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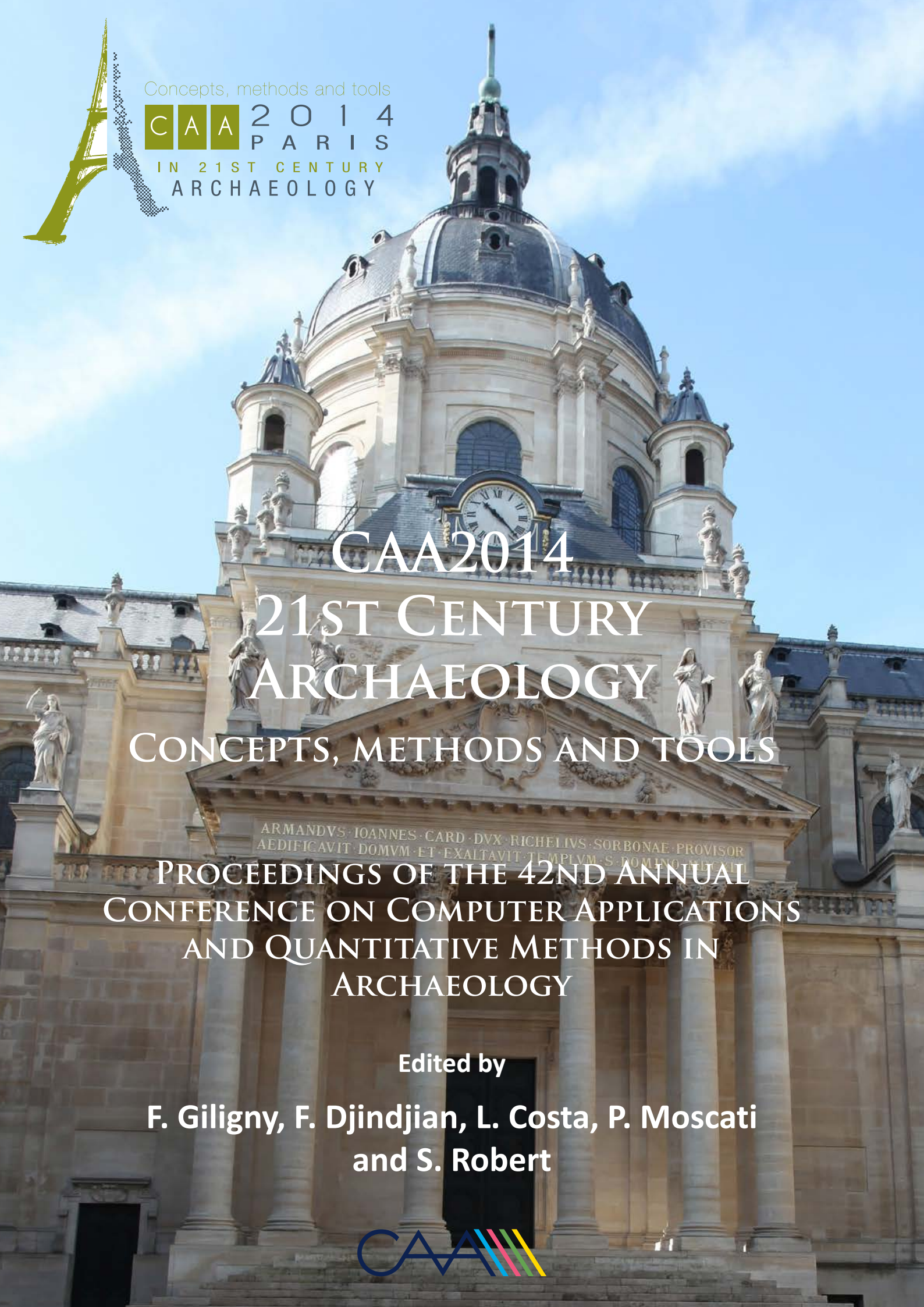

CAA2014 21st Century Archaeology

Concepts, methods and tools

Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology

Edited by

F. Giligny, F. Djindjian, L. Costa, P. Moscati and S. Robert

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Challenges and Perspectives of Woodland Archaeology Across Europe

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Abstract
This paper reviews the challenges and prospects of woodland archaeology across Europe and proposes a European network to safeguard archaeological heritage in woodlands. Woodlands and forests cover important parts of the European landmass but are often uncharted territory on the archaeological map since traditional methods of archaeological survey do not work well here. Many forests have grown on formerly open lands used for farming or settlement, and some forests have been used for charcoal burning and wood pasture. As a consequence they contain important archaeological remains that are often well preserved but little known and protected. Recent developments in the field of remote sensing have opened up new avenues for important archaeological research in woodlands. However, the legal and administrative framework to protect archaeological sites is of equal importance. While the economical, recreational, and ecological dimensions of forests are commonly known and accepted, their archaeological dimensions are rarely recognized.

