Contemporary research in forest history in Germany: aims, methodology and results

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Forest history research is based both on philological and ecological methods. Forest history as a philological subject deals mainly with written sources, whereas pollen analysis is the central method of ecological research in forest history. Obviously research based on written sources can only deal with periods from which historic documents are available. Therefore it is often assumed, that the recent history of woodlands can be outlined on the basis of written sources, whereas pollen analysis gives an insight into earlier periods. A differentiation in such a way is too easy; the two ways of getting insight into the development of woodlands are much more connected than assumed. And the two ways of research characterize woodlands in different ways. This can be demonstrated by discussing central aims of forest history research in Germany.

WRITTEN SOURCES

Forest history *sensu strictu* is a historic discipline mainly dealing with written sources. Therefore, the development of woodlands in historic times is predominantly analysed and presented in textbooks (Hasel, 1985, Hasel & Schwartz, 2006). In Germany, this does not only mean the presentation of the history of woodlands during the last few centuries, but even much further back in time. There is one very ancient written source concerning woodlands in this country: it is recorded in the work 'Germania' by the important Roman author Publius Cornelius Tacitus, which was written already at the end of the 1st century A.D. Tacitus characterized the environment of Germanic tribes as dominated by large woodlands and awful ponds. In forest history research it was therefore often thought, that before the Roman age the woodlands were in a natural state, which was described by Tacitus. This was the reason for starting a project to reconstruct the vegetation in South West Germany during the Roman Age (Dieterich & Hauff, 1980). The results should be taken into account in practical forestry to build up optimally growing woodlands.

Since the Roman Age and especially during the Middle Ages, a degradation of woodlands took place by exploitation and overexploitation. At the end of Medieval and in early Modern times (14th to 18th centuries) wood shortages were felt in many regions of Central Europe. There are a lot of sources from this period in which authors discuss how to save wood and timber in construction and domestic use, ore smelting and saltern management. All these activities demanded a lot of wood and timber. Timber was also sold and exported. From the centre of Europe it was transported on rivers to urban agglomerations at the rim of the continent. In the areas around the river mouths with their brackish water and especially in the salt marshes along the coasts Central European trees could not grow, as they do not stand salty soils. Therefore, urban development in Venice, the Netherlands, as well as in Hamburg and Bremen, depended on timber

transport from the upper parts of the rivers to the local markets (Keweloh, 1985). Large amounts of timber and wood were produced in the areas along the rivers Adige, Danube, Rhine, Elbe and others. But not only on large rivers, also on smaller creeks and little rivers wood and timber were transported, such as on rivers between the Harz Mountains and in the Southern Lüneburg Heath (e.g. Saemann, 2012). It is quite possible that general or regional shortages of wood and timber may have occurred. Woodlands were carefully registered and mapped to bring to mind the size of the wood and timber stock, e.g. in the Harz Mountains (Bei der Wieden & Böckmann, 2010).

Large fir trees (Abies alba) are still well-known as 'Holländertannen' in the Black Forest, indicating that these trees should be transported to Dutch markets (photo: H. Küster).

Since the 1980s there is an intensive debate in German forest history research whether a wood and timber shortage really took place or that it was only felt that a shortage of these very important raw materials could occur (e.g. Sieferle, 1982, Radkau, 1986). The fear of wood and timber shortage of early modern times might be compared with actual debates on a shortage of oil; nowadays it is often feared that a shortage of oil might happen, but still it is available. Contemporaries in the 17th and 18th centuries assumed that ancient civilisations, such as the Roman civilisation, suffered from wood and timber shortage and that therefore their states and economies broke down.

In Central Europe it became possible to master the crises. One very important idea in this process was the concept of sustainable development of forests. Hannß Carl von Carlowitz argued as early as 1713 that the amount of wood and timber which is removed from a forest must not be larger than the increment of wood. Carlowitz is often regarded as the 'first forester', but he had another profession: he had to care for the mining industry in Saxony. He noticed that there was obviously enough ore, but he felt that there might be not enough wood to smelt the ore. Therefore he had to care for woodlands, too. In the following period of time the concept of sustainable development became very important in German forestry. And as we all know, it is nowadays even a much more important concept. It is applied to many fields of the economy and, even more, to many other aspects of human life. Since the beginning of the 18th century well-documented afforestation took place in Germany. There are a lot of maps and descriptions presenting the re-introduction of large woodlands in many parts of the country. Mainly conifers were planted. Spruce and pine, but also larch and Douglas fir grow faster than broad-leaved trees, even on poor and over-exploited soils. Therefore conifers were introduced in large areas where they

Planted spruce forest from early Modern Times on Medieval field strips (photo: H. Küster).

