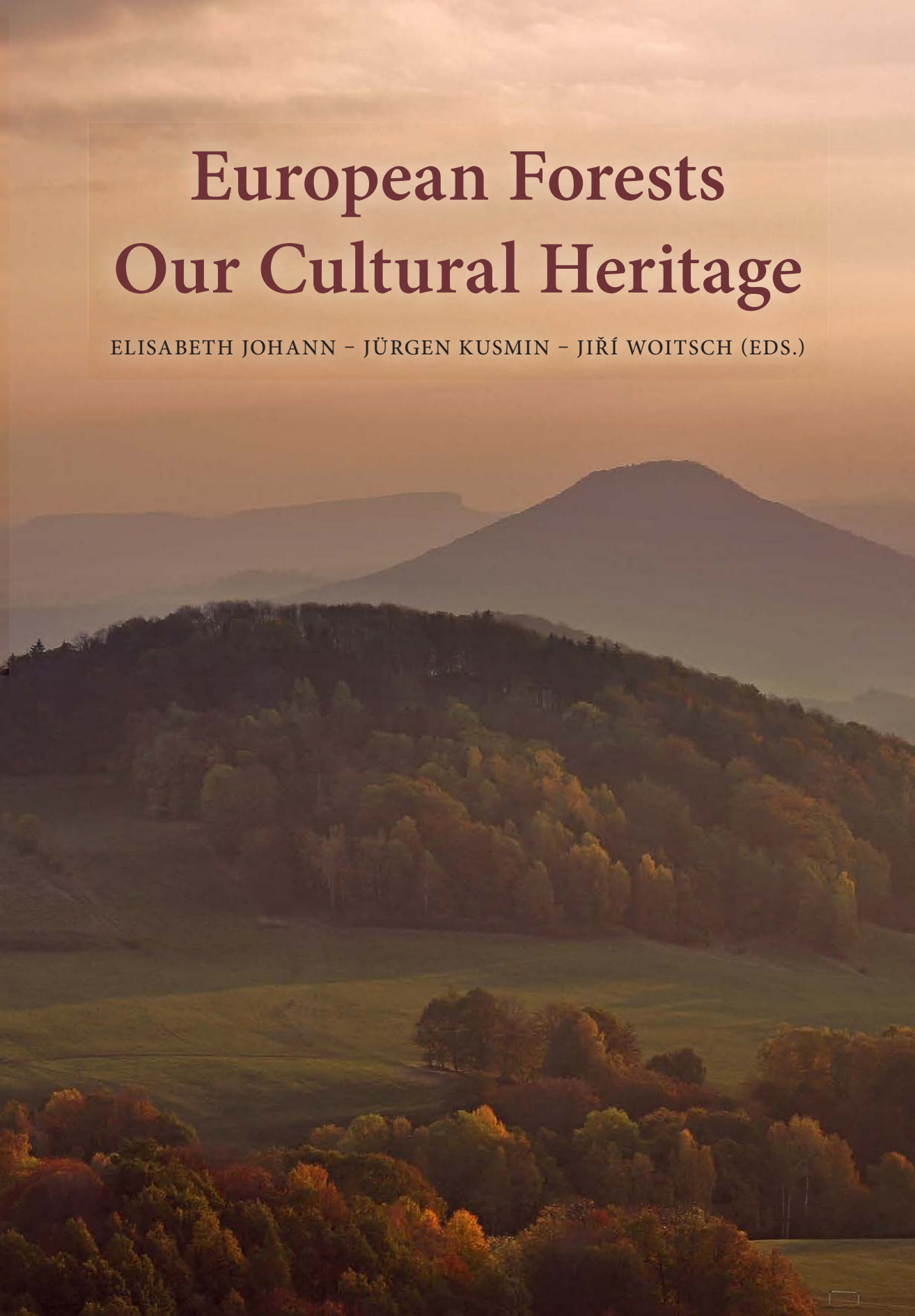
European Forests
Our Cultural Heritage

ELISABETH JOHANN – JÜRGEN KUSMIN – JIŘÍ WOITSCH (EDS.)



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Proceedings of the International Conference
European Forests – Our Cultural Heritage
organized by IUFRO 9.03.01 Economic and Social Forest History
and IUFRO 9.03.02 Forest and Culture jointly with
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ELISABETH JOHANN – JÜRGEN KUSMIN – JIŘÍ WOITSCH (EDS.)

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Obsah

Preface
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The aim of the European Year of Cultural Heritage 2018 was to raise awareness of the social and economic importance of cultural heritage and to pay tribute to Europe's cultural richness and diversity. Europe is famous worldwide for its rich, diverse cultural expressions, including its nature reserves, cultural sites and archaeological excavation sites, museums, monuments, works of art, historical cities, musical and literary works, as well as for the knowledge, customs and traditions. The term cultural heritage denotes cultural resources of tangible and intangible heritage the value of which has been publicly recognized for society so that they can be safeguarded and preserved for future generations. This heritage has been particularly recognized by UNESCO and could be labelled as official heritage.

At the same time, however, there are other forms of heritage that are harder to classify as official tangible or intangible heritage. Many elements of this heritage transcend the now obsolete nature-culture dichotomy and can be classified as a biocultural heritage, which has recently received increasing attention also by UNESCO and other official bodies. European forests, whose current form is a unique combination of natural elements and human cultivation and exploitation activities lasting for centuries, are a fascinating example of such a biocultural heritage.

Forest heritage is a term that became, however, established only in the first decade of the 21st century, especially since the Ministerial Conference on

the Protection of Forests in Vienna in 2003. The so called Vienna Resolution 3 – for the first time – dealt in depth with the social and cultural values of sustainable forest management and the International Year of Forests 2011 was intended to draw attention worldwide to the great importance of sustainable management, conservation and sustainable development of forests for the benefit of present and future generations. In Germany, the campaigns were based on the extraordinary universal value of the UNESCO World Heritage Site under the motto "Discover our forest cultural heritage!"