Keywords: Woodland Archaeology, Cultural Landscapes, Heritage Conservation, Forestry, Ecology

Introduction

Forests and woodlands tend to be distinguished by the density of tree coverage and tree height, with 'woodlands' often being used as a more general term that also covers less densely overgrown areas. However, this distinction is gradual and often ambiguous (see for example, Forestry Commission, 2011, 4), and it is even less clear in other European languages, e.g. in German. In the following, both terms are used interchangeably. Following a recent official European Union publication on forest ecosystems, about 33% of Europe and 42% of the 27 EU countries are today covered by forests and woodlands (European Environment Agency, 2010, 4 f.). This percentage is even higher in the mountain ranges of Central, Eastern, and Northern Europe (fig. 1). Forests and woodlands are thus a formative part of the European cultural landscape, and are an important resource in economic, ecological, social, and cultural terms.

Less well known is the fact that forests in Europe have continuously expanded over the last 60 years and are still increasing today. Just in the EU countries, the forested area increased by 17 million hectares in the last two decades. Only a small part of this increase is due to natural regrowth in former agricultural or industrial areas. Most forest expansions are artificially planted and serving purposes such as timber production, promotion of renewable energy, biodiversity conservation, carbon storage, or prevention of erosion and soil degradation (Forest Europe *et al.,* 2011). Generally, there is little knowledge about tree planting having started already in the late Medieval Period, e.g. as firewood and a source for building material or as a means for preparing hunting ground for noblemen. Already in 1368, pine and fir trees were artificially seeded for reforestation in the Nuremberg Reichswald in the southeast of Germany (Stromer 1968, 26). Consequently, today only 26 percent of European forests, located primarily in remote and inaccessible areas in eastern and northern Europe, are regarded as more or less undisturbed (Forest Europe *et al.* 2011, 8). This means that most areas covered by forests today were once wholly or partially cleared and cultivated, as was the case during the Bronze and Iron Ages, in the Roman Period or during the Middle Ages. These areas were reclaimed by natural or artificially planted forest regrowth in later periods. As a result, many of these secondary forests cover today important vestiges of prehistoric and historic settlement and land use. Forests can thus be regarded as archives (Hamberger *et al.,* 2012) or time-machines (Angelstam *et al.,* 2011). This archaeology 'in the forest', dealing with archaeological sites and features in once open landscapes now covered by secondary forest, is one aspect of cultural heritage research in, and management of woodlands. Archaeology 'in the forest' can take on different forms, as accounts in classical sources show. For example, according to Caesar and Tacitus, woodlands served as buffer zones between neighbouring tribes. Thus, documenting no finds from a specific period in forests can also be interpreted as valuable historical information. Another important aspect is the archaeology 'of the forest', e.g., the study of the use of the forest itself as a natural resource for people in the past, e.g. as fire wood, charcoal and source of building material, as wood pasture, or as a hunting ground. Even forests that persist until the present day were used extensively in the past, especially those forests close to inhabited areas. Those forests often had a different, more open appearance than forests have today. Industrial sites such as mining, iron production or glass manufacture required a steady supply of wood fuel. Their remains are often located in or close to wooded environments, and they are therefore forming a link between the overall distinction of an archaeology 'in the

forest' and 'of the forest' (e.g. Forestry Commission, 2011, 3 f.; Hamberger *et al.,* 2012; Ritchie and Wordsworth, 2010).

1. Challenge

On the one hand, the tree cover protected and preserved many archaeological monuments and landscapes in woodlands for a long time. Intrusion into, and disturbance and erosion of soils as well as sediments covering or containing archaeological remains was minimal as compared to open areas. More so than in arable land, many archaeological sites and features in forests are therefore still visible on the ground surface. This facilitates their study by non-invasive or minimally invasive methods causing less destruction than excavations. Thus, archaeological sites in woodlands are often better preserved than open-area sites, a fact that further increases their importance as historic monuments. However, some forest-specific disturbances, e.g. windfall and bioturbation, often affect woodland sites as well (Crow, 2004; Sippel and Stiehl, 2005, 48 ff.). On the other hand, tree cover has also prevented many of these sites and monuments from being detected, properly recorded, and preserved by archaeologists and cultural heritage managers. One of the reasons is that excavations and common methods of archaeological survey, such as aerial archaeology, field walking, and geophysical prospection are more difficult in forests than in open farmland since vegetation acts as a barrier. Furthermore, archaeological prospection is often focused on or even limited to open areas, the reason being that commonly used techniques are more easily applied there. Archaeological sites in open areas are also at a higher risk to be exposed to disturbances, such as in farmland or in areas under development. In addition, forests tend to be considered by the public as a natural landscape rather than a cultural landscape, such as e.g. open farmland, often preventing archaeological research in forests to receive appropriate public support and funding.

