

Forests and climate change – a Swiss research program to gain knowledge for effective outreach

Peter Brang, PhD¹; Sabine Augustin, PhD²

INTRODUCTION

Climate change puts critical forest services at risk over the long term. In order to close knowledge gaps and develop decision support tools, in 2009 the Federal Office for the Environment (FOEN) and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) launched the joint research program 'Forests and climate change'. More than 40 research teams from 11 institutions have studied how a warmer and drier climate may affect forests and forest ecosystem services until 2100, and which adaptation measures may be suitable to secure these services.

In several projects, issues related to the preventive role of mountain forests against natural hazards have been studied. In the contribution to INTERPRAEVENT 2016, an overview over research results and extension activities regarding four topics will be given.

EFFECTS OF A CHANGING CLIMATE ON PROTECTION FORESTS

Empirical and modelling studies conducted in the research program have shown that impacts depend on site conditions and tree species. While on most sites, growth is predicted to decrease and mortality to increase, the inverse is the case in high-elevation forests. Increased extreme events, in particular drought periods, are likely to temporarily reduce forest cover and to impair protective effects accordingly. Increased temperatures and drought periods favor bark beetle infestations especially affecting Norway spruce, the most important tree species in protection forests. The site-specific suitability of tree species is likely to change markedly, and many species may need to migrate, be it by natural propagation or by assisted migration.

THE ADAPTIVE CAPACITY OF FOREST ECOSYSTEMS

Forest ecosystems are adapted to environmental change of a certain extent. They are able to buffer climate change impacts mainly through genetic,

species and structural diversity. Research has shown that tree species such as Norway spruce, silver fir, European beech and oak are genetically diverse at the population and the landscape levels and show thus a certain adaptedness to their current environment. However, this adaptedness is likely to become insufficient if climatic changes are large. High species richness at the stand level, which prevails in Swiss forests according to data from the National Forest Inventory, allows for a marked capacity to buffer reduced growth or potentially increased mortality of vulnerable tree species. Structural diversity varies in Swiss forests, with stands with high structural diversity having the highest capacity of buffering climate change impacts.

THE EFFECTIVENESS OF ADAPTATION MEASURES IN PROTECTION FORESTS

A suite of adaptation measures has been proposed to increase the forests' adaptive capacity and to ensure a continuous provision of ecosystem services. As several studies in the research program show that the tree species composition, i.e. the degree of mixture and the participating species themselves, is decisive for the forests' adaptive capacity, measures to increase species richness, and to achieve a pro-active shift in species composition anticipating future climates, are of particular importance. The main means to achieve this are a) appropriate felling designs which foster natural regeneration with high species richness, b) enrichment planting to complement natural regeneration and c) wildlife management to protect young forests against browsing ungulates. Ensuring structural forest continuity is likely to require a higher management intensity, in particular in protection forests with high damage potential.

EFFECTIVE KNOWLEDGE TRANSFER THROUGH EXISTING CHANNELS

In the research program, emphasis is laid on achieving great impact through effective knowledge transfer. A stakeholder advisory group established in 2010 supports the research program in this task. The advisory group has prioritized knowledge gaps and discussed in depth different transfer tools, the most important of which are ecograms, i.e. diagrams which show base cation availability and water availability in different forest types (forest associations), and which are tied to recommendations for tree species suitability. A drier and warmer climate will change the position of sites within the ecogram (Fig. 1), and this shift and its impact on tree species recommendations are currently quantified by combining climate scenarios with information about soil properties.

The research program is investing in a suite of knowledge transfer activities, including: a) a scientific synthesis in book form in which the state-of-knowledge is synthesized (planned appearance:

end of 2016); b) a special issue of the Swiss Forestry Journal which publishes reviewed papers for forestry professionals with academic training, and which appeared in November 2015; c) about 10 information leaflets for forest managers (most to appear after 2016); d) training courses for forest managers (starting in 2016). For the training courses, the research program is co-operating with institutions which are already engaged in knowledge transfer, and which will integrate research results into their on-going training activities. An important partner is the mountain forest tending group, which will devote its activities in 2016 to managing mountain forests in a changing climate.