The forest is a natural source of raw materials, which in principle is permanently available with sustainable management and constant environmental conditions. However, it is also – far beyond the aspect of the raw material supplier – an inseparable part and companion of earlier generations. The forest is a silent witness and keeper of the legacies of bygone peoples and generations: places of worship, settlements, defensive structures, etc. From all ages, so-called ground monuments have outlasted times and testify to an eventful past.

The reality that we encounter in the forest consists of natural elements, but is always also a cultural product because these elements are put together according to human standards. Culture is shared human experience, but also process knowledge, for example from individual professional groups such as foresters. The building block of forest identity and self-perception is the preservation of nature and the creation of values that are made available to society. In the past, forests were used in a variety of ways. Trades that required a lot of wood, such as glassworks, charcoal burning or potash making, were located directly in the forests. For other uses, wood was transported into the valleys by means of drifts and rafting. Even today we can find traces of pre-industrial uses in our forests. In addition, numerous monuments from prehistory and early history have been preserved through permanent forest cover. These objects are called historical cultural landscape elements. The forest and its condition are thus integrated into the societal and social processes of the respective time. The cultural footprint of mankind is ubiquitous in the forests.

Since the conference in Vienna "Preserving and Enhancing the Social and Cultural Dimensions of Sustainable Forest Management in Europe", which took place in 2003, the use of cultural potential in the forest environment by the implementation of innovative projects at a technically high level has been promoted in different ways in several European countries. Many of them also take into consideration the Convention for the Safeguarding of the Intangible Cultural Heritage and the Declaration on People and Culture of 2006 under

the Alpine Convention. The UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (ratified so far by 80 contracting states) is based on the principle of sustainable use to the same extent as the goal of preservation of cultural and natural diversity. The content ranges from scientific research, the "everyday" cultivation of cultural landscapes, through a new recognition and upgrading of specific professional/craft knowledge, to the utilization of local knowledge concerning the use of natural resources.

Without knowing it, many forest owners are often site archivists and cultural archivists. In the forest, the ground often remained untouched for centuries, which is why things survive there that have long been destroyed outside the forest. At the same time, there is an increasing demand by forest owners related to new markets and additional income beside forestry and an increasing interest of tourism in the utilization of forest areas and beautiful sceneries. At present numerous initiatives, collections and museums exist; however, they are often not adequately linked. Thus, a new approach for co-operation of forest and woodland history including traditional knowledge and forest and tourist enterprises is necessary and there is an increasing need to deepen the knowledge related to the forest related cultural heritage which should be fulfilled.

The International Conference "European Forests – Our Cultural heritage" aimed to bridge the addressed gaps in the research of the forests framed as biocultural heritage and to highlight the recent developments in the field. The topic of forests as a biocultural heritage was illuminated and discussed from the most diverse scientific disciplines. Contributions came from the fields of landscape ecology, archeology, environmental policy, social history, dendrochronology, biology, botany, ethnology, mapping, forest management, forestry history and tourism, just to name a few. The exploration and representation of cultural sites were discussed as well as their relevance in today's time. As diverse as the research areas and perspectives was the circle of participants from 16 European countries, which spanned from England to Romania and from Estonia to Italy and Spain. Overall, the need was expressed to incorporate the knowledge related to the cultural heritage of European Forests into today's forest management plans for the purpose of maintaining and safeguarding. Moreover, the integration of forest-related heritage into tourism concepts can provide valuable outcomes.

Sustainable forest management might preserve the biocultural heritage in and of forests and serve for future generations. With the protection of the cultural heritage, the function of the all-rounder forest is expanded to include a further component. Several examples of research both basic and

applied into above mentioned topics are presented in the proceedings that you hold in your hand. As editors, we hope that they will help raise awareness of the biocultural heritage of Europe's forests and pave the way for further research and protection of this heritage, which should be an important part of sustainable management of European forests.

ELISABETH JOHANN ▪ (IUFRO 9.03.02, Austrian Forest Association, Working group Forest History, Austria)

JÜRGEN KUSMIN ▪ (IUFRO 9.03.02, Forest Department, Estonian State Forest Management Centre, Estonia)

JIŘÍ WOITSCH ▪ (IUFRO 9.03.01, Institute of Ethnology, Czech Academy of Sciences, Czech Republic)

Forest & Wood as Historic Archives of People, Place & Past

IAN D. ROTHERHAM, Sheffield Hallam University

Abstract: Forests and woods are eco-cultural landscapes where human activities over centuries interact with nature to shape the countryside. This process of interaction between people and natural resources is dynamic and on-going as vegetation cover ebbs and flows with the fluxes of people and climate. The resulting footprint of human activities on these lands provides evidence of people and of nature through time. Indeed, treed landscapes are amongst our most important living archives of human-nature interactions throughout history.

Human communities have exploited the natural resources of treed landscapes and benefitted from ecosystem services (such as protection from flooding, landscapes and avalanches) provided by forests. In order to secure these products and services over long periods, people managed forests and woods and this evolved to reflect local demands and circumstances. Such utilisation left its mark in many rural landscapes. Furthermore, this imprint is often long-lasting because of the longevity of woodland or forest landscape, and generally limited large-scale disruption, at least historically. However, with cultural severance and the twin changes of a) abandonment and b) industrialisation of forestry, the evidence and the archives are at best blurred and at worst erased. A further legacy of now lost activities and traditions of both traditional woodland management and of early 'forestry' is cultural knowledge embedded in local communities.

As human communities become more distanced from direct dependence on local natural resources from their immediate landscape, even memories of long-held traditions may be lost. This chapter explores connections between people and place in wood and forest. It considers aspects of heritage (both tangible and intangible) and archaeology resulting from deep-rooted human attachment to place and on-going utilisation of natural resources over centuries.

In modern, western societies the importance of wood and timber to everyday life has diminished with Industrial Revolution, urbanisation, and globalisation. Replaced by the immediate convenience of plastics for example for manufactured goods, and by gas, oil and electricity for fuel, demand for locally-sourced natural products waned. However, with changing ideas of sustainability and of the environmental costs of alternatives to wood (for example widespread occurrence of micro-plastics in the biota and especially the oceans) there may be a fresh interest in the produce of wood and forest. In this case, it is vitally important

to understand the history of human relationships with the resources of treed landscapes (be they wood or forest) and for this to better inform future exploitation.

