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Abstract: Selective browsing of young trees by wild ungulates is generally considered one of the most severe problems in Swiss mountain forests. Browsing by wild ungulates is supposed to increase mortality in young trees, thereby affecting forest structure and compromising the protective function of mountain forests. The silver fir being a major species in these forests is preferentially browsed and therefore considered to be threatened by wild ungulates. Scientific evidence supporting such fears is largely missing. We found clear evidence that forest management practices had promoted Norway spruce at the expense of silver fir during the last one hundred years. The common practice of grazing forests with domestic animals furthered these trends. Wild ungulates were not involved in these developments as they were extirpated in Switzerland or reduced to extremely low densities until far into the 20th century before populations started to recover.
Silver fir and the mountain forest – ungulate conflict: Do browsing ungulates drive forest landscape changes in the Alps? (Summary)

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Selective browsing of young trees by wild ungulates is generally considered one of the most severe problems in Swiss mountain forests. Browsing by wild ungulates is supposed to increase mortality in young trees, thereby affecting forest structure and compromising the protective function of mountain forests. The silver fir being a major species in these forests is preferentially browsed and therefore considered to be threatened by wild ungulates. Scientific evidence supporting such fears is largely missing.

At present the proportion of silver fir is smaller in many mountain forests than would be desired by forest managers. In order to clarify the present situation, we analyzed historical trends in proportions of silver fir in standing timber stock for several mountain forest regions, using old forest inventories and protocols on timber harvest. We found clear evidence that forest management practices had promoted Norway spruce at the expense of silver fir during the last one hundred years. The common practice of grazing forests with domestic animals furthered these trends. Wild ungulates were not involved in these developments as they were extirpated in Switzerland or reduced to extremely low densities until far into the 20th century before populations started to recover.

Data from the first and the second Swiss national forest inventory and additional surveys indicated that in the recent past densities of silver fir in forests at elevations above 1400 m were significantly lower than densities considered “natural” by silvicultural theory. The potential to promote silver fir in forests above 1400 m is therefore very limited. Browsing pressure of wild ungulates was found to be highest in forest between 1000 and 1100 m above sea level.

Relationships between ungulate browsing and (insufficient) regeneration rate of silver fir were studied at four sites along a gradient of anticipated increasing browsing pressure running from west to east. Data on regeneration of silver fir and on biotic and abiotic site parameters were collected on permanent transects. Habitat use by wild ungulates was recorded on the same transects in spring, summer, autumn and in winter. This type of design allowed for small scale analyses of relationships between fir regeneration and possible impacts of ungulates and of other microsite parameters. We found large variation between sites in density of young silver fir as well as in habitat use of wild ungulates. Three ungulates species were present at all four sites, chamois (Rupicapra rupicapra), red deer (Cervus elaphus), and roe deer (Capreolus capreolus). Relative abundance of species varied between sites. Habitat use by ungulates and browsing intensity were significantly correlated but it was impossible to draw any conclusions on regeneration status or on the demography of silver fir from this relationship. High proportions of browsed seedlings and small numbers of saplings in the larger height classes, as well as high numbers of both mouse holes and hare feces indicated that smaller herbivores may have affected regeneration of silver fir to a larger extent than ungulates did. Young fir trees growing in the shadow were browsed more often than trees growing on open ground.

Reactions of silver fir to browsing were studied by means of a garden experiment. Leader shoot and/or lateral shoots of trees either growing in the open or in the shadow were clipped (artificially browsed). Later growth of treated trees was measured and compared with growth of untreated control trees, and analyzed for interactions with light condi-
tions. Type and magnitude of reaction strongly depended on the light conditions. The proportion of trees producing a new leader shoot was three times smaller in the shadow than in full light. Two years after leader shoot browsing, trees growing in full light had grown to almost the same height as untreated control trees, whereas treated trees growing in the shadow were still significantly smaller. Although silver fir is considered a shadow-adapted species, the fir trees in the experiment took advantage of full light conditions. Browsing of lateral shoots did not affect height growth.

The research project was accompanied by an extension project designed to solve a regional forest-ungulate-conflict. "Stotzigwald" is a forest close to Gurtellen in the canton Uri protecting the Gotthard motorway against rock fall and snow avalanches. The same forest is used as a winter habitat by chamois. Adverse site conditions and browsing by chamois seem to prevent sustainable regeneration of silver fir. Silver fir, however, is considered a major element for guaranteeing the protective function of the forest. Previous attempts to mitigate the problem did not succeed, and perceptions how to deal with the situation remained controversial. By engaging all relevant stakeholders (land owners, foresters and farmers, hunters and game rangers, conservationists, tourism managers, road network managers, political authorities, and scientists) on a “platform for resource use negotiation” an integrated concept for a sustainable forest- and wildlife management has been developed by means of collaborative learning. The management concept is based on a common understanding and defines common objectives and the most appropriate measures to improve and maintain the protection function of the "Stotzigwald". This concept was agreed upon by all and it will be implemented in cooperation with cantonal authorities. It includes measures in the following fields: forestry, hunting, habitat management, agriculture and public information. The platform will be kept functional as an advisory body and to develop a procedure for reviewing objectives and achievements.

Both participation by scientists in the platform and mutual learning between scientists and practitioners have significantly contributed to a common understanding of the conflict over the use of resources and how to resolve it.