Joanne Fitzgerald

Forest management and planning in a changing climate

Northern Forests in a Changing Climate
September 17th 2013

www.efi.int
Forest management

• < 10 Years → >100 Years
• Forest managers are used to adapting silvicultural practices to new insights gained on past experience.
• Climate change proceeding at unprecedented magnitude and speed – impacts now have to be factored into account
Reactive Management

• Passive waiting
• Responding only to impacts after they have occurred
• Does not include forecasting or forming expectations about future climate or impacts on forest ecosystems

• Might be a relevant approach where uncertainty about direction and/or impact of change is very large.
• Also might be relevant if expected changes are very small or gradual in form
North Karelia

- Climate change not expected to drastically impact health or stability of forest ecosystem
- Gradual change expected
- However monitoring climate developments and potential impacts is always advisable!
Proactive Management

- Actively monitor changes in current climate and forest ecosystems
- Assess likely projected developments and impacts of cc
- Base decisions both on observed current forest status and on expectations of future climate change impacts.

- If proactive manager succeeds in anticipating future changes, should perform at least as well as reactive manager
- Quality of information on which decisions are based is paramount!
MOTIVE Case studies

- MOdels for AdapTIVE forest Management
- 10 Case studies from different bioclimatic zones around Europe
- Goals
  - Assess likely changes to forest stand dynamics and ecosystem goods and services
  - Assess utility of adaptive vs conventional management regimes
## Portugal – Chamusca Region

### Case study forest area: 51,339 ha

<table>
<thead>
<tr>
<th>Forest goods and services:</th>
<th>Ownership: 98.7% Private, 1.3% Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non wood products: cork, pine nuts, mushrooms</td>
<td><strong>Special local conditions:</strong></td>
</tr>
<tr>
<td>Wood products: pulpwood, wood biomass</td>
<td>40 landowners hold 72% of the area in large scale</td>
</tr>
<tr>
<td>Services: grazing, hunting, fishing</td>
<td>properties (&gt;500 ha)</td>
</tr>
<tr>
<td>Non market services: carbon stock, forest protection, habitat conservation</td>
<td>Most owners have properties &lt;1ha</td>
</tr>
<tr>
<td></td>
<td>Most stands leased by pulp/paper industry</td>
</tr>
</tbody>
</table>

### Forest composition

- **44%**: Pure Cork Oak
- **11%**: Pure Eucalyptus
- **2%**: Pure Maritime Pine
- **2%**: Pure Stone Pine
- **40%**: Mixed
- **1%**: Other Species

1.10.2013
Climate Change Challenge:
Forest fires are already the main threat in the Chamusca region and they are expected to increase as future climate will be characterized by dryer summers and longer fire seasons.

Cork oak which is quite well adapted to dry conditions will suffer from more frequent and severe droughts in this region. In sites with lower water-holding capacity a reduction on tree and cork growth is expected, and an increase of tree mortality.

Photo: Joana Amaral Paulo
Adaptive management Chamusca

• The stand density (traditionally low in the area due to silvopastoral management) may be increased to offset the reduction in growth.

• Proper management (e.g. thinning, pruning, understory management) will be particularly important to increase resistance of forest landscapes to forest fires.

• Forest managers may extend the debarking rotation period to more than 9 years in order to allow the increase of cork thickness as cork will grow more slowly due to the dryer climate.
### Prades, Catalonia, Spain

<table>
<thead>
<tr>
<th>Case study forest area: 2,460 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership: 90% Private and 10% Public in the Prades mountain, 100% public in the Natural Site of National Interest</td>
</tr>
</tbody>
</table>

**Forest goods and services:**
- Tourism, recreation, conservation,
  - small scale forestry, mushroom picking

**Special local conditions:**
- Large areas of the forest were coppiced for charcoal until the 1960s and now left unmanaged with high densities over 20,000 trees ha\(^{-1}\)

### Forest Types

- **41%** Aleppo pine
- **18%** Holm oak
- **10%** Portuguese oak
- **9%** Other oak
- **2%** Other broadleaved
- **1%** Mixed forest
- **1%** Other coniferous
- **1%** Black pine
- **1%** Scots pine

![Pie chart showing forest types distribution](chart.png)
Climate Challenge: Climate change in the region is revealing itself by rapid increase in aridity, and more frequent extreme events such as droughts.