Finally, it is important to note how intangible heritage is vulnerable to loss as individuals and communities age and traditions slip away. Additionally, physical heritage manifested as either artefacts like tools and equipment, or archaeological features, such as earthworks or building remains, are frequently ephemeral, often unrecognised, and easily damaged. In such cases, recognition, recording, and conservation are immediate priorities.

Key words: Cultural landscape, heritage, traditional knowledge, woodland and forest utilization

1. Forests & woods

In traditional countryside across Britain and much of Europe, treescapes of various forms of wood and forest were central to human activities for many centuries[1]. Woods and forests provided human communities directly with food, fuel, building materials, and grazing lands; and they also delivered wider ecosystem services including soil conservation, water management, and in Alpine regions, protection from avalanches and mudslides. These are eco-cultural landscapes where human activities over centuries interacted with nature to shape countryside[2]. Furthermore, until relatively recently, these were rural landscapes in part formed by ordinary people through utilisation and management of local resources. Much knowledge concerning these uses was held as oral traditions passed down over generations and which may be 'lost' surprisingly quickly (see Rotherham, 2007 for example). The core processes which determine the nature and character of these areas are dynamic and on-going as vegetation cover ebbs and flows with fluxes of people and climate.

Our modern perception of woods and forests is influenced strongly by more recent economic and commercial forestry which developed from the 1700s onwards and increasingly intensive during the twentieth century. A consequence of the changes in management of European forested landscapes during the past three centuries has been 'cultural severance'[3]. This

1 Rackham, O. (1980) *Ancient Woodland: its history, vegetation and uses in England*. Edward Arnold, London.

2 Rotherham, I.D. (2007) The implications of perceptions and cultural knowledge loss for the management of wooded landscapes: a UK case-study. *Forest Ecology and Management*, **249**, 100–115.

3 Rotherham, I.D. (2008) *The Importance of Cultural Severance in Landscape Ecology Re-*

involves the loss of traditional knowledge alongside the ending of traditional or customary practices (see Rotherham, 2013[4] for example). With cultural severance there is also either displacement of traditional usage by more modern economically-driven management, or else abandonment. Both of these outcomes lead to major changes in the ecological systems and potentially significant losses of ecosystem services.

2. People, nature and grazing animals

Within the treed, wooded, or forested landscapes there were important grazing lands and indeed, Frans Vera[5] has argued strongly that wild, large, grazing herbivores were important in driving the landscape dynamics of at least lowland areas in primeval Europe. However, by the medieval period there were undoubtedly intimate mixes of both wild grazing herbivores and domesticated stock; the latter often carefully selected and bred to thrive in specific, regional conditions. From mountain high forests to extensive lowland wood-pastures, people and their livestock populated many rural parts of Britain and Europe. Hunting and culling of wild grazing herbivores was also a part of this long-term relationship between humanity and natural resources. In some cases, there were sophisticated social structures evolved to control who might hunt which animal, how they could do it, and where this could take place. Again, over long periods this utilisation helped shape the nature of the forested landscape strongly that wild, large, grazing herbivores were important in driving the landscape dynamics at least of lowland areas in primeval Europe. However, by the time of the medieval period there were undoubtedly intimate mixes of both wild grazing herbivores and domesticated stock; the latter often carefully selected and bred to thrive in specific, regional conditions. From mountain high forests to extensive lowland wood-pastures, people and their livestock populated many rural parts of Britain and Europe. The hunting and culling of wild grazing herbivores was also a part of this long-term relationship between humanity and natural resources. In some cases, there were sophisticated social structures evolved

search. In: Editors: Dupont, A. & Jacobs, H. *Landscape Ecology Research Trends*, ISBN 978-1-60456-672-7, Nova Science Publishers Inc., USA, Chapter 4, pp 71–87.

4 Rotherham, I.D. (ed.) (2013) *Cultural Severance and the Environment: The Ending of Traditional and Customary Practice on Commons and Landscapes Managed in Common*. Springer, Dordrecht.

5 Vera, F.H.W. *Grazing Ecology and Forest History,* (Oxon: CABI Publishing, 2000).

to control who might hunt which animal, how they could do it, and where this could take place. Again, over long periods this utilisation helped shape the nature of the forested landscape (see Samolijk *et al.*, 2013[6] for example). By medieval times the hunting of larger 'game' (animals and birds) was often strictly controlled and furthermore, large areas of land were set-aside specifically for the sporting hunts of the privileged classes within within society[7].

These grazing and hunting uses of the countryside have proved important in the heritage surviving today; from areas such as heaths and moors, to deer parks, royal forests, and chases[1.] These include recently-identified survivals of so-called 'shadow woods'[8]. Many of these former grazing and / or hunting lands incorporate importance heritage and ecological features such as ancient 'worked' trees and the associated fauna, flora and fungi. In many cases, the species concerned no longer survive outside these formerly managed and protected areas and their longevity back to medieval hunting preserves for example, has been critical to their persistence. In some cases, the pollarding of trees for leaf fodder for example, management for hunting or by local farmers and peasants, was essential in both shaping the 'working' trees and also through this management, extending their natural lifespans. So today, it is in these landscapes, often separated from their working origins, that we find our most ancient trees and their associated ecologies[8, 9].

In many cases too, where ancient rural landscapes survive they have been incorporated into seventeenth-, eighteenth-, and nineteenth-century parks. In such cases, they may have evolved new economic and social functions which have aided their survival (See for example, Rotherham & Handley (eds), 2017[10]), and this may have safeguarded elements of their ecology and heritage to the present-day. However, surviving as 'leisurely landscapes' these areas are different and distinctive from how they would have appeared as working countryside. Even our modern perceptions and understanding of

6 Samojlik, T., Rotherham I.D., Jędrzejewska, B. 'A conceptual model to estimate and quantify historic human impacts on forest environments – a case study in Europe's last primeval lowland forest', *Environmental History* **18** (2013): 576–602.

7 Fletcher, J. *Gardens of Earthly Delight. The History of Deer Parks,* (Oxford: Windgather Press, 2011).

8 Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

9 Rotherham, I.D. 'Bio-Cultural Heritage & Biodiversity – emerging paradigms in conservation and planning', *Biodiversity & Conservation* **24** (2015): 3405–3429.

