Is there a Future for Mountain Forestry?

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Tyrol has a powerful timber industry, processing at least 3 million m$^3$ of timber every year. The share of trees derived from tyrolean forests is relatively small (30%), while the majority of timber processed in Tyrol is grown in Bavaria and other neighbouring countries, where harvesting is done fully mechanized and at low production costs. Forestry on steep mountain slopes has become an exception in Europe and has an uncertain future.

In addition to economic uncertainty, ecological risks for forests are also rising. Climate change may affect trees and forests of the Alps in diverse ways. Trees may either suffer from heatwaves and drought or increase in growth even on forest sites that are close to each other. Effects on the treeline are uncertain as well. Expanding forests in the timberline ecotone are attributed to landuse changes rather than to climate change.

Alpine forests are managed since centuries
Timber and fuelwood were the key resources for the mining and refining of salt in Tyrol. Timber and fuelwood were floated along the river Inn from St. Moritz (CH) to Hall. According to Palme (1975) the total timber consumption of a single mine amounted to more than 100,000 m$^3$ in the 16th century. Even today, the Engadin-valley in Switzerland still shows the scars of deforestation and its consequences in an alpine landscape. Tyrolean forest history is a story of overusage and resource depletion. We have learned from the past that sustainable forestry is essential for the alps.

Current state of forests

Forest area
Since the middle of the 20th century, forests in the Alps have been expanding (Russ, 2004; Strobel et al., 1999), as a consequence of land use and maybe also due to climate change. In Tyrol, the forest area has been expanding at an annual rate of 800 ha since 1960, resulting in an 5% increase of forest area in Tyrol during this period.
Global Change and Sustainable Development in Mountain Regions

The main reasons for this development are:
- as steep meadows and pastures were abandoned, trees have invaded agricultural land through natural regeneration,
- high elevation afforestations were implemented in some regions to protect settlements from avalanches, land slide or floods.

The expansion rate of forests might further increase in the future, if climatic effects stimulate an accelerated upward movement of the tree line.

**Growing stock**

In most regions of the Alps, forests have closed in the last decades. Cautious timber removals, well below the annual increment, have lead to high growing stock levels. Other reasons for this development are the decreasing intensity of cattle and sheep grazing inside forests and the disappearance of other forms of agricultural use in forests, such as litter racking and tree pollarding (Haas, 2002, Stuber and Burgi, 2001), resulting in better conditions for tree regeneration.
Forest health and vitality
Forest health and vitality indicators have not developed in the same direction as forest growth indicators, especially in protective forests (characterized by a dominance of older trees). Crown conditions are still a cause of concern as the amount of trees with satisfactory crown condition is still decreasing (Amt der Tiroler Landesregierung, 2006).

Mass propagations of bark beetles are another threat for alpine forests that have become more important in the last decade, even though the incidence of windthrow and snow break, which trigger outbreaks of bark beetles, did not show a clear trend during this period (Krehan and Steyrer, 2007). The increasing frequency of massive bark beetles outbreaks might be influenced by climate change and eutrophication of forest ecosystems by atmospheric deposition.

Growth rates increase whereas crown conditions decline
This directly opposite trends between growth rates and crown condition seem to be inconsistent and hard to explain. The following comparison may be helpful: Forests might respond similarly to people with an imbalanced diet, increasing in weight but loosing overall fitness at the same time.

Scientific questions to be answered:

- How do we identify sites affected by:
  - eutrophication
  - climate change
  - massive pest outbreaks

- What are possible measures to limit the effects of eutrophication and climate change on these sensitive sites
Productive functions

Alpine forests were often over-exploited in the past, but after World War II the general conditions changed. Reduction of agro-forestry, eutrophication with nitrogen by atmospheric deposition and climate change have lead to increasing increments in most of the alpine forests. In most areas of the Alps, fellings were reduced due to the decreased timber prices, growing production costs and rigorous forest laws.

In Tyrol the situation is considerably different: Forest owners, advised by the Tyrolean Forest Service, have conducted fellings at an „all time high“ rate in recent years. One of the primary objectives for this enhancement of harvest activities in Tyrolean forests is to rejuvenate the old stands in protective forests to sustain their protective function in the future.

Forestry on steep slopes is expensive

In Tyrol only 10% of timber harvest is done fully mechanized, while 90% of all the trees are still cut with manually operated chainsaws. To sustain forestry in mountain forest, the Tyrolean Forest Service provides a package of subsidies to encourage forest owners to manage their forests. Ninety percent of all the government aid is invested in measures to improve the stability and rejuvenate protective forests.

