STSM Report: COST ACTION FP 1301
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Climatic change and silvicultural effects on the coppice forests of the Southern Black Forest

Background

Coppice is cut periodically and the trees are allowed to regrow from the cut stumps, which are termed stools. The word coppice is derived from the French "couper" meaning to cut. Most coppices is grown as coppice-with –standards but occasionally woods consist purely of underwood and these are termed simple coppice. Standards trees are usually oak but ash is also common. The trees which coppice readily are alder, ash, birch, field maple, hazel, oak, sallow, lime, chestnut and elm. Other species which are also coppiced but which can be slow to respond on some sites are beech and hornbeam. The interval between cuts (the rotation length) depends on the species and the intended product. In general, the shorter the rotation can be the greater the density of coppice stools.

Coppice forests, for instance, include plant species adapted to disturbances such as periodical felling and burning (Rackham, 2008). Historical silvicultural systems could also create flexibility, for example by shorter rotation periods in the under storey or selected parts of the forest (e.g. coppice-with-standard) or by increasing diversity. Hence, the management of ancient woodlands and historical silvicultural systems might be a valuable part of an integrative nature conservation concept in the context of climate change and should be an object of further research (Milad et al., 2011).

It's commonly known that the global warming and climate changes which can be observed nowadays are a result of human activities related largely to the combustion of fossil fuels, utilization of natural gas and oil products and energy consumption (IPCC, 2001). It is expected that the frequency and intensity of summer droughts and heat waves in Europe, especially in Central and Southern Europe, will increase (Metzger et al., 2008; Lindner et al., 2010; Milad et al., 2011). So this STSM study was working in central European region (the black forest).

The Black Forest is located in the central European forest region especially situated in the southwest of Germany, in the state of Baden-Württemberg, close to the borders of France and Switzerland. The climate and soils of the Black Forest are ideally suited for the growth of beech (*Fagus sylvatica*). Forest management in Germany and the Black Forest between 1300 and 1800 was towards multiple use, including timber production, food and shelter for farm animals, firewood, and litter raking to provide nutrients for the agricultural fields. The Black Forest contains approximately 600,000 ha of almost unbroken forest, and evidence of its exploitation dates back to pre-Roman times. Since then the forest has undergone dramatic transformations due to land clearing for agriculture and harvesting for fuel and construction wood over the last centuries. This extensive harvesting and clear felling led to a deterioration of the forest's overall quality. Southern Black Forest a lot of ecological and aesthetical precious coppice-forests is situated. Coppice systems have been used in this area since Roman times. Large quantities of timber were needed in relatively short periods of time.

Purpose of the STSM

Recently renewed interest in coppicing has developed in many European countries because of the increasing importance of fuel wood as a substitute for fossil fuels and the preservation of coppice forests as a historical landscape element and habitat with high nature conservation value (Pyttel at al., 2010). Today, traditional forest management of coppice is not being practice. In this reason, forests lose their typical ecological attributes and their characteristic look, while the living area for a lot of scarce animal and plant species becomes rare. In recent year's climatic change and silvicultural management affected coppice forests. Moreover, there has been a reduction in the water levels of the region. Thus, not only amount of coppice forests but also its species was changed. As well as new plants need to be introduced (from seed) to replace stumps those have lost their vigour after many coppicing cycles.

The Short-Term Scientific Mission (STSM) sought to clarify the effects of climate change and silviculture on the coppice stands of the Southern Black Forest. We accomplished this goal by studying various coppice areas. We also discuss the possibility of defining indicator species for coppice forests in Freiburg (Germany) and Colmar (France).

Material and Methods

In this study, we selected three coppice forests that have suffered drought and climate change, and possess different species: in Innerberg, Badenweiler, located near Freiburg in the Black Forest mountain range of south-western Germany (Fig. 1 and Fig. 2); in Wolfgantzen, Alsace region, near Colmar, France (Fig. 3); and in Ingersheim, Alsace region, France (Fig. 4).