10 Rotherham I.D., Handley, C. (eds) *What did Capability Brown do for Ecology? The legacy for biodiversity, landscapes, and nature conservation*, (Sheffield: Wildtrack Publishing, 2017).

these areas may be different from their reality; as David Lowenthal wrote, 'the past is a foreign foreign country'[11].

3. Eco-cultural landscapes

These treed landscapes hold evidence of people and nature through time, historic and prehistoric; the footprint of human activities on these lands written deep into their ecologies. Examples are visible across Britain and Europe and include sites such as Burnham Beeches in London[12] for example, or Białowieża Forest in Poland or Białowieża Forest in Poland.[13] Here the aged pollard oaks and beeches were seated in huge fuel allotments to supply the energy needs of London on what was previously commonland.[14] As noted already, this locally-based resource management created the rural landscape and maintained elements of it to modern times. These areas fused nature and human utilisation to become the countryside experienced today; 'eco-cultural' in their origins[15] they hold significant assets of biocultural heritage.[16] Once abandoned by traditional or cultural utilisation, if not displaced by destructive modern land-uses, these rural treescapes proceed through ecological successions and along predictable trajectories. However, the ecology does not return to its condition before major human intervention, but to a new 'futurescape' condition.[17] This is influenced by the base-line condition when the site or area is abandoned and by other factors such as air pollution,

11 Lowenthal, D. *The Past is a Foreign Country*, (Cambridge: Cambridge University Press, 1985).

12 Rotherham, I.D. *Ancient Woodland: History, Industry and Crafts*, (Oxford: Shire Publications, 2013), 64.

13 Samojlik, T., Rotherham I.D., Jędrzejewska, B. 'A conceptual model to estimate and quantify historic human impacts on forest environments – a case study in Europe's last primeval lowland forest', *Environmental History* **18** (2013): 576–602.

14 Rotherham, I.D., Egan, D. 'The Economics of Fuel Wood, Charcoal and Coal: An Interpretation of Coppice Management of British Woodlands', in Agnoletti, M., Armiero, M., Barca, S., Corona, G. (eds.), *History and Sustainability,* (European Society for Environmental History, 2005), 100–104.

15 Rotherham, I.D. 'Bio-Cultural Heritage & Biodiversity – emerging paradigms in conservation and planning', *Biodiversity & Conservation* **24** (2015): 3405–3429.

16 Agnoletti, M., Rotherham, I.D. Landscape and biocultural diversity, *Biodiversity & Conservation* **24** (2015): 3155–3165.

17 Rotherham, I.D. *Recombinant Ecology – a hybrid future?,* (Dordrecht: Springer Briefs, 2017).

non-native and invasive species, and also, of course, by climate change. With the modern scale of human intervention and influence on the environment, clearly all future landscapes and their ecologies will also be deeply eco-cultural and be a synthesis of nature and human processes.

4. The nature of the European landscape

At the heart of a discussion about treed European landscapes are the questions of how it was in say medieval or even primeval times.[18] Research on these landscapes has led to the emergence of concepts such as for example 'cultural severance'[19], 'Shadow Woods'[20], and eco-cultural landscapes.[21] These ideas have developed in recent years and stem from debates extending back to the 1980s. Importantly, these emerging ideas and concepts address the inherent duality of the drivers of environmental change – human usage impacting on and being influenced by nature and natural resources to generate 'landscape'. How the biocultural and heritage assets might be safeguarded or conserved going forwards is a huge challenge and requires an understanding of the resources, both tangible and intangible. The relationship between 'natural forest' and human-managed treescapes has been the subject of close scrutiny.[22]

Therefore, alongside these developing paradigms there are emerging concepts of both 'tangible' and 'intangible' cultural heritage[23, 24]. These help to

18 Vera, F.H.W. *Grazing Ecology and Forest History,* (Oxon: CABI Publishing, 2000). Rackham, O. (1980) *Ancient Woodland: its history, vegetation and uses in England*. Edward Arnold, London.

19 Rotherham, I.D. 'The Importance of Cultural Severance in Landscape Ecology Research', in Dupont, A., Jacobs, H. (eds.), *Landscape Ecology Research Trends*, (USA: Nova Science Publishers Inc., 2008), pp. 71–87.

20 Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

21 Rotherham, I.D. 'Bio-Cultural Heritage & Biodiversity – emerging paradigms in conservation and planning', *Biodiversity & Conservation* **24** (2015): 3405–3429.

22 Peterken, G.F. *Natural Woodland – ecology and conservation in northern temperate regions,* (Cambridge: Cambridge University Press, 1996).

23 Agnoletti, M. (ed.), *The Conservation of Cultural Landscapes*, (Wallingford, Oxon, UK: CAB International, 2006).

24 Agnoletti, M. (ed.), 'Guidelines for the Implementation of Social and Cultural Values in Sustainable Forest Management', *A Scientific Contribution to the Implementation of MCPFE – Vienna Resolution 3. IUFRO Occasional Paper No. 19*, (2007).

underpin both our understanding of the landscape and its history, and efforts to conserve the resource.

4.1. Tangible cultural heritage

Tangible cultural heritage may include things such as built structures and artefacts, for example, the charcoal burner's memorial stone in an ancient woodland in Sheffield dated 1786 (Figure 1) or a charcoal burner's hut (again in Sheffield and photographed in the late 1800s) (Figure 2). The latter was from a complex of ancient, worked woods of which only small fragments remain. Artefacts might include the tools and equipment used in traditional crafts and activities, for example, specialist axes, hammers, spades *etc* (see for example, Figure 3 – a Bulgarian forester's axe).

For woodlands the heritage includes products (such as timbers) from wood and forest in buildings, and other products manufactured e.g., tent pegs for the military.[25] Much vernacular architecture reflects locally available resources and the associated processing and manufacturing which occurred either in the forest or close by. In we consider a starting point in ancient woodland and the associated products, there will often be evidence of the harvesting of coppice wood and its processing on site to make charcoal (or kiln-dried wood – 'white coal'[26] and specifically manufactured to smelt lead). The landscape artefacts connected to such processing include charcoal manufacturing platforms, metal smelting sites, and workers' hut circles, all of which can today be categorised as both archaeology and heritage[27].