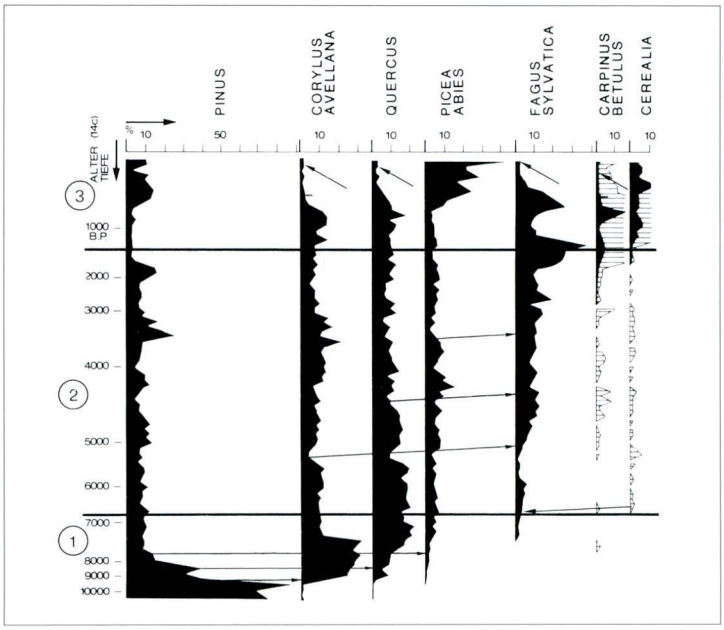
did not occur before. The documentation of the results of these processes, laid down in written sources, is the main scope of forest historic research in Germany and other countries (for further information see Küster, 2008, 2012).

POLLEN ANALYSIS

Pollen analysis is an important ecological research method. Pollen grains contain the male genetic material, which is transferred to the female parts of flowers. Especially plants which distribute their pollen by wind produce huge amounts of pollen grains, as it is very unlikely that one single pollen grain out of millions is deposited on the female part of another flower. Most pollen grains are deposited on the surface of the soil. If they are deposited on the surface of a lake, they sink to the bottom. If they are deposited on the surface of a bog or fenland, they end up in agglomerating peat. The coat of pollen grains is very solid and does not decompose in the absence of oxygen. Included in lake sediment or peat, the outer layers of pollen grains can be conserved for thousands of years. In a peat bog where peat is formed continuously over millennia, pollen grains are deposited in a stratified manner. In a profile section of the peat it is possible to detect how the pollen sedimentation changed through time: a section is taken from the bog, then cut into slices and processed. Each component of the sediment is destroyed except the pollen grains, which can be identified and counted by microscopic screening. After counting, the percentages of pollen grains originating from the different the pollen types indicate which plant taxa grew outside the lake or bog in the past.

Pollen diagrams are also prominent sources for the reconstruction of woodland history in periods from which written sources are lacking. On the basis of pollen analysis, it was possible to outline the history of the vegetation in many parts of Europe (Firbas, 1949, 1952, Huntley & Birks, 1984, Lang, 1994). At first, pollen analysis was mainly practiced to reconstruct climate history. During the last Ice Age no trees grew in most parts of Europe because the temperatures were too low and the summers too short. After the Ice Age the climatic conditions improved so that trees could expand and form woodlands. Some millennia later Europe was nearly entirely densely wooded. This development was clearly caused by improving climactic conditions. But it became obvious that later