In turn, large woodland areas in different parts of Europe could not be explored in the past, and are literally uncharted territory on the archaeological map (fig. 2). Hence, important parts of the existing archaeological record remain inaccessible for analysis and interpretation by archaeological and historical research. Important geographical parts of the archaeological record are simply non-existent for those periods of European cultural history, such as the High Middle Ages, during which forest coverage in certain regions was more limited than today. The large gap in archaeological research affects our

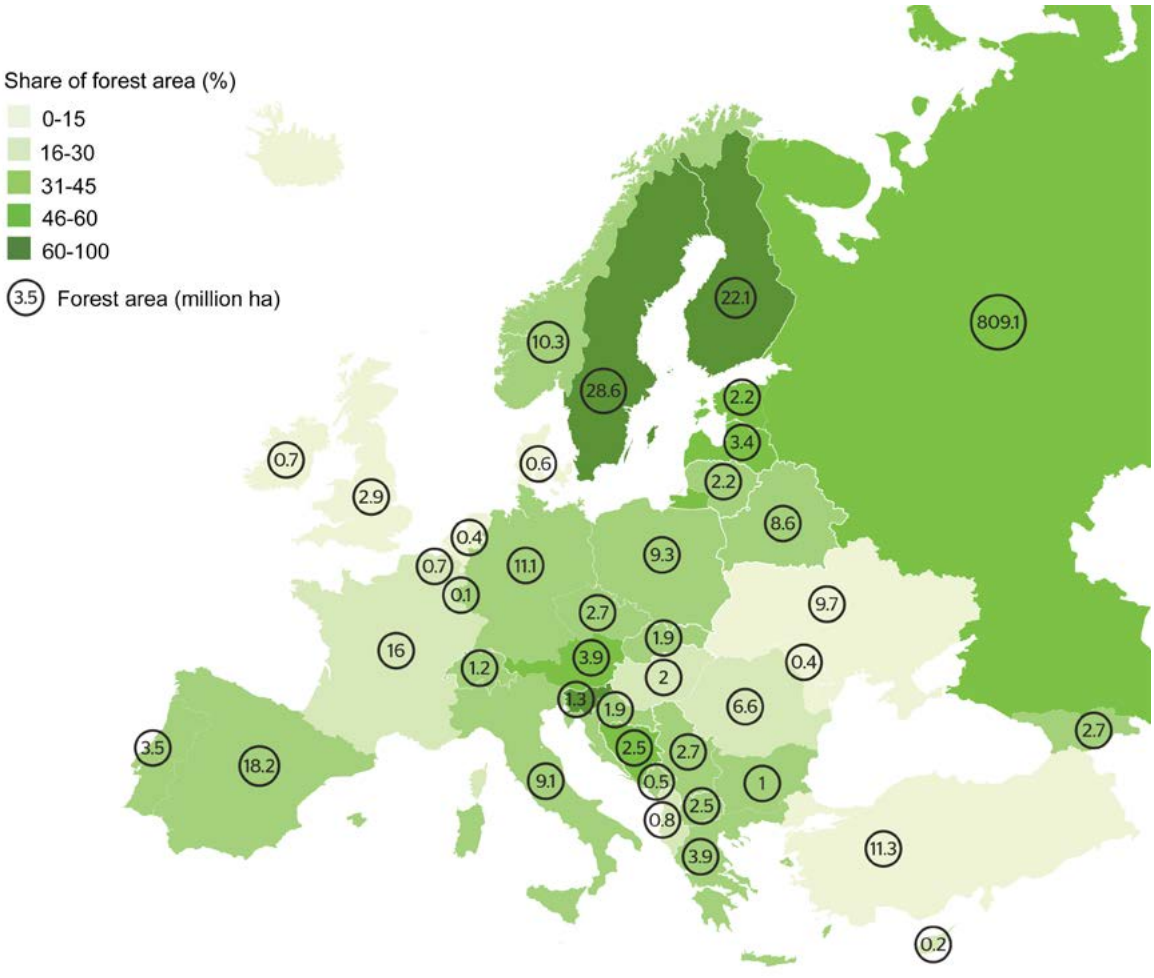

Figure 1: Forest area (million ha) and share (percent) of land area by country (after Forest Europe *et al.* 2011, 19).

