humans
- *Invasive* are alien species that cause *ecological* or *economic harm*
- Ecological impacts on biodiversity and ecosystem functions
- Economic costs are enormous: > €12.5 billion/year
  (Kettunen et al. 2008)
Alien species richness decreases with altitude, but…

- Holarctic species can invade higher altitudes,
- While tropical species remain in the lowlands
  ➔ With CC more alien species moving upslope


Factors affecting mountain plant invasions and pathways


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## Global change impacts biodiversity

<table>
<thead>
<tr>
<th>Driver</th>
<th>Trend</th>
<th>Effect on biodiversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Change</td>
<td>➔</td>
<td>➔</td>
</tr>
<tr>
<td>Biological Invasions</td>
<td>➔</td>
<td>➔</td>
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<tr>
<td>Land Use/Management:</td>
<td></td>
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<tr>
<td>• Intensification</td>
<td>?</td>
<td>➔</td>
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<tr>
<td>• Abandonment</td>
<td>➔</td>
<td>➔</td>
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<tr>
<td>• Forest area</td>
<td>➔</td>
<td>?</td>
</tr>
</tbody>
</table>

Long-term observations are crucial!

- Detect Trends
- Attribute Trends
- Disentangle complexities
  (resolution, extent, climate, land use, …)
- Interactions with humans
- Derive management recommendations

We are currently just at the beginning!

Rotmoosferner (Austria), Long-term study area of Prof. Brigitta Erischbärmer, U. Innsbruck
Thank you very much for your attention
Disproportional risk for habitat loss of high-altitude endemic species under climate change

Current species richness (1-20)  Proportional loss of habitat Moderate Climate Change Scenario

Severe Climate Change Scenario

The upward range shift of plants averaging 6.1 m per decade in altitude (IPBES 2018)

Population dynamics may lag behind climatic changes (Dullinger et al. 2012, Nature Climate Change 2: 619-622.)