It is important to have a clear view of what is meant or implied by a 'wood' and for example a 'forest', and significantly these definitions may vary from region to region, and country to country. However, from a British perspective we take a 'wood' to be an area of woodland enclosed by a boundary and managed for the production of coppice wood and timber and this is generally from around the early medieval period onwards.[28] Forest on the other hand is a large area of land subjected in medieval times to 'forest law' and preserved

25 Rotherham, I.D. *Ancient Woodland: History, Industry and Crafts*, (Oxford: Shire Publications, 2013), 64.

26 Jones, M. *Sheffield's Woodland Heritage,* 4th Edition, (Sheffield: Wildtrack Publishing, 2009).

27 Rotherham, I.D., Jones, M., Smith, L., Handley, C. (eds.), *The Woodland Heritage Manual: A Guide to Investigating Wooded Landscapes*, (Sheffield: Wildtrack Publishing, 2008).

28 Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

Figure 1: Wood-collier's monument in Ecclesall Woods, Sheffield

Figure 2: Wood-collier's wigwam hut, Parkwood Springs, Sheffield, late 1800s

Figure 3: A Bulgarian forester's axe

for hunting but to include woods and other productive lands within it.[29] However, the term 'forest' can also apply to a perceived 'natural' land-cover dominated by trees and utilised in various ways by people. Within these broad concepts, the medieval forest was essentially a large area of wood-pasture or pasture wood,[30] and the idea of 'ancient woods' is also important…[31] Ancient woods in England for example, were generally enclosed from the wider wood-pastures at or following the time of the Domesday account of 1086.[32] The type and age or longevity of a treescape influences the associated heritage, ecology and archaeology today. Occasionally this date of enclosure

29 Rackham, O. (1980) *Ancient Woodland: its history, vegetation and uses in England*. Edward Arnold, London.

Rotherham, I.D. 'Bio-Cultural Heritage & Biodiversity – emerging paradigms in conservation and planning', *Biodiversity & Conservation* **24** (2015): 3405–3429.

30 Fletcher, J. *Gardens of Earthly Delight. The History of Deer Parks,* (Oxford: Windgather Press, 2011).

Rotherham, I.D. 'Bio-Cultural Heritage & Biodiversity – emerging paradigms in conservation and planning', *Biodiversity & Conservation* **24** (2015): 3405–3429.

31 Rackham, O. (1980) *Ancient Woodland: its history, vegetation and uses in England*. Edward Arnold, London.

Peterken, G.F. *Woodland Conservation and Management,* (London: Chapman and Hall, 1981).

32 Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017). Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

may be documented but more often it is indicated by a place-name for example. The name of Yarncliff Wood in the English Peak District for instance is derived from 'Erne–cliff' which equals 'Eagle–cliff', is derived from Old English and suggests enclose and naming when eagles still nested close by.

When we consider archaeology and heritage in wooded landscapes it is helpful and informative to separate the archaeology and heritage 'of' the wood and that 'in' the wood but not specifically associated with woodland industries.[33] The latter include features and items such as derived from non-woodland phases and / or pre-woodland phases of land-use, such as medieval of Romano-British quern stones (portable antiquities), or early industrial track-ways (landscape features).[34] The former, ('of' the wood), include woodbanks and associated features, or charcoal pits and platforms. 'Worked' trees as eco-cultural artefacts are also included in this tangible heritage. The archaeology 'in' the woods includes features associated with other non-woodland activities such as former farming features, stone quarries, and both coal- and ironstone mines.

In England for example, many of these woodland and forest traditional uses were lost through periods of intensive social transformation and associated landscape transformation. This occurred especially during the parliamentary enclosures from the 1700s into the 1800s, and also associated with both industrial and agricultural revolutions.[35] Associated with these changes there was also widespread de-population of rural areas and this is a process that continued across Europe until the twenty-first century. Many wooded and forested areas were transformed into modern economically-driven forestry, into agriculture, or else absorbed into expanding urban centres. In other cases, increased grazing pressures simply prevented tree regeneration and ultimately removed woodland cover. One major result of these changes occurring over decades or centuries, has been the progressive loss of knowledge of the former skills and traditions of the treescapes, and in many cases,

33 Rotherham, I.D. 'Traditional Woodland Management: the Implications of Cultural Severance and Knowledge Loss', in Rotherham, I.D., Jones, M., Handley, C. (eds.), *Working & Walking in the Footsteps of Ghosts. Volume 1: the Wooded Landscape,* (Sheffield: Wildtrack Publishing, 2012), 223–264. Rotherham, I.D. (2007) The implications of perceptions and cultural knowledge loss for the management of wooded landscapes: a UK case-study. *Forest Ecology and Management*, **249**, 100–115.

34 Rotherham, I.D. (2007) The implications of perceptions and cultural knowledge loss for the management of wooded landscapes: a UK case-study. *Forest Ecology and Management*, **249**, 100–115.

35 Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

even the cultural memory that they once existed.[36] This is the intangible cultural heritage of the wooded landscapes.

4.2. Intangible cultural heritage

Intangible cultural heritage[37] involves traditions and knowledge of say woodland crafts and industries and of early industrial forestry. It may include for example, local uses of woodland products and harvests such as taking mushrooms (see Figure 5) or gathering leaf-litter. This heritage can include local knowledge of traditions and processes and documentation or other evidence. In this context, the persistence and recording of oral traditions and intergenerational memories become very significant. An example is the case of the descendants of Thomas Haber (Balcombe Forest (England) charcoal burner in the early 1900s,[38] and of Julie Cook, his great-great-grand-daughter (see Figure 4). Another example is the persistence of a public house (closed circa 2019) called the 'Woodcolliers' close by the Wyre Forest in the West Midlands of England long after charcoal burning in the Forest ceased. Much of the cultural knowledge was passed on down the generations as oral traditions rather than written. Consequent on rural de-population and migration of people to towns and cities, knowledge was lost as people simply left the countryside. Furthermore, with the breakdown of rural, often subsistence communities, the value of knowledge held by the older generations is less recognised with traditions neglected and forgotten.[39]

36 Rotherham, I.D. (2007) The implications of perceptions and cultural knowledge loss for the management of wooded landscapes: a UK case-study. *Forest Ecology and Management*, **249**, 100–115.