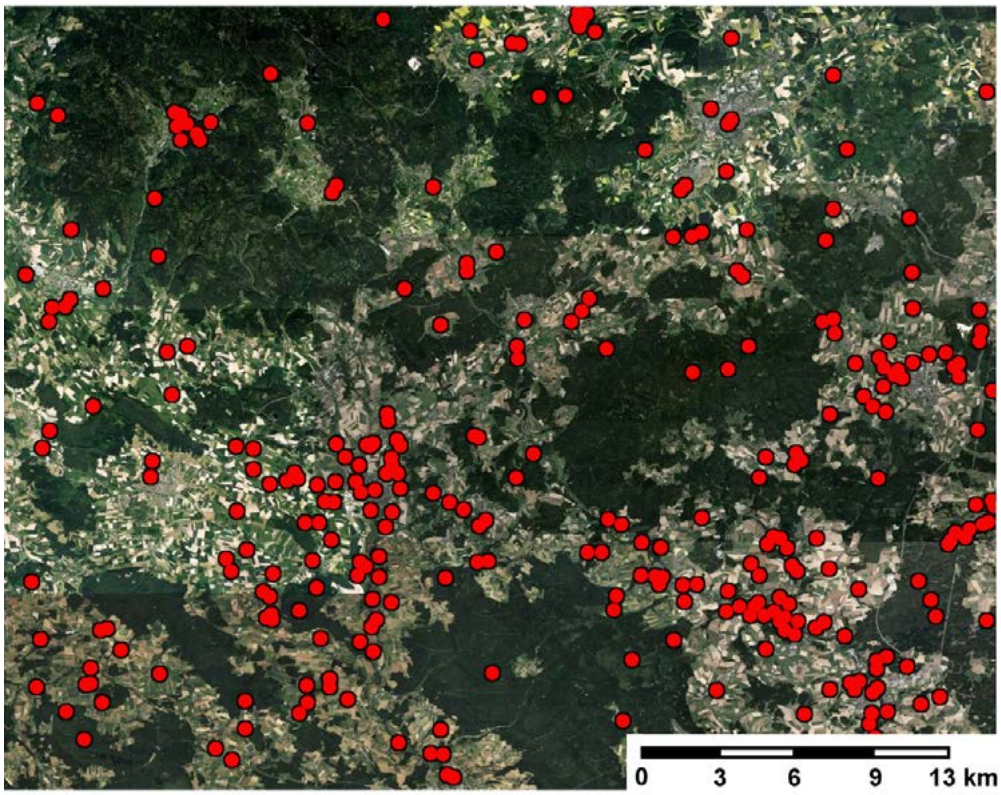

Figure 2: The archaeological map around Kemnath in Bavaria reveals forested areas as uncharted territories. (Authors, Bavarian State Department of Monuments and Sites).

understanding of the cultural history of these epochs and regions significantly. For cultural heritage management, the problem is even more pronounced since limited knowledge about existing archaeological sites and features makes it difficult to devise and implement effective strategies for their protection and preservation.

2. Technological and methodological aspects

The situation has markedly improved over the past 10 to 15 years. New tools have become available to archaeologists and cultural heritage managers opening up new and promising avenues of archaeological prospection in forests and woodlands. Where applied, these tools have significantly improved our knowledge about the rich archaeological heritage contained in forests. Many of these new tools have been developed from recent technological and methodological innovations in remote sensing. During the last two decades, the introduction of Airborne Laser Scanning (ALS, also known as LiDAR: Light Detection and Ranging) into cartography has proven the most important step in this development. Using an airborne laser sensor along with highly accurate positioning devices, ALS records ground elevation data in very high resolution (Crutchley and Crow, 2009). The nature of the laser signal allows differentiating between signals returned to the sensor from the ground, and signals returned from vegetation and other objects on or above the ground surface. Computationally removing these non-ground signals virtually strips the ground surface from vegetation cover, thus allowing an unimpeded and high-resolution view on the topography of the ground even beneath dense vegetation cover, such as forests. As demonstrated by numerous recent case studies, this technology has proven to be a major breakthrough for archaeological research (see examples in Cowley, 2011; Opitz and Cowley, 2013). In regions where ALS-derived digital terrain models (DTMs) have been analysed for the purpose of archaeological prospection, the number of known archaeological sites has increased greatly. The increased application of ALS over large areas also broadens our perspective of single archaeological sites and features as well as entire archaeological landscapes that hold not just settlements, but also field systems, roads and pathways, workshops, quarries. The wide variety of other features from different periods considerably improve our picture of historic and prehistoric landscape use (e.g. Doneus and Briese, 2011; Hesse, 2013; Risbøl, 2013). While ALS is a major technological breakthrough, it is by far not the only step forward in archaeological prospection. Other remote sensing technologies such as radar or multispectral and hyperspectral sensing are now being tested over forests (Beck, 2011; Wiseman and El-Baz, 2007). Terrestrial laser scanning (TLS), conventional pedestrian surveys, geoarchaeological investigations, analyses of phosphate contents and increasingly geophysical prospection such as geomagnetic or ground penetrating radar (GPR, fig. 3) have all contributed in recent years to a better knowledge and understanding of the archaeological record in woodlands. In some countries, conventional geodetic-topographical and geophysical survey methods have been significantly improved and adjusted to the special requirements of woodlands. The same applies to the interpretation of

