Long terms effects of invasive tree species on the protective function of forests against rockfall

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INTRODUCTION

Forests play a key role in integrated risk management of natural hazards. Especially for the prevention of shallow landsliding, snow avalanches and the mitigation of rockfall hazards, existing forests are the most privileged means of hazard prevention. This is because the protection provided is cost-efficient, forests integrate well in the landscape, they are multi-functional (also wood production and non-wood forest services are provided) and they can simultaneously mitigate multiple natural hazards). Only in situations where the risk posed by natural hazards cannot be reduced by the existing forest to a level acceptable level acceptable for society, expensive technical protective measures have to be created. Because of this reason, the Swiss federal government yearly invests 60% of the total sum of 100 million CHF, used for prevention against landslides, snow avalanches and rockfall, in protection forest management (personal communication A. Sandri - BAFU, 2014).

For protection forests, two aspects are important: long-term overall stability of the forests and the degree of protection provided by the forests. Both aspects are strongly related to the forest structure, i.e. the distribution of age classes and tree species in the forests, the spatial positions, diameters and heights of the trees. Today we know how to quantify the risk reduction provided by forests regarding snow avalanches and rockfall for near-natural forest types that generally occur in Switzerland and France (forests consisting of fir, spruce, beech and other native broadleaved and coniferous tree species in various mixtures).

Decades of fundamental research on both the ecological and mechanical characteristics of these forests allowed the development of tools which enable quantitative comparisons between technical protective measures and protection forests. The expansion of the invasive species Ailanthus altissima in „traditional“ protection forests invokes many questions related to the future development and stability of the affected protection forests, as well as to the protective capacity of those forests.

Ailanthus altissima, commonly known as tree of heaven, is a deciduous tree native to both northeast and central China and Taiwan. The tree grows rapidly and is capable of reaching heights of 15 metres in 25 years (Arnaboldi et al., 2003). However, the species is also short-lived rarely exceeding ages of 50 years. The tree was first brought from China to Europe in the 1740s. It has become an invasive species due to its ability both to colonise disturbed areas quickly and to suppress competition with allelopathic compounds. The tree also resprouts vigorously when cut, making its eradication difficult and time consuming.

In January 2015, a Swiss-French project called ALIEN, financed by both national research foundations, started to work on the assessment of the long terms effects of Ailanthus altissima on the protective function of forests against rockfall. The objective of this extended abstract is to present a poster with the first results of the ALIEN project in 2016.

METHODS USED IN THE PROJECT

Collecting forest ecological data on Ailanthus altissma via field experiments, forest inventories and existing literature - in both Southern Switzerland (invasive region) and Central China (native region). Thus, current explorative research in Southern Switzerland will be expanded from the individual tree scale within single stands to the stand scale along an environmental gradient (e.g. altitude). Parameters critical for succession modelling such as slow-growth tolerance and longevity will be assessed via tree-ring analyses in near-primary forests of Ailanthus altissima in Central China.

Developing a model for mechanical response and energy dissipation of Ailanthus altissima subjected to rock impacts. This model will be developed on the basis of impact experiments on green stems in the laboratory and in situ real-size field experiments in Ticino.

Identify determinants of invasion success of Ailanthus altissima and develop scenarios of the development of Ailanthus invaded protection forests using the forest landscape simulation model LandClim.

Developing models and tools for quantifying the protective function of Ailanthus invaded protection forests over time (a.o. Rockyfor3D).

Validation of the modelled results redarding the protective function and validation of the suitability of Ailanthus altissima trees as potential recorder for rockfalls on the basis of dendrogeomorphology.

RESULTS

The project ends on the 31st December 2017. During the Interpraevent 2016 conference, we will be able to present first results on the collected forest ecological data and the mechanical properties of Ailanthus altissima trees.

REFERENCES

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KEYWORDS

Invasive species; Protection forest; Rockfall; Dendrogeomorphology

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