37 Rotherham, I.D. *Recombinant Ecology – a hybrid future?,* (Dordrecht: Springer Briefs, 2017). Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

38 Rotherham, I.D. *Ancient Woodland: History, Industry and Crafts*, (Oxford: Shire Publications, 2013), 64.

39 Rotherham ID (2014) *Eco-history: An Introduction to Biodiversity and Conservation*. The White Horse Press, Cambridge. Rotherham, I.D. *Ancient Woodland: History, Industry and Crafts*, (Oxford: Shire Publications, 2013), 64. Rotherham, I.D. (2007) The implications of perceptions and cultural knowledge loss for the management of wooded landscapes: a UK case-study. *Forest Ecology and Management*, **249**, 100–115.

Figure 4: A Hearty Meal – Charcoal Burners, Balcombe Forest, West Sussex, 1908

Figure 5: Gathering mushrooms in the Alps early 1900s

5. Ancient landscapes and continuity

In terms of the tangible heritage and archaeology associated with ancient woods and forests, a key factor is the depth of the human imprint and that the results are often long-lasting. This is due to the longevity of woodland or forest, and the generally limited large-scale disruption. With transformation to intensive forestry, agriculture, urbanisation, or to other industrial uses such as large-scale mineral extraction for example, continuity ends and the resources are lost. In order to safeguard and preserve the tangible heritage and the archaeology both 'of' and 'in' the woods, landscape antiquity and continuity are both necessary. In order to maintain the intangible cultural heritage, unless traditions and crafts carry on as a necessary part of societal function, then effective recording and archiving are necessary. However, as communities age on the one hand and migrate on the other, resources themselves are time-limited.

6. Cultural severance

A consequence of severance and abandonment is the loss of potential legacies of former activities and traditions of both woodland management and uses, and of early 'forestry'. Cultural knowledge largely embedded in local frequently illiterate communities as oral tradition is simply forgotten. An example is the once widespread occupation of the 'bark-peeler' for the tanning industry and involving tasks like felling, peeling, carting and processing of bark.[40] When we are able to unravel evidence and document now ended traditions, this provides intimate insights into a lost way of life.

In these circumstances the countryside involved may be compromised in various ways. Modern forestry for example can erase the heritage of traditional uses and bring about the displacement of local communities and associated loss of cultural knowledge. In modern forestry, the use of heavy machinery where people, oxen and horses once worked the woods erases the earthworks which form the archaeology and tangible cultural heritage from times past. Abandonment may release ecological successional processes but at the same time, help preserve earthwork remains, built structures, and formerly worked trees. However, worked trees once abandoned may themselves

40 Rotherham I.D. *Shadow Woods: A Search for Lost Landscapes,* (Sheffield: Wildtrack Publishing, 2017).

deteriorate through competition with neighbours and resulting shade. There may also be the growing on (of say coppice or pollards) to a point of instability and structural collapse. Furthermore, through root ingression, self-set saplings and young trees will eventually damage both earthworks and built structures relating to earlier cultural uses.

The alternative to abandonment or commercial forestry is other land-uses (such as agriculture, extractive industries, or urban development) and these too will compromise or even totally erase the former traditional woodland or forest landscape. Even conservation is often not good at preserving heritage landscapes rather than biodiversity interest. Indeed, limited understanding of landscape and heritage can lead to environmental organisations damaging or even erasing cultural heritage through uninformed 'conservation' management. Even use of so-called 'low impact' vehicles for activities such as logging can be hugely damaging. In cases where there is an absence of preliminary survey, of understanding of the heritage resource, and even a basic site management plan, then centuries of cultural heritage can be erased and eroded in a single season of work. Unlike the ecology, which in some cases at least can recover with sympathetic management, archaeology and heritage features are destroyed or comprised forever.

Some projects are perhaps better thought out and more effectively prepared. In cases where there are attempt to conserve and even to mimic the former traditional management then there may be a degree of success. Most frequently the projects attempt to replicate or continue traditional coppicing of 'spring wood'[41] or cutting of pollards. But even these attempts can be problematic if the precise techniques are not understood and maybe modern tools and equipment are used but produce subtly different results. Wrongly cutting coppice or pollards can result in avoidable deaths of ancient trees. In recent years, bodies such as the Ancient Tree Forum have been researching how best to undertake such conservation restoration works with least risk to the trees[42, 43]. This work and the associated guidelines have helped improve success rates when long-abandoned coppices or pollards are brought back into management. These attempts are laudable and even essential if the ecological and cultural interests are to be conserved. Nevertheless, it should be realised

41 Rotherham, I.D. 'Bio-Cultural Heritage & Biodiversity – emerging paradigms in conservation and planning', *Biodiversity & Conservation* **24** (2015): 3405–3429.

42 Read, H. *Veteran Trees: A Guide to Good Management*, (Peterborough: English Nature, 2000).

43 Lonsdale, D. *Ancient and Other Veteran Trees: Further Guidance on Management*, (London: Tree Council, 2013).

that for a range of reasons, this conservation management does not replicate the actions or effects of traditional or customary usage. At best it allows the persistence of selected aspects of the ecology and landscape heritage.

7. Heritage generated by traditional and economic usage

The reasons for the difficulty in maintaining or at least conserving the eco-cultural heritage of woods and forests are related to the origins of the eco-cultural landscapes and its biocultural assets. The heritage and archaeology are the by-products of traditional and early industrial management driven by local subsistence uses and or local economic exploitation[44, 45, 46]. Today's conservation management mimics some aspects of former usage but is not on the scale or at the same intensity as the past activities[47]. When woods and forests were managed in traditional societies, the workers and their families together with livestock for example, might spend weeks or even months living in or near the forest or wood during the season of woodland work. This meant a wide range of human and animal impacts and in many cases working sites which looked very different from today's conservation areas.