Efficient forestry is restricted by small plots

In many areas of the Alps, forests are owned by a multitude of landowners. In Tyrol alone 30,000 forest owners own a total forest area of 510,000 ha. In addition, more
than 20,000 beneficial owners have specific rights to obtain fuel wood and timber and to graze cattle in the forests. As a consequence, most timber harvests need to be harmonized between neighbours. Our local foresters in the communities try to convince land owners to coordinate their timber harvest, to share the costs and bring an appropriate assortment of timber to the market.

A first attempt to manage timber logistics from forest to the sawmill efficiently, is a GIS – system providing the timber industry with all the information about the planned timber harvests within the current season.

Timber industry plays an important role in the economy of the Alps

In Austria wood products are exported, representing 8.5 billion € in annual revenues. So the timber industry plays a key role in the economy of some regions in the Alps. However, some of the risks, as mentioned above, jeopardize the timber supply.

Scientific questions to be answered:

• How to manage forests with a multitude of land owners, most of them without any experience in forestry?
• How can forests on steep slopes, affected by avalanches, erosion and rockfall be managed efficiently?
• How to enhance productivity without adverse effects on other functions (biodiversity, erosion,...)
• How to maintain sustainable forestry with landowners living far away from the forest and with no experience in forestry?

Protective functions

In Tyrol, only 12% of the land area is suitable for permanent settlements. The rest is too steep, endangered by natural disasters, or located at too high an altitudine. So the protective functions of our forests play an important role to the safety of our settlements. Figure 5 shows the hazard zone map of the village of Neustift. The map illustrates the shortage of areas where the risk of natural disasters is low. In areas surrounded by red lines, buildings may be destroyed by torrents or avalanches; the yellow lines indicate areas where buildings may be damaged by these hazards.
Is forestry needed to preserve a forest's protective functions?

There is no single general answer to this question. Due to specific site conditions, forest community composition and historic forest management, every stand bears a specific risk. The so-called “Stockwald” in St. Jakob i. Defereggental is an example of
how things might go wrong when forest management is absent for several decades
in a steep mountain forest. Some characteristic features of the “Stockwald” are:

• protective forest by decree
• no fellings since 1850
• forest dominated by a single tree species (spruce)
• unfavourable height/diameter relationship

In 1977 Mayer and Pitterle (1988) stated that uniform stands dominating the whole
Stockwald, bear a high risk of windthrow. This forecast proved to be surprisingly
accurate, as most of the stands mapped as unstable, collapsed within 30 years, leaving
behind an area of 20 ha without mature trees. Massive snowpack-stabilizing struc-
tures which also protect the village from rockfall had to be established on the site.

Scientific questions to be answered:

• Are their new opportunities, linked with climate change, to prevent natural
disasters
• How can forests on steep slopes, affected by avalanches, erosion and rockfall
be managed efficiently?
  – reliable technics of pest control
  – are there sites, which do not need be managed?
• Which tree species will cope best with the future climate?
• How to establish forests now, in anticipation of future climatic conditions that
might be quite different?
• How to reintroduce tree species that are vulnerable to deer browsing?

Biodiversity

Biodiversity may not be a priority goal for local foresters, but the way forests are
managed has strong implications for biodiversity.

Scientific questions to be answered:

• Does increasing growing stocks, dense forests and eutrophication lead to de-
creasing biodiversity?
• How does damage by wildlife affect biodiversity in the long run?
Recreation and forestry

Forests are also an important „sport facility“ for tourists and locals in many areas of the Alps. This development produces conflicts with the traditional land users such as forest owners, hunters and farmers. To find consensus between different groups of land users, the Tyrolean Forest Service has developed some nice examples for cooperation between tourism, land owners and other user groups:

- The Tyrolean mountainbike model: opening more than 5,000 km of forest roads for cycling and transferring fees from tourism to landowners (all the routes are accessible via the internet).
- The ski mountaineering project in cooperation with the Austrian Alpine Club: establishing small pastures in certain forests to reopen common ski routes which have become impassable by expanding forests.
- Various projects where landowners receive rent from tourism for allocating their land for recreational activities like climbing, paragliding, canyoning and others.

Scientific questions to be answered:
- What are the effects of recreational activities on wildlife and deer damage?
- How can forestry and tourism coexist or benefit from each other?

Literature: