

# Structure and Regeneration of Silver Fir in Natural mixed Stands - Implication for Silviculture

Dorota Dobrowolska

*Department of Forest Ecology, Forest Research Institute, Poland*

Silver fir (*Abies alba* Mill.) is a large conifer that can be found in central Europe and some parts of Southern and Eastern Europe. This tree is considered an important ecological and functional balancer of European forests and a fundamental species for maintaining high biodiversity in forested ecosystems. Silver fir is mostly found in mixed stands with Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*) or montane pine (*P. uncinata*) at the upper tree limit. At lower altitudes it competes with beech (*Fagus sylvatica*). It is very shade tolerant and can remain as a “seedling bank” under the canopy of older dominant trees for decades. It often invades deciduous forests due to its easy natural regeneration. However, silver fir may become a very rare and even extinct species in contemporary strictly protected forest reserves under current conditions influenced by humans. Its fate will depend on the management methods selected.

European forests have been affected by humans and gradually cultivated since the Neolithic Age. Silver fir forests in the Carpathians were affected by sheep and cattle grazing, litter raking, charcoal production in charcoal pits, and by patch cutting of individual trees.

Silver fir has frequently received particular attention from foresters and researchers, mainly because of fir's economic, environmental, and social significance combined with its intensive decline in the last decades and problems concerning natural regeneration. The decline was first interpreted as a periphery effect of fir's natural range. In the 1970s and 1980s widespread decline and even dieback of fir was observed in Central Europe, a phenomenon that was called “fir dieback”. The phenomenon of fir decline followed by its recovery caused the creation of untypical periods, significantly different from stages and phases typical of an undisturbed development cycle. The exact causes of fir decline are still unknown. It is a complex disease, since several environmental factors apparently interact with each other, such as drought, frost, strong temperature decreases, competition, pollution, soil acidification, mineral deficiencies, inappropriate silvicultural treatments, insects, and pathogens. Decline of silver fir has occurred periodically in Europe since about 1500 both gradually and in a step-like fashion with particular stress events causing a sharp increase in the incidence of declines. However, silver fir has increased its dominance within European forests.

Fir conservation has been significantly affected by forest management systems. Fir is less competitive in areas where management systems caused rapid and major changes in forest stands (e.g. clear cutting). Fir was rarely used in plantations or for planting and seeding in artificial regeneration. Low regeneration could be related to dominant layer species composition, ungulate browsing, allelopathic phenomena or inappropriate regeneration treatments. Irregular shelterwood or/and selection forest management have been practiced in all forest types, which should have a beneficiary impact on fir regeneration. Regeneration occurrence can also be controlled by more temporarily stable factors such as seedbed features, competition of forest floor vegetation, understory, post-dispersal seed predation, or microtopography.

Less intensive logging practices, which focus on silver fir trees of several sizes and ages, may be more desirable for the long-term management of these forests in the context of a forecasted warmer and drier climate. Forest management might take advantage of these procedures to identify and selectively cut low-vitality trees, so as to release the remaining healthy trees. Better adaptation to shelter (single tree selection) might be associated with prolonged rotation periods. Fir conservation is still a challenging task in forest management. The increasing risks due to environmental changes make fir conservation even more challenging.