surface features that can reveal important information about a certain archaeological monument without the need for expensive and destructive excavations (e.g. Večeřa, 2004). Due to appropriate adaptation of the equipment and the used measurement method, geophysical prospection has been successfully applied in woodlands despite obstructions caused by trees and roots. To achieve the best results, there has been a strong trend in these recent developments to combine different techniques and methods, as well as the combined analysis of the resulting data using computational approaches, e.g., digital image analysis and computer vision (Doneus, 2013; see also recent examples in Neubauer *et al.,* 2013).

These advancements show that archaeology and cultural heritage management to date have more powerful tools at their disposal for archaeological prospection in woodlands than was the case only 15 years ago. In countries where Airborne Laser Scanning (ALS) has already been used for several years to explore monuments in forested areas, the techniques have led to an enormous increase of known sites. Additionally, these new techniques allow for a better protection of important monuments. Even central European landscapes that have been explored archaeologically for well over a hundred years, observe due to the more effective techniques a 40% growth of archaeological monuments in certain areas. Thus, the amount and importance of knowledge gained is comparable to what has been learned after the introduction of aerial archaeology to arable land many decades ago. While these developments are encouraging, their downsides should not be overlooked. The application of new approaches and methods often requires heavy investments in terms of finances, time, training, and infrastructure for data processing, analysis and storage. These requirements often face limited, or even decreased resources available to archaeological and heritage professionals and institutions. Thus, access to these new approaches is not only unevenly distributed across Europe but often also limited, impeding the application of effective methods. In addition, these methodological and technical approaches are often not sufficiently available for the teaching and training of young professionals, which is likely to slow down their prospective application.

Figure 3: Ground Penetrating Radar with 400 mHz antenna in Ruppertshütten, 'Kloster Einsiedel', Germany. (Harald Rosmanitz, Spessart Archaeological Project).

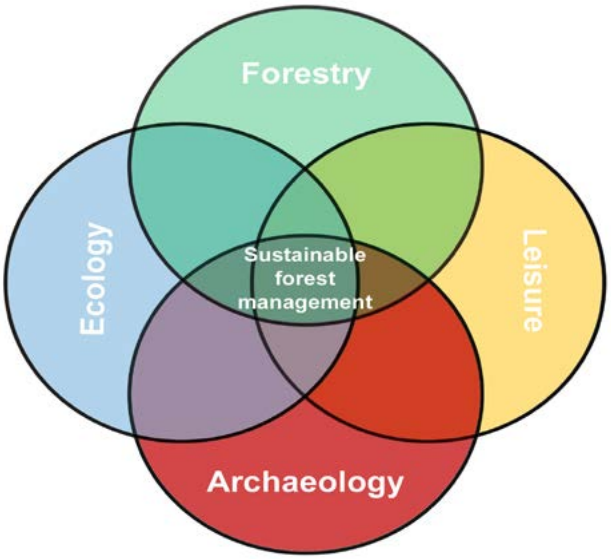

Figure 4: Different stakeholder interests are linked by a sustainable forest management. (Authors).

3. Legal and administrative aspects

The technological and methodological progress described above is yet to be matched by similar progress in the legal and administrative domain. There is little knowledge among the public as well as the individual stakeholders and decision makers involved in forest management about the fact that forests often hold well-preserved but understudied and underprotected archaeological remains. Features and sites forming the historic environment provide the key for a better understanding of our past. These sites are a finite, non-renewable resource, and once lost, they cannot be replaced. This historical archive of our society (Hamberger *et al.,* 2012, 47) is endangered by forestry, building activities, recreational use, tourism, and other activities. In many parts of Europe, forests continue to play an important economic role. In some industrial countries and regions, wood was and still is mainly used as building material or as raw material for paper. This type of economic use has led to fast-growing monocultures that have replaced traditional, more diverse forests. Additionally, in recent years forests have to a certain extent regained their traditional role as energy source through the production of bioenergy. This is especially true in countries with a policy to promote the percentage of renewable energy. As a result, large or straight timbers are just as much in demand today as is the entire available biomass, including coppice, hedgerows etc. The appreciation of the commodity wood has led to developments in agro-forestry that have damaged and destroyed ancient monuments in previously unknown ways. One example is the increased use of heavy machinery, such as bulldozers and harvesters that cause lasting damage to the ground. Another example is the preference of fast-growing monocultures that necessitate area-based forest establishment and planting as well as harvesting and extraction practices causing

