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Climate change induced effects on the predisposition of forests of the water protection zone Wildalpen to disturbances by bark beetles

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The provision of drinking water of high quality is a precious service of forests. Large-scale disturbances like forest fires, wind throws, pest outbreaks and subsequent clear cutting may lead to changes in hydrology (runoff as well as percolation). Furthermore, water quality can be negatively influenced by increased erosion, increased decomposition of litter and humus and leaching of nitrate. Large-scale epidemics of forest pests may induce forest decline at landscape scale with subsequent long-lasting negative effects on water quality.
The European spruce bark beetle, Ips typographus (L.), is one of the most significant sources of mortality in mature spruce forest ecosystems in Eurasia. The objective of this study was to apply a complex predisposition assessment system for hazard rating and for the evaluation of climate change impacts for the water protection forests of the City of Vienna in Wildalpen. The following steps have been done to adapt/apply the bark beetle phenology model and the hazard rating system:
-application, adaptation and validation of the bark beetle phenology model PHENIPS concerning start of dispersion, brood initiation, duration of development, beginning of sister broods, voltinism and hibernation
- spatial/temporal modelling of the phenology and voltinism of I. typographus using past, present as well as projected climate data
- application and validation of the stand- and site related long-term predisposition assessment system using forest stand/site data, annual damage reports and outputs of phenology modelling as data input
- mapping of endangered areas and assessment of future susceptibility to infestations by I. typographus and other disturbing agents based on climate scenarios using GIS.
The assessment of site- and stand-related predisposition revealed that the forest stands in Wildalpen are highly susceptible to bark beetle infestation. More than 65% of the stands were assigned to the predisposition classes high/very high. Only 10% of the stands showed a low stand-related predisposition to bark beetle infestations. This high susceptibility to bark beetle damage is related to the dominance of even-aged, spruce-dominated mature stands. The projected change in voltinism of I. typographus will further increase total predisposition of the stands to bark beetle infestations. Mapping the projected predisposition of present-day forest stands at the end of the century clearly indicated that stands with high/very high susceptibility to bark beetle infestation form large continuous areas, a pre-requisite for extended epidemics of I. typographus.