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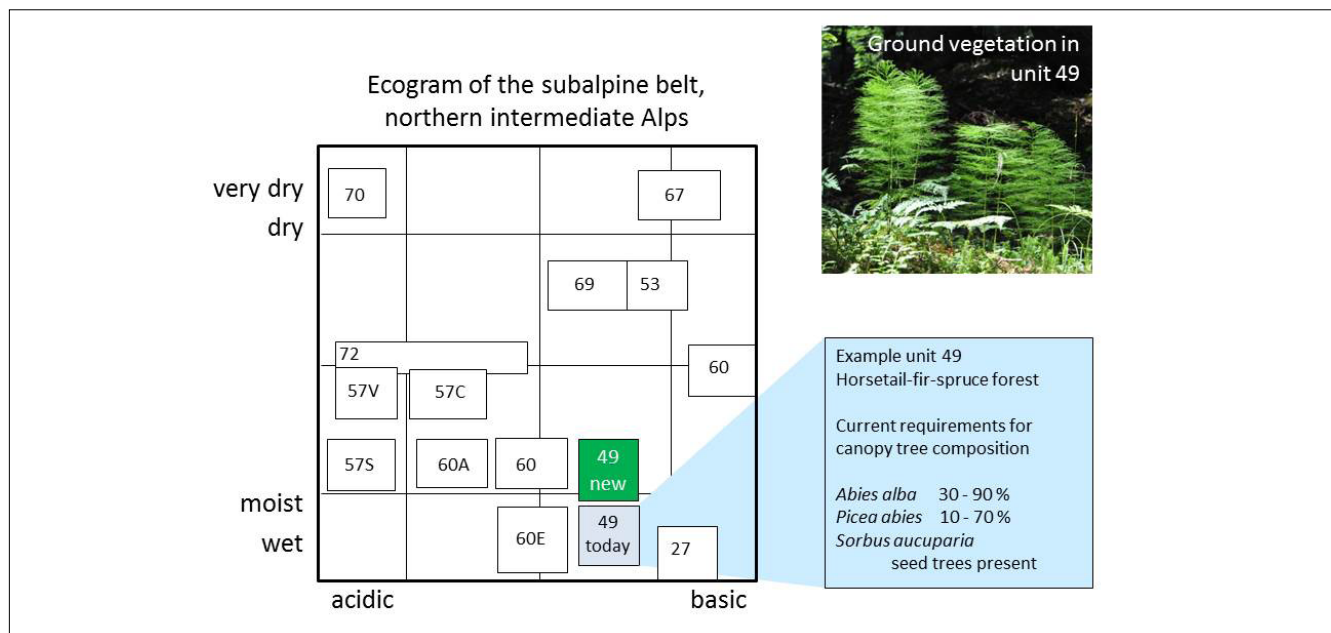


Figure 1. Example of an ecogram describing water supply (vertical axis) and nutrient supply (horizontal axis) of site types. Ecograms are specific for altitude (here: subalpine belt) and regions (here: northern intermediate Alps). Numbers designate site types according to the classification used in Swiss protection forests (Frehner et al. 2005). „49 new“ designates a potential new position of unit 49 (horsetail-fir-spruce forest) in a drier climate, with a shift from wet to moist conditions. Future requirements for canopy tree composition for each site type (example in the figure: current values for unit 49) are about to be defined, and may include a lower proportion of spruce.

KEYWORDS

protection forests; climate change; outreach; impact assessment; adaptation

1 Swiss Federal Institute of Forest, Snow and Landscape Research WSL, Birmensdorf, SWITZERLAND, brang@wsl.ch

2 Federal Office for the Environment, SWITZERLAND