changes in tree frequencies did not occur synchronously all over Europe so that it is not likely that they were triggered by climate change (Küster, 1996).
By reconstructing climate history from pollen diagrams, a very important general result was mainly overlooked. It is not indicated by any pollen diagram that woodlands were stable in any period. The pollen percentages were changing permanently so it must be concluded firstly that natural woodlands were never stable. New species could expand whereas other became more rare. There can not be a specific reason for this, such as pests or climate change. Woodland dynamics can only be the result of the fact that the evolution of one species was more successful than that of another one. It is therefore generally not possible to reconstruct the 'natural state' of woodland. Its nature is characterized by permanent change.
It is much more likely that changing pollen percentages of trees have been influenced by strategies employed by man in the use of land over millennia. This becomes obvious if records of cereal pollen grains are compared with tree pollen percentages. A pollen diagram can be separated into three sections. In the first section no cereal pollen grains are recorded. That means that woodlands were developing naturally, they were not cleared, and no agriculture was practised. In the second section occasional cereal pollen grains are recorded, indicating that some agriculture was taking place. Woodlands were cleared to till the soil. From archaeological records we know that during the same period settlements only existed for some decades and were given up afterwards. As a result new woodlands could expand on former settlement areas.
In the third section, higher percentages of cereal pollen grains are recorded. This is the historical period in which settlements were not given up, so that new woodlands could not develop. Rather woodlands were exploited more intensively and later on afforested.
In this section the period is recorded from which written sources are available as well, as mentioned in the beginning of this paper.
It is very interesting to see in the diagram how tree species reacted to the developments taking place during the three sections.



Pollen diagram from Görbelmoos, SW of Munich (from Küster, 1995). The pollen percentages of some tree taxa are plotted against time. Hatched curves are 10 times banked. The diagram is separated into 3 sections: 1 – without cereal pollen records (no agriculture recorded); 2 – with single cereal pollen records (shifting prehistoric agriculture recorded); 3 – with a lot of cereal pollen grains (historic times with permanent settlements).

Coppice woodlands were formed during intensive utilization. But often there is a remarkable biodiversity in coppices so that many of them are protected as nature reserves (Echinger Loh north of Munich) (photo: H. Küster).

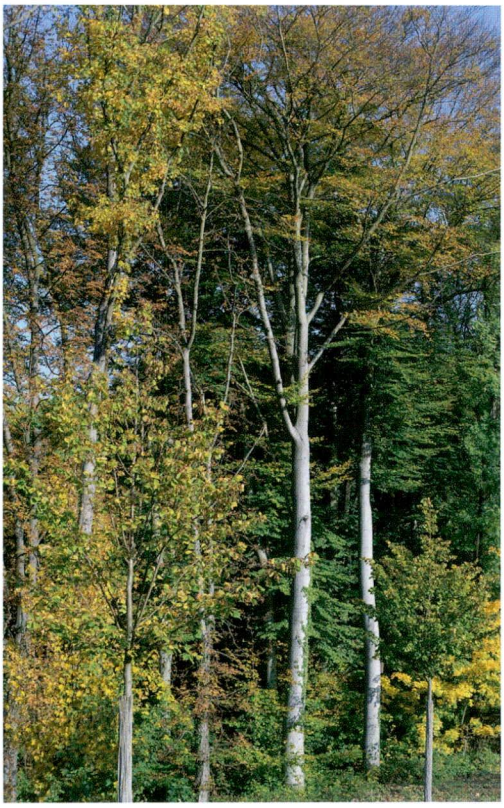
During phase 1, several tree taxa expanded, except beech (Fagus sylvatica). In the early Holocene, the period after the last Ice Age, beech was still rare in most parts of Europe. During phase 2, obviously a long-lasting expansion of beech took place. On the other hand, taxa like oak (Quercus) became more rare. During phase 3, beech expansion came to an end; rather this tree species became remarkably more rare in the woodlands. Oak and hornbeam (Carpinus betulus), on the other hand, became more frequent at the beginning of the section. In the second part of the section, spruce (Picea abies) became remarkably more frequent as a consequence of plantation.

This development may be interpreted as follows: after a phase of natural development some parts of woodland were cleared to establish settlements together with their fields. They were abandoned after some decades. During the following secondary succession of woodland the expansion of beech was furthered. This does not mean that beech immigrated just after the fields were abandoned; first pioneer tree taxa like birch (*Betula*), pine (*Pinus sylvestris*) and willow (*Salix*) expanded and later on beech, together with oak. This development could only take place as long as an area was not integrated to a civilisation. Inside a civilisation, settlements became stable and were no longer removed, so that secondary successions could not take place. Beech became rarer, tree taxa which can overcome intensive exploitation expanded such as oak and hornbeam. Later on spruce forests were planted.