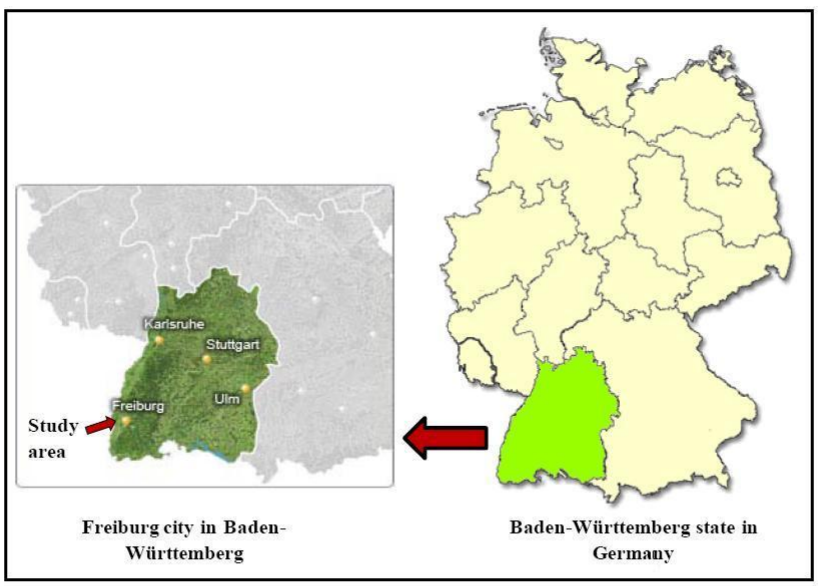

Figure 1. Map of Freiburg in Baden-Württemberg State in Germany (Source: http://www.goyellow.de)

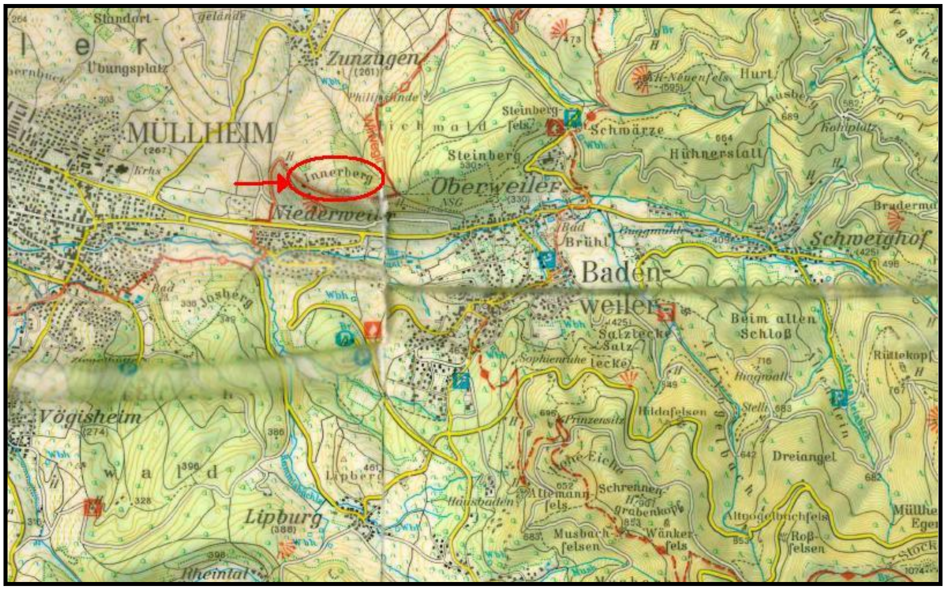

Figure 2. Innerberg, Badenweiler located near Freiburg, Germany.