- Impact on forest dynamics as well as biotic and abiotic risks (e.g. forest fires).
- The level of these impacts and the adaptive capacity of forest ecosystems will affect the provision of relevant forest ecosystem goods and services.
Managers are recommended to follow a more intensive management which reduces canopy density. The effect of this is a decrease of competition between trees, which means more water available per tree, less mortality, and better overall growth performance.
Bulgaria – Panagiurishte

**Case study forest area:** 6584 ha

**Ownership:** 93% Public, 7% Private

**Forest goods and services:**
- **Wood products:** firewood for local citizens, pulpwood, technology wood (for wood-based panels)
- **Non wood products:** mushrooms, herbs, tourism
- **Services:** grazing, hunting
- **Non market services:** Protection against landslides and soil erosion.

**Special local conditions:**
The Executive Forest Agency is responsible for forest management in all types of forest in Bulgaria, irrespective of ownership. It participates in the process of design and implementation of forest management plans together with the owners.

- Sessile oak: 55%
- Turkey oak: 17%
- Hungarian oak: 15%
- Pine: 13%
- Oak: 13%
Climate Change Challenge: Droughts and less favourable growing conditions will cause substantial decrease in mean annual increment of forest stands, a decrease in seed regeneration and increased fire risk.

• Seed regeneration will become difficult for oak coppice stands as mature oak trees need favourable climate to produce acorns.

• Young seedlings are also more sensitive to drought stress. Warmer winters could lead to early blossoming and susceptibility to frost damage.

• Fire risk ↑

Photo: Georgi Kostov
Adaptive management Panagiurishte

- Current management aims to convert coppice to high forest through natural regeneration.
- Adaptive management includes shortening rotation of coppice stands to allow conversion to high forest and more tending and thinning of young forest stands.
- However the long term modeled projection indicates that area-wide conversion to high forest will not occur because of time-lags and the underlying set of different sites, climatic conditions and management actions affecting regeneration processes.
Romania – Frasin

Case study forest area: 10,500 ha

Ownership: 60% public, 40% private

Forest goods and services:
Timber, fuel wood,
Carbon sequestration, biodiversity,
non timber forest products, hunting grazing, fishing,
berries and mushrooms
tourism, conservation

Special local conditions:
The restitution of forests to heirs of pre-war owners between 1991 and 2005 as well as privatisation of wood harvesting, transport and processing sectors had a big impact on the development of the forest sector and forest management.

- Silver fir
- Norway spruce
- Beech
- Acer pseudoplatanus
- Carpinus betula
- Betula pendula
- Other species
**Climate Challenge:** The current humid climate brings harsh winters and cool summers, and a moderate regime of air temperature fluctuations. More variations in temperature and rain regime are expected.

- The Norway spruce forests from Frasin will suffer more frequently from drought, insect damage (*Ips typographus*) and windthrow.
- Norway spruce may decline or disappear.
- More thermophilic species such as larch, pine and maple may come to dominate.
Both adaptive management scenarios will produce higher timber volumes and higher biodiversity than BAU management.

They are based on a strategy of saving water: more intense and more frequent thinning is combined with the reduction of the rotation length from 120 year (BAU) to 110 years (AM1) and to 100 years (AM2).

Growing stock in t ha⁻¹ at different elevations in the year 2000 for Norway spruce (Picea abies), Scots pine (Pinus sylvestris), beech (Fagus sylvatica), oak (Quercus petreae), Sycamore maple (Acer pseudoplatanus), birch (Betula pendula) and other coniferous and deciduous species.
UK, North Wales

Case study forest area: Clocaenog 5662 ha

Ownership: 100% Public

Forest goods and services:
- Sustainable production of timber, paper pulp, biomass for energy
- Recreation
- Habitat protection and connectivity
- Water

Special local conditions:
Clocaenog is typical of an exposed upland site. It was largely created in its current form, through planting over a relatively short period of time.