extensive damage and ground disturbance. Although, the use of wood chips requires more frequent transport related intrusions to the forests, the whole-tree harvesting practiced increasingly across Europe is the most devastating form of forestry since the roots also have to be removed. (Crow, 2004, 31 ff.). Over the last decades, these developments have affected forest soils as well as archaeological sites and features contained within them more severely than was the case during the entire history of forestry (Crow, 2004; Hamberger *et al.,* 2012, 42 ff.; Möllers, 2004; Sippel and Stiehl, 2005, 48 ff.). Sites of which private or public landowners, forest industry and authorities are unaware are obviously the least protected. For example, damage due to access roads cutting through well-preserved archaeological monuments like walls or grave mounds could have easily been avoided if the significance of these archaeological sites had been known. In essence, damage to archaeological monuments is mostly caused by ignorance, rather than intent (Hamberger *et al.* 2012, 42 f.; Sippel and Stiehl, 2005, 51). Since 1989, a special threat has been affecting forests along the former Iron Curtain across Europe. While in some regions new natural reserves were established on former border fortifications, in other regions it was the re-opening of closed or little frequented traffic during the Cold War. The economic and demographic development of formerly marginal regions, led to intensive road and railroad building and other developmental measures that required forests to be opened up.

Apart from their economic role, forests are nowadays also an important resource for tourism, recreation and leisure. Archaeology shares many interests with these fields. Some forest authorities have utilised the presence of important archaeological vestiges and created heritage walks with information signs to raise people's interest in the forest. Such trails attract more tourists and locals to the forests and thus provide both health and educational benefits. Archaeological sites and landscapes thus become part of the recreational value of forests. At the same time, a sprawling tourism and recreational and leisure-time activities can cause damage to valuable monuments, e.g. damage caused by the wear and tear due to mountain biking. However, destruction of historical features is mostly caused by hiking or biking trails, access roads, car parks or service facilities. Although, archaeology and tourism respectively leisure industry have many common interests, these have so far rarely been discussed between archaeologists and ecologists (fig. 4). A changing perception of the public constitutes a chance for an effective archaeological heritage management in woodlands. In some parts of Europe, where the industrial use and economic value of forests are slowly decreasing, forests are increasingly appreciated for their ecological and/or recreational value, especially among the urban population. This has led in some areas to a change of woodland resources management enforcing more sustainable practices. For example, industrial monocultures are replaced by more diversified vegetation closer to their natural composition. The result is a higher recreational, environmental and aesthetic value of forests, as variedly composed forests are more resilient to soil degradation and extreme weather events. Another motivation for the change of woodland resources management is an increasing biodiversity and reduced CO2 levels, to strengthen the importance of forests in the mitigation of the adverse effects in climate change. While slow, this process of forest conversion is often profound and brings about important changes of forest composition, perception, and management. A more sustainable management of forests and their different kinds of resources is clearly a chance for archaeological heritage management. Subsurface and near-surface archaeological remains benefit from decreased soil degradation, limited use of heavy machinery, and a general appreciation of forest variety and diversity. The creation of near-natural forests as compensation areas for landscape losses elsewhere is welcome specifically on archaeological sites, which are protected by permanent exclusion from intensive forest management. Conflicts may arise however, when measures to investigate and protect archaeological sites require the removal of trees.

4. Pathways toward the safeguarding of archaeological heritage in woodlands

The examples above show that woodlands today are subject to widely differing and often conflicting demands imposed upon them by a variety of stakeholders. These stakeholders include, but are not limited to, private and public landowners and forestry industry, public authorities in charge of administration, transportation, and the management of economic, cultural, and environmental resources, local communities, researchers across different disciplines, and people, companies and institutions engaged in recreational and leisure activities. While there is some interaction and exchange between these stakeholders to reconcile conflicting interests, cultural heritage management is usually underrepresented, among others because some stakeholders are often not even aware of cultural heritage being present in many wooded areas. In fact, the important function of forests as time capsules for cultural history is generally little known or acknowledged. For example, the archaeological dimension of forests is not mentioned in the recent EU Green Paper on forests (European Commission, 2010), in which a wide variety of other socio-economic and environmental functions of forests are listed and discussed in detail. The current State of Europe's forests report (Forest Europe *et al.,* 2011, 108) only states that there is a 'growing recognition of the importance of the cultural and spiritual values associated with forests', resulting in an increased number of countries being able to provide data on these categories. Thus, effective communication, interaction, and engagement between the different stakeholders are urgently needed to raise awareness of the cultural dimension of forests, and of the necessity of designing and implementing a strategy to preserve and protect the archaeological heritage in forests (fig. 4). This is a common challenge across most European countries, and joint international efforts are needed to define a baseline for future action. However, interaction between different stakeholders is organised in quite

different ways from country to country, and sometimes from region to region, requiring individual solutions for each country and region.