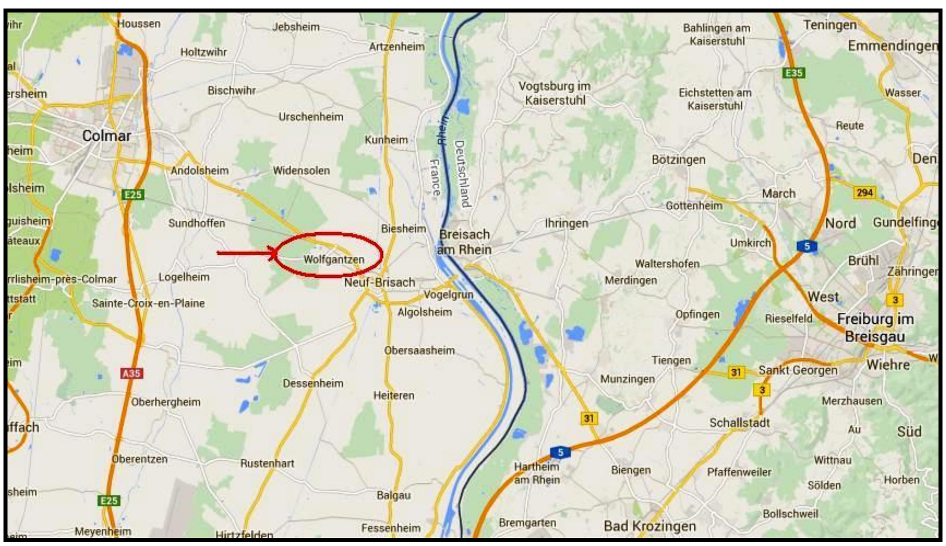

Figure 3. Wolfgantzen, Alsace Region, located near Colmar, France.

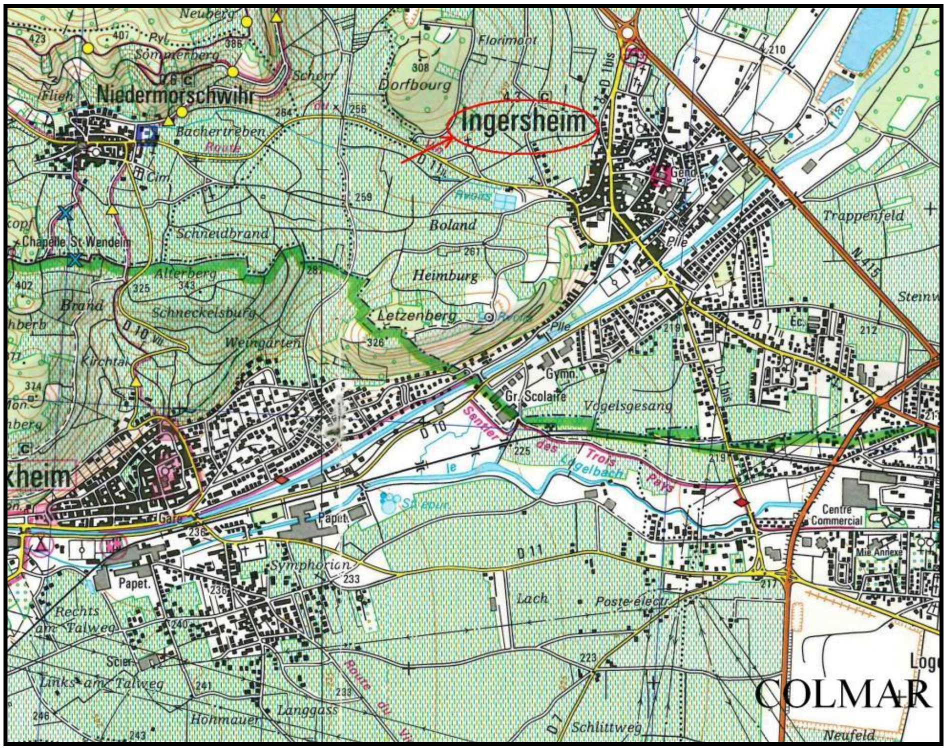

Figure 4. Ingersheim, Alsace Region, located near Colmar, France.

We determined the following parameters for each plot:

1. Altitude (metres above sea level, m a.s.l.)
2. Aspect
3. Slope (%)
4. Relief
5. Soil type
6. Cover of trees, shrubs, grass, moss, soil and humus using the Braun–Blanquet method
7. Diameter (cm), height (m), number of stems and roots, crown radius (m), crown height (m), number of dead stems, branches and leaves, and an estimated number of all trees in plots
8. Dominant plant species and cover using the Braun–Blanquet method

Using these data, we calculated crown dieback or branch mortality, expressed as the percentage of dead above-ground biomass (stems, branches and leaves), which was used as a measure of tree vitality. The pattern of branch mortality was recorded in various vertical sections of the crown, and differences in ground vegetation were determined among coppice forests.