![Clocaenog and Gwydyr forest composition charts](chart.png)
Climate Challenge: Climate change is expected to affect the growth and survival of forest trees through increased mean annual temperature and rainfall, while increasing the risks from storms, summer drought, pests and diseases.

• Towards the end of century some variants of the A1B scenario indicate much drier conditions in the region.
• This would be expected to cause previously high yielding sites to be constrained by drought, so yield would drop.
Diversification as an adaptation strategy led to less uncertainty, BAU has a possibility of higher returns, it also has a possibility of much lower returns, and the safer strategy in Wales would be to select a Diversification strategy.
### Black Forest, Germany

<table>
<thead>
<tr>
<th>Case study forest area: 1,400 ha</th>
<th>Ownership: Community 60%, State 24%, Private 16%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest goods and services:</td>
<td>Special local conditions:</td>
</tr>
<tr>
<td>Timber production, tourism, recreation, biodiversity.</td>
<td>The promotion of Norway spruce at the expense of European beech and other deciduous tree species in the past resulted in large areas stocked with Norway spruce outside its potential natural distribution.</td>
</tr>
</tbody>
</table>

- Silver fir
- Beech
- Spruce
- Scots pine
- Douglas-fir
- Others

Photo: Thomas Nissen

Silver fir
Beech
Spruce
Scots pine
Douglas-fir
Others
Climate Change Challenge: Norway spruce stands are susceptible to increasing occurrence of drought and disturbances such as bark beetle attacks

• In the region climate change induced droughts threaten the forests directly and indirectly via insect calamities, especially Norway spruce plantations outside their natural distribution

• In addition to droughts and insect calamities, large-scale storm events like the hurricane “Lothar” in 1999 or local thunderstorms are the major disturbance regime in the region.

Photo: Thomas Nissen
Adaptation in the Black Forest

- Under climate change, timber production in even-aged spruce forests cannot be maintained.
- Adaptive management needs to consider trade-offs. However, in the long term a joint promotion of forest diversity and timber production can be achieved by mixed forest management.
### Austria, Montafon Valley

<table>
<thead>
<tr>
<th>Case study forest area:</th>
<th>6470 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forest goods and services:</strong></td>
<td></td>
</tr>
<tr>
<td>Timber and fuel wood for local citizens, wood processing and biomass heating plants.</td>
<td></td>
</tr>
<tr>
<td>Protection against avalanches, rock fall, landslides and erosion.</td>
<td></td>
</tr>
<tr>
<td>Grazing, hunting, tourism</td>
<td></td>
</tr>
</tbody>
</table>

#### Proportion of Species of Montafon

<table>
<thead>
<tr>
<th>Silver fir</th>
<th>Norway spruce</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>96%</td>
<td>1%</td>
</tr>
</tbody>
</table>

A limestone rock retained by beech trees. (photo: Rupert Seidl)
**Climate Challenge:** Due to the high share of Norway spruce in the forests of the Montafon, timber production, as well as protection against gravitational hazards are likely to be negatively affected by an increase in disturbances, particularly from bark beetles.

- All tree species in the region will physiologically benefit from a warmer climate because water supply on most sites is not a limiting factor
- For Norway spruce the risk of bark beetle (*Ips typographus*) infestations will increase substantially due to better development conditions for poikilothermic insects
- Reduced timber production, increased biodiversity (e.g. woodpeckers due to more poikilothermic insects and dead wood)

Photo: Manfred Lexer
Visualization of 70 ha forest on a slope in the Rellstal Valley.
Conclusions

• In order for European forests to fulfill all their functions in the future, management has to be adapted
• Adaptation strategies: regional/local approaches needed
• Trade-offs and synergies between ecosystem goods and services
• Adaptive measures depend on perceptions of stakeholders
• Limited success of adaptation strategies under difficult growth conditions and strong scenarios
• A diverse forest is a resilient forest.
When expected impacts are drastic....

Proactive measures can pay off.

Cartoon: Svenja Lindner
Đakka þér

- www.motive-project.net
- www.efi.int
- Joanne.fitzgerald at efi.int