However, historically these exploited landscapes were subjected to long-term, repeated (predictable) management and impacts of 'micro-disturbance' over long periods that differ dramatically from the 'macro-disturbance' and unpredictability of modern forestry[3, 9]. Furthermore, the traditional and early industrial utilisation generally withdrew available nutrients from the woodland or forest system whereas in the modern environment, factors such as widespread air pollution tend to raise nutrient levels. These changes of key drivers in the system move its ecology from stress-tolerant and stress-tolerant ruderal species, towards competitors[48] and this reflected in so-called botanical indicators of ancient woods. The approach has been refined from

44 Perlin, J. *A Forest Journey*, (Massachusetts: Harvard University Press, 1989).

45 Fowler, J. *Landscapes and Lives. The Scottish Forest through the ages,* (Edinburgh: Canongate Books, 2002).

46 Hayman, R. *Trees. Woodlands and Western Civilization,* (London: Hambledon and London, 2003).

47 Jones, M., Rotherham, I.D. 'Managing urban ancient woodlands: a case study of Bowden Housteads Wood, Sheffield', *Arboricultural Journal* **34** (3) (2012): 215–233.

48 Grime, J.P., Hodgson, J.G., Hunt, R. *Comparative Plant Ecology. A Functional approach to common British species,* Second Edition (Dalbeattie: Castlepoint Press, 2007).

work by Grime for example[49] and by Ellenburg[50] to develop sophisticated and pragmatic approaches to help identify important sites for future conservation[51]. Over time, this is a fundamental shift in the ecological dynamics.

8. Conclusions

The research described highlights the importance of recognising the eco-cultural nature of historic and traditional woodlands and forests. These are eco-cultural landscapes with biocultural heritage. Furthermore, the heritage manifests itself as a) tangible cultural heritage, and b) intangible cultural heritage. The former includes the archaeology 'of' the wood or forest alongside that merely 'in' the wood or forest. This archaeology is made up of physical features such as earthworks and building remains, and of artefacts or portable antiquities.[52] The trees and other vegetation can also be considered a part of this tangible cultural heritage which has been altered and managed over centuries of human utilisation.

Cultural severance is the ending of traditional or customary usage of wooded landscapes and replacement by other, more intensive uses or by abandonment; both options have significant consequence for both ecology and heritage.

Finally, this paper argues that in order to understand the present countryside, we must have knowledge of the history of past land-use and the eco-cultural nature of the landscape. This knowledge is in the form of cultural heritage, both tangible and intangible. Such understanding can inform our assessment of the present landscape and help guide decisions on futurescape options. Priorities are therefore to a) gain better recognition of the heritage landscapes so that inadvertent damage by otherwise conservation-orientated

49 Grime, J.P., Hodgson, J.G., Hunt, R. *Comparative Plant Ecology. A Functional approach to common British species,* Second Edition (Dalbeattie: Castlepoint Press, 2007).

50 Hill, M.O. & Ellenberg, H.H. (1999) *Ellenberg's Indicator Values for British Plants: Technical Annex (ECOFACT Research Report S.*) Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, Huntingdon.

51 Rotherham, I.D. (2011) *A Landscape History Approach to the Assessment of Ancient Woodlands*. In: Wallace, E.B. (ed.) *Woodlands: Ecology, Management and Conservation*. Nova Science Publishers Inc., USA, 161–184.

52 Peterken, G.F. *Natural Woodland – ecology and conservation in northern temperate regions,* (Cambridge: Cambridge University Press, 1996).

management can be avoided, and b) to identify and record oral histories, artefacts and other heritage relating to lost traditions.

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Forgotten Heritage
Sustainable forest management and the safeguarding of forestry-related cultural heritage in Austria

ELISABETH JOHANN, Austrian Forest Association

Abstract: The study analyses the interrelation of sustainable forest management and the safeguarding of the forest-related cultural heritage in Austria. It tackles social conflicts and agreements and investigates what kind and to what extent traditional forest related knowledge and practices concerning nature and traditional craftsmanship are still relevant. Thus, also options are discussed in which way the revitalization of this knowledge could contribute to the strengthening of rural areas.

Keywords: forest management, cultural heritage, sustainability, forest history

1. Introduction

Almost half of Austria's federal territory is covered by forests. Forests offer space for recreation, provide environmentally friendly energy sources such as wood, and protect against natural hazards such as avalanches.[1] The internationalisation of the trade in timber, the international approach to environmental and economic policies, the increase in the rate of illegal logging, the fight against poverty and hunger, and the huge efforts to effectively protect the climate and natural resources all highlight the need to conserve and manage the forests on Earth and the fact that this aim must be a global as well as a local one. In comparison with other countries, Austria has a considerable amount of well-maintained forests, the result of the historical development

1 Bundesministerium für Nachhaltigkeit und Tourismus (BMNT), Kommunikation und Service (Abteilung Präs. 5), *Austria: A Model of Sustainable Forest Management (*Vienna: BMNT 2018) https://www.bmnt.gv.at/english/forestry/Austriasforests.html.

Figure 1: Transportation of fire wood in the Austrian Alps around 1830 (source: Pater Chrisostomus Sandweger, fresco parsonage Josefsberg, Lower Austria)

of small-scale forest ownership in which peasants play an important role by managing about 50 percent of forest area. This is why forestry has been and still is a key element in rural development.

The importance of centuries of forestry experience lies in trial and error, in the accumulation of experience by generations under the risk of error. Köpf argues that the decisions and actions of the past are still visible after a hundred years.[2] During this long period, mistakes become visible that need to be corrected. But the future, in turn, creates new demands that need to be addressed. Climate change and the growing world population are new challenges. People who live and work in and with the forest are bearers of a historical trove of experience related to the development of the forest. Their experience, which is expressed in practical acts, should be promoted and fairly used.