We recorded the coordinates (latitude, longitude), altitude, aspect and inclination of nine sampling plots. At each plot, we recorded woody vegetation, and morphological and growth parameters of trees.

We used a systematic sampling design for this study. Three 10 × 10-m plots were placed 25 m apart in each of the three coppice forests for a total of nine plots. All statistical analyses were performed using SPSS version 9.0 and PC-Ord version 6.

Analysis of differences among the plots was tested by Kolmogorov–Smirnov test for normal distributions. Equality of population medians among groups (defined by plots, species, living status (i.e. alive or dead)) were tested by applying the Kruskal–Wallis test to compare more than two groups followed by Mann–Whitney-U test post hoc test. All statistical tests were performed at $p < 0.05$ and carried out using the software package SPSS 9.0. Final choice of number of groups by means of the indicator species analysis.

Main results

First of all, all the data was recorded in an excel file, then calculated, ordered and analysed mean values per plots of the following parameters: height, diameter, dead stem or branch number. It was evaluated growth, crown dieback or branch mortality. It was compared the results of those plots with the best and with the worst rates of growth and mortality. To be able to carry out this analysis, different statistic tools were used: non parametric test for several independent samples to compare means, applying the Kruskal–Wallis test to compare more than two groups followed by Mann–Whitney-U test post hoc test.

This sampling method is ideal for determining the adaptation of central European plants to stressful climate conditions such as drought, which in Europe are expected to increase in frequency due to climate change.

Generally, stand at south facing slope is getting high exposure to sunlight throughout the whole vegetation period. It has a limestone and clay-silt loam. 'Hagerhumus' type humus shows a patchy thin (0.5 to 1.5 cm) or no humus layer, bare mineral soil surface or exposed bedrock with a moss cover. Oaks are standing with crooked stem and branches, some of them showing crown dieback and dead branches. Few young trees (above 3 meter height) show either high crown dieback with stunted growth or some are standing dead (Photo 1).

Photo 1. Dead trees and dry branches.

On average, we found four dead trees per plot in the coppice forest in Innerberg, Badenweiler. The soil surface was dry and moderately stony in some areas. We found clay–silt loam soils. In general, *Quercus pubescens* (mean height: 12.3 m; mean diameter: 22.1 cm) was the dominant species but some individuals of *Acer campestre*, *Cretaegus laevigata* and *Sorbus torminalis* were also present (Photo 2). While dead stems were observed only on *Quercus* trees, dead branches were found on every tree. On average, six dead stems and 91 dead branches were found per plot. Finally, *S. torminalis* and *C. laevigata* were identified as indicator species.

Photo 2. The coppice forests of Innerberg, Badenweiler.

Deep, highly stony soil was found in the coppice forest of Wolfgantzen in Alsace, France, which had silt loam soil. In general, *Carpinus betulus* (mean height: 8.5 m;

mean diameter: 8.3 cm) was dominant but some *A. campestre* and *Quercus robur* individuals were also present (Photo 3). While some dead stems were observed on *Carpinus* trees, dead branches occurred mostly on *Quercus* trees. On average, four dead stems and 12 dead branches were observed per plot. *Atrichum undulatum* and *Eurhynchium striatum* were identified as indicator species.

Photo 3. The coppice forests of Wolfgantzen in Alsace, France.

On average, we found four dead trees per plot in the coppice forest of Ingersheim in Alsace, France. Because of Jurassic rendzinas and Jurassic limestone, the soil surface was very dry and extremely stony. In such areas, the effects of drought due to climate change were observed more frequently. *Q. pubescens* (mean height: 7.5 m; mean diameter: 13.7 cm) was dominant in this coppice forest (Photo 4). On average, we found 14 dead stems and 113 dead branches per plot. *Cretaegus monogyna* and *Cornus sanguinea* were identified as indicator species.