4.1. Public outreach

In order to put woodland archaeology on the agenda it is necessary to raise awareness of the cultural dimension of forests and woodlands among the public, the broad research community, stakeholders, and decision makers. Scientific results need to be presented to the public in order to achieve appreciation and approval. On a local level, this may mean to prepare dissemination material such as leaflets, brochures, information boards etc (Forestry Commission, 2011; Hamberger *et al.,* 2012). Guided tours to archaeological monuments or special events are an approved instrument to directly reach specific groups of people. Furthermore, it has become highly important to promote ideas via Social Media due to their wide distribution. The outreach to the research community is the easiest task. The increased interest of archaeologists and heritage professionals in woodland archaeology has been demonstrated at recent pan-European conferences, for example through thematic sessions at the annual conference of the European Association of Archaeologists (EAA) in September 2013 in Pilzen (CZ) and the annual Computer Applications and Quantitative Methods in Archaeology (CAA) conference in April 2014 in Paris. Similar conferences have also taken place in several European countries on a smaller scale. In larger networks such as the European Forest Institute (www.efi.int), Archaeolandscapes Europe (ArcLand, www.archaeolandscapes.eu), or the EAA and EAC Joint Working Group on Farming, Forestry and Rural Land Management (http://www.e-a-a.org/wg2.htm), the subject treated here is also represented, although it is not their main focus. The best approach to achieve an impact on policies affecting the archaeological heritage in forests will be by exchanging experiences, identifying best practice and elaborating guidelines. Ultimately, such undertakings have always been promoted through the initiative of individual researchers and institutions. So far there has been little coordination, cooperation, or even exchange. Thus, it is necessary to bring these attempts from a regional to a national and maybe even European level.

4.2. Legal framework

While the fundamental problem of archaeological and cultural heritage resources in woodlands is principally the same across Europe, the management of woodland resources is organized on different levels (national, regional, local) and within different legal frameworks. Besides the overall lack of awareness for the archaeological heritage in forests, this has led to a high degree of fragmentation within the professional heritage research community. Public ownership of forests is common in the Russian Federation, Central-East and South-East Europe. For Central-West Europe, North Europe and South-West Europe the average percentage of forests in public ownership is only around 30 percent. Particularly high proportions of privately owned forest are found in Austria, France, Denmark, Norway, Sweden, Slovenia, Portugal and Spain (fig. 5). In general, the proportion of private forests and numbers of private forest holdings has increased over the last 20 years. The main driving force behind the changes in ownership is the efforts towards privatization and restitution of forestland in countries formerly under centrally planned economies. Mixed ownerships or forests owned by institutions that are considered neither public nor private, like churches or charities, are extremely rare (Forest Europe *et al.,* 2011, 109 ff., fig. 67 and 68).

The responsibility and jurisdiction concerning forest management is as fragmented as the forested landscape itself or its ownership. Although most European countries have a national forest programme or a similar process in place, formally endorsed sub-national forest policy documents are still very important in several countries. However, many countries changed their legal/ regulatory framework over the last few years, with most changes affecting silvicultural practice (often related to regeneration/tending, biodiversity provisions), enshrining institutional reorganization, and reorganizing financing arrangements. The most directly relevant international commitments are the European Union Regulations and Directives on forests, which have heavily influenced a range of national regulations in Member States (Forest Europe *et al.,* 2011, 145 ff.). The declining importance of local communities and regional authorities in favour of uniform EU rules should be used by archaeologists respectively heritage conservators as an opportunity to represent their interests with a common Pan-European voice as well.

4.3. Proposed European network

For this reason, the authors, in collaboration with interested partners across Europe, have endeavoured to establish a European network. Under the title ARCFOR (Recording and preserving archaeological heritage in forests), a network of archaeologists and heritage professionals engaged in woodland archaeology from several EU and associated countries is currently being established and is open to further interested colleagues. The main challenge will be to secure financial support. While various network members have been very successful in raising funds for individual research projects on a national, sometimes even on a European level, to our knowledge collaborative projects between more than two countries do not exist at present. We are currently exploring different funding opportunities on the European level to support transnational exchange and cooperation. Building on existing collaboration of researchers based at universities and heritage agencies who share a common interest in archaeological research in woodlands, the proposed European network will aim at the following goals:

To promote the use of modern technologies for archaeological prospection in woodlands.