WRITTEN SOURCES AND POLLEN RECORDS: A SYNTHESIS

The two branches of forest history research yield different results. It is possible to bring them together. Pollen analysis shows how woodland development took place in general (but not exactly where changes took place), whereas written sources deal with a specific site. Written sources do not reflect facts alone, but are influenced by ideas. The message from Tacitus that the area of the Germanic tribes was totally wooded during the Roman Age must be interpreted on the basis of the knowledge from pollen analysis. During the 1st century A.D. Romans lived in a state; this means that there were stable settlements. No new woodlands developed, they were rather exploited more intensively than before. On the other hand, tribes outside the Limes founded settlements, lived there for some decades and then left them, so that secondary developments of woodlands were still possible. The two systems of land-use were incompatible. The differences in land-

use systems which was evident in Central Europe during Roman times, is to some extent comparable to that between modern states and indigenous tribes in the Amazone Basin or in Central Africa. People who are part of the one or the other system normally do not understand how the other land-use system works. This was also the case with the Romans who did not understand why people outside the *Imperium Romanum* changed the location of their settlements from time to time. Tacitus described this as 'living in large woodlands'. He certainly admitted that these were not as dense as thought, as he knew well that the Germanic tribes grew cereals. Therefore they certainly cleared woodland. Tacitus' message became very important because it was later on often thought that the Romans were not able to subjugate Germanic tribes because they were not able to penetrate the large German woodlands. But not the woodlands *in se* were the reason for the Roman failure in Central Europe, but the largeness of an area without roads. It was very hard to build-up an infrastructure there within very short time.



Beech expanded to most parts of Central Europe after the beginning of human activities (photo: H. Küster).

But later on it was often said that Romans were not able to establish state structures and to live in large woodland, and centuries later this view was considered applicable to the French as well, as they too are a Romanic people. After some success with forest management in the 18th century, many Germans were convinced that the French were not able to do the same. The Germans claim to have planted forests along the French border when the Napoleonic troops invaded Central Europe in order to prevent the French troops from penetrating Germany (Weyergraf, 1987, Küster, 2008). Woodlands were regarded as being the 'German nature'. After the Vienna Congress (1813-1815) a German state was not founded, as desired by many Germans before. But the connection between woodlands and German identity was intensified. It is remarkable that in 1812 the best distributed German book was published for the first time: Grimms' Fairy Tales. Woodlands play a very important role in those tales and in many other books and poems which were published in Germany at the beginning of the 19th century. During the following decades large woodlands were afforested. It is obvious that this was not only done because wood and timber was lacking, but that it was the aim to plant 'German nature'.

CONCLUSION

'German nature', certainly, is one of the main reasons why written sources on forest history have been assigned a prominent meaning in Germany since the 18th century. These documents present how German foresters

Hornbeam can reach a very high age, but only after regular cuttings (photo: H. Küster).

Waldsterben at Feldberg in the Black Forest (photo: H. Küster).

were able to reintroduce woodlands. But it must not be overlooked that this development is mainly influenced by an idea and not only by economic necessity.

Besides all nationalistic interpretations, the model is too simple: that natural woodlands, be they stable or not, were destroyed by human impact and re-established by foresters. Rather woodlands were never stable. Their development was influenced in different ways by different land-use strategies. They were not restored completely as broad-leaved trees dominated before human land-use began, whereas mainly conifers were planted since the 18th century. As natural woodland ecosystems were never stable they were also never sustainable. Sustainability, therefore, is not characteristic of natural ecosystems but can only be established when aimed at for science-based economic or cultural reasons. It seems to be more important to stress these results from forest history research than only to tell how woodlands developed through time. It is possible to obtain from these results general and essential information on woodlands. As they were in the past, are in the present time, and will be in the future in some respects predictably, in others unpredictably changing ecosystems. Men, who aspire to manage them as a stable and sustainable basis for their life, influence them.

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Remnants of a former artificial lake to collect water for rafting timber (photo: H. Küster).

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