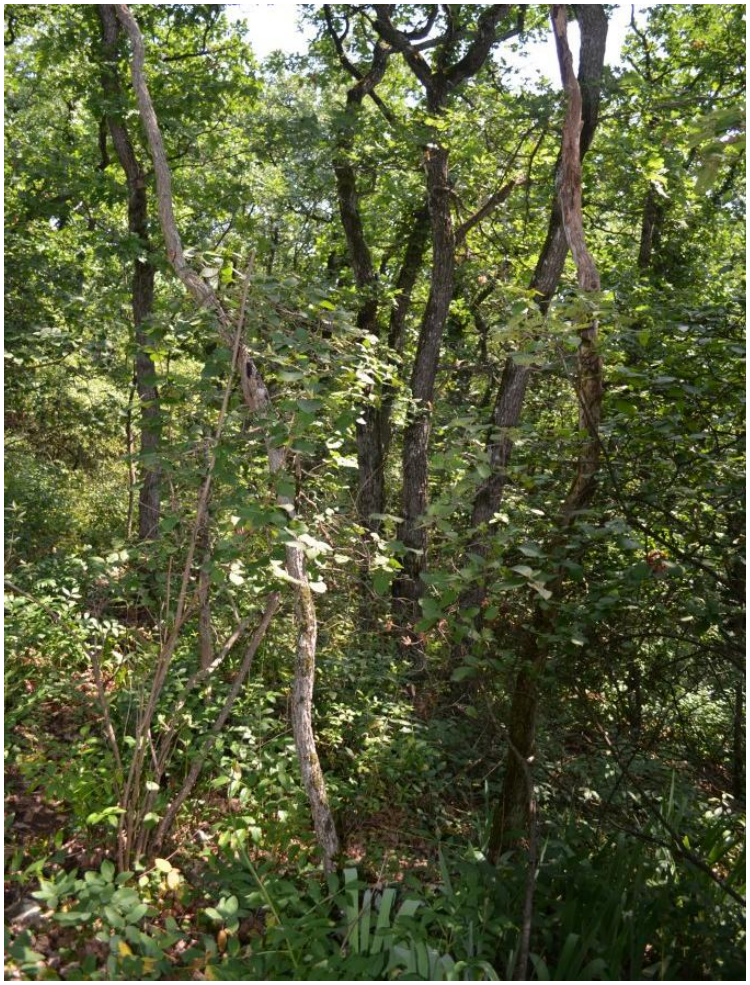

Photo 4. The coppice forests of Ingersheim in Alsace, France.

Using these results, we will produce a joint article for submission to an international peer-reviewed journal. We will contribute to understanding how drought affects coppice forests and propose ways by which society can become more aware of its implications.

Future collaboration with host institution

I am satisfied with the collaboration that I could achieve during the time of my visit. The visit of my STSM has elapsed with good work conditions due to the collaboration of the Host Institute as they have provided me in every moment material, help, statistical program (PC-Ord) and other required information. It has been really notable the behaviour of the Host Institute that I have received in every moment during my stay.

Particularly I am grateful to Prof. Dr. Albert Reif. I strongly hope to maintain further collaboration with Silviculture Institute of Freiburg University. I would like to express my sincere thanks to the COST Action and to my hosts.

Foreseen publications/articles resulting or to result from the STSM

It is anticipated that there will be one peer-reviewed publication emanating from the results of this STSM. Our planning foresees that this manuscript could be published during 2015.

Confirmation by the host institution of the successful execution of the STSM

You can find attached to the email the letter of the Host Institution that confirms the successful execution of the mission.

References

IPCC. Climate Change 2001. The Scientific Basis. Inter-Governmental Panel on Climate Change, Cambridge University Press, Cambridge; 2001; UK.

Lindner, M., Maroschek, M., Netherer, S., Kremer, A., Barbati, A., Garcia-Gonzalo, J., et al., 2010. Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. Forest Ecology and Management 259, 698–709.

Metzger, M.J., Schroeter, D., Leemans, R., Cramer, W., 2008. A spatially explicit and quantitative vulnerability assessment of ecosystem service change in Europe. Regional Environmental Change 8, 91–107.

Milad M, Schaich H, Bürgi M, Konold W. 2011 Climate change and nature conservation in Central European forests: A review of consequences, concepts and challenges, Forest Ecology and Management 261 (2011) 829–843

Pyttel P, Fischer U, Bauhus J. 2010. Restoration of central European coppice forests through utilizationUFRO Landscape Ecology Conference 2012: "Sustaining Forest and landscape in Changing Landscape"

Rackham, O., 2008. Ancient woodlands: modern threats. New Phytologist 180, 571–586.

http:// www.goyellow.de