- To foster communication, exchange and collaboration in order to streamline past and ongoing

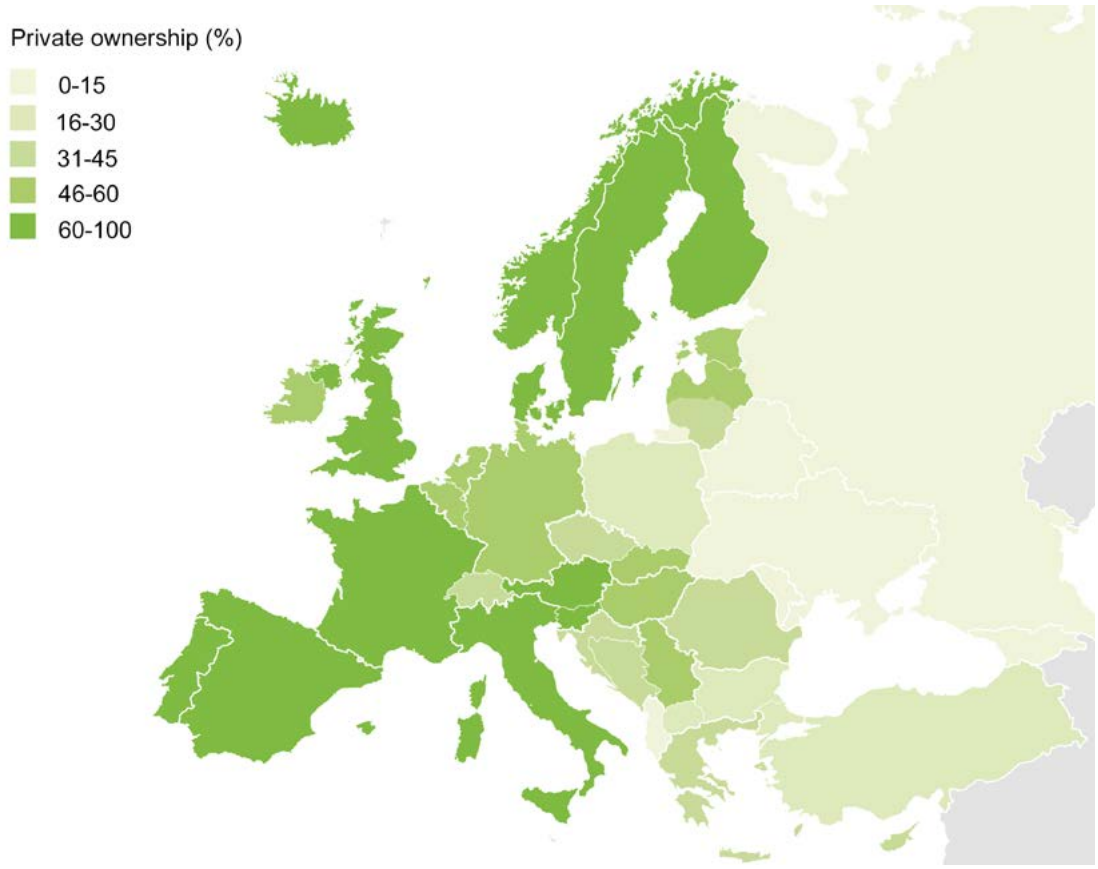

Figure 5 : Area of privately owned forest as percent of total forest. (after Forest Europe et al. 2011, 109)

research, and coordinate future activities, including training of students and young professionals, and the development of best practice.

- To involve other stakeholders engaged in the use and management of woodland resources, such as local communities, private and public land owners, forest industry and authorities, environmental agencies, as well as recreational and leisure activities and tourism; and
- To jointly negotiate, develop, test, implement, and disseminate best practice that enables the sustainable use of cultural, economic and ecological woodland resources by reconciling the interests of heritage conservation, woodland ecology, forestry, tourism and recreation.

The contacts and collaboration that the network seeks to establish between archaeologists and heritage professionals across Europe, and between them and other stakeholders engaged in forest management, are expected to provide a continuous platform from which an impact on public perception and policy making can be achieved long-term. It is supposed to give archaeology and cultural heritage management the much-needed additional weight when negotiating the sustainable use of forest resources with other stakeholders. The presentation of this initiative during a session on woodland archaeology at the CAA meeting in Paris in April 2014 is expected to further promote international cooperation to raise awareness of the important cultural legacy of woodlands.

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