Bern University of Applied Sciences
School of Agricultural, Forest and
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HAFL Master's Thesis Abstract

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Title: **Klimaangepasste Stadtentwicklung: Klimafitte Bäume für Schweizer Städte**

English Summary:

In the face of climate change, Swiss climate policy managed by the Federal Office for the Environment (FOEN) pursues two strategies. On the one hand, it wants to contribute to climate change **mitigation** by reducing domestic greenhouse gas emissions by 20% (compared to the 1990 level) until 2020; and thereby contain the phenomena. On the other hand, **adaptation** implies acclimatization to negative climate change consequences, which are already taking place, like major thermal load in cities. In the course of **climate adapted urban development,** the federal government asks to create tree vegetated urban green spaces. Not only are they expected to reduce urban heat island effects trough trees' shade- and transpiration cooling, but also to enhance urban biodiversity and quality of life.
The question is which tree species are able to satisfy all these requirements: to adapt to climate change, show tolerance to urban stress, contribute to urban biodiversity and mitigate climate change by sequestering effectively the greenhouse gas element carbon (C). Current urban tree population is not able to meet all the requirements since 50% of Bern's trees show decreased vitality. In addition, scientific reports predict a partial shortfall of some urban tree species.
Therefore, the master's thesis which forms part of the FOEN-research project **Urban Green & Climate (UG&C)** at Bern University of Applied Sciences uses the example of Bern and judges popular urban tree species on their tolerance of **drought** and **urban stress**, **hardiness, C-sink efficiency** as well as on their **value for biodiversity** and searches for **further climate-fit species**. Additionally, it reviews both urban forestry's history and urban trees' ecosystem services, e.g. cooling effects. As a product, this research presents a list of climate-fit tree species (drought- and urban stress tolerant, hardy) with low invasion potential. By means of a numerical index (Climate-fit Urban Tree Index- KSI) it provides a practical tool to assess the climate-fit requirements of selected urban tree species in an easy and fast way.
To analyze history and ecosystem services, the master's thesis read up on literature. In the case of C sequestration it took samples in the field. Index creation involved pooling existing urban tree assessment methods like KlimaArtenMatrix (KLAM), Relative Urban Tree C Index (RUTCI) and the biodiversity index of the environment agency SWILD. Research identified future species for Bern by climate analogy in Europe for the time period 2045-2074 using the climate model scenarios RCP3PD, A1B and A2.
Findings indicate only a **partial climate-fitness of Bern's tree population**. Indeed, *Acer campestre* and *Pinus nigra* will mould Bern's cityscape also tomorrow. However, 18% of the trees like *Aesculus hippocastanum, Tilia platyphyllos* and *Acer pseudoplatanus* do not show drought-, urban stress-, and spring freeze tolerances, which are required in times of climate

change. Species like *Quercus cerris, Acer monspessulanum, Acer opalus, Carpinus orientalis* and *Ostrya carpinifolia,* which come from the continental Balkan area, to wit from regions climate analog to Bern in 2060, have potential to substitute them. Biodiversity will raise notably by planting *Quercus, Tilia* and *Acer* species as well as species of the *Rosaceae* family. Cities can optimize C-sinks efficiency if they consider planned lifespan, high wood density and rate of growth of the species to be planted. For example, on the long run *Quercus* species with their high wood densities and huge dimensions sequester most. In the medium term, transition species like *Carpinus betulus* (in the first 20 years) or *Platanus x hispanica* (first 50 years) are more efficient C-sinks. Concerning further ecosystem services, the increasing importance of tree cooling become apparent. Furthermore, real estate prices and human well-being incl. work productivity correlate positively with vicinity to urban green. From a historical perspective, already ancient societies appreciated urban trees for their shading. In the 20th century both communist and western oriented countries incorporated urban trees systematically in their city planning for a healthier city life.
The master's thesis recommends **raising the proportion of climate-fit trees** in Bern's cadaster. **Less drought resistant species should not be planted** again. The promotion of **citizen loyalty** to urban trees ought to play a more crucial role to free up financial resources and practical support. In times of climate change, these three points will not only increase trees' vitality but also endow added value.

Keywords: Urban forestry, Street trees, climate change adaptation, climate change mitigation, biodiversity conservation

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