Sustainable forest management is a traditional research field with a remarkable history. Since Hanns von Carlowitz practically invented the concept

2 Köpf, E.U., *Forstpolitik* (Stuttgart: Verlag Eugen Ulmer 2002), p. 288.

of sustainability in the context of forest management in 1713, the general understanding of sustainable forest management (SFM) has evolved.[3] The experience gained over the centuries is indispensable and also unrepeatable for humankind and therefore of invaluable importance to politics and public administration concerning the new experiment of sustainable development.[4] The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 achieved for the first time a high level of political commitment to advancing SFM.[5] The adopted 'forest principles' captured the general international understanding of SFM at that time. Since then several sets of criteria and indicators have been developed to evaluate the achievement of SFM at the global, regional, country and management unit levels.[6]

Wiersum postulates that the original concept of sustained yield has gradually broadened into a more inclusive principle of SFM that also encompasses social values.[7] The work conducted by the Ministerial Conference on the Protection of Forests in Europe, or Forest Europe, from 1990 onwards has been based on developing a common understanding of what SFM encompasses. The term was defined in 1993 in Helsinki Resolution H1 as *the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems for both current and future generations.*[8]

Within the framework of Forest Europe the ministers responsible for forests in their countries have been working for more than 25 years to promote, improve and implement SFM in Europe. Forest Europe elaborated

3 Carlowitz, H. C.v., *Sylvicultura oeconomica, oder haußwirthliche Nachricht und Naturgemäße Anweisung zur Wilden Baum-Zucht*. Reprint of 2nd edition (Oberwinter: Verlag Kessel 2009).

4 Köpf, E.U., *Forstpolitik* (Stuttgart: Verlag Eugen Ulmer 2002), p. 288.

5 UN, *Report of the United Nations Conference on Environment and Development*, Rio de Janeiro, Brazil, June 3–14, 1992 (New York: United Nations 1992).

6 Antony, J. R., Lal, S.B., *Forestry Principles and Applications* (Jodhupur: Scientific Publishers 2013), p. 166.

7 Wiersum, K.F. '200 years of Sustainability in Forestry: Lessons from History', *Environmental Management*, 19 (3) (1995): 321–329.

8 Forest Europe, *RESOLUTION H1 General Guidelines for the Sustainable Management of Forests in Europe,* Second Ministerial Conference on the Protection of Forests in Europe 16–17 June 1993 (Helsinki: Forest Europe 1993). https://www.foresteurope.org/docs/MC/MC_helsinki_resolutionH1.pdf.

the 'Pan-European Operational Level Guidelines for Sustainable Forest Management', which were endorsed at the Lisbon Ministerial Conference in 1998.[9] In 1989 the Standing Forestry Committee was set up as a consultative committee for the European Commission. On 15 December 1998 the Council of the European Union passed a resolution on a forestry strategy for the European Union, which created a framework for implementing policies designed to promote sustainable forestry. This resolution strongly emphasises the obligations of the European Community and its Member States in important international processes, in particular regarding the UNCED and follow-up conferences, such as the Ministerial Conferences on the Protection of Forests in Europe (MCPFE) held in Vienna (2003) and Warsaw (2007). This strategy emphasises the importance of multifunctional forests and SFM for the development of society and highlights key components regarding their implementation.

Austria's forest policy pursues the principle of SFM as defined at the Second Ministerial Conference on the Protection of Forests in Europe held in 1993 in Helsinki. In various regional and global forest-related agreements, Austria has committed itself to accepting responsibility for global sustainable forest management. The 'Pan-European Criteria and Indicators for Sustainable Forest Management' are used to assess the state and development of sustainable forestry in Austria. They concern (1) forest resources, (2) forest health and vitality, (3) the productive functions of forests, (4) biodiversity, (5) the protective functions of forests and (6) the socioeconomic functions of forests. SFM must maintain balance between three main pillars: ecological, economic and sociocultural. This concept can be described as the attainment of balance, balance between society's increasing demands for forest products and benefits, and the preservation of forest health and diversity.[10]

This paper intends to analyse the extent to which Austria has implemented at the national level the guidelines, measures and visions that were agreed on at the global and European levels, particularly with regard to the preservation of intangible and material cultural heritage. It also investigates the extent to which social and cultural dimensions of forest management, the third

9 Forest Europe, *Annex of the RESOLUTION L2 Pan-European Operational Level Guidelines for Sustainable Forest Management,* Third Ministerial Conference on the Protection of Forests in Europe 2–4 June 1998 (Lisbon: Forest Europe 1998). https://foresteurope.org/wp content/uploads/2016/10/MC_lisbon_resolutionL2_with_annexes.pdf#page=18.

10 Evans, K., Jong, W., Cronkleton, P., 'Future Scenarios as a Tool for Collaboration in Forest Communities', *Surveys and Perspectives Integrating Environment and Society* Vol 1/2 (2008).

pillar of sustainability, are taken into account and how experience-related knowledge attracts public attention and probably influences forest policy.

2. Study Area

Forests are the most characteristic element of Austria's landscape covering 47 per cent of its territory. Two-thirds of the land are situated in mountainous regions. Only about 15 per cent of forests are state owned, while 85 per cent of forest land is privately owned, of which about 70 per cent is held by small-scale farmers. Woodlands and their products are a precondition for maintaining the welfare of the population. SFM and related legislation have been implemented from the sixteenth century onwards. Forestry and the wood sector contribute about 2.1 per cent to the gross domestic product. In terms of economic welfare, the importance of forests and forestry for society should be rated higher. Farm forests have many functions for farmers such as providing jobs, income, fuel and timber, grazing and hunting land, and other non-wood products and increasing property value and capital reserves. The tourism and leisure industry in Austria has become a prominent segment of the economy. It is an important employer and foreign exchange earner, and thus contributes to slowing down migration from structurally deprived regions. About 80 per cent of tourism and the major part of the entire recreational tourism sector are highly landscape-oriented.

3. Methods and Sources

To study strategy implementation, Austria-wide activities in the fields of forest policy, education and dissemination of knowledge are examined. This study relies on several sources at different levels. First, it takes into consideration global and European agreements that have been signed by all or most EU Member States and the EU, particularly Resolution 3 of the Fourth Ministerial Conference on the Protection of Forests in Europe held in Vienna in 2003, 'Preserving and Enhancing the Social and Cultural Dimensions of Sustainable Forest Management in Europe'; [11] the Convention for the Safeguarding

11 Forest Europe, *Declaration and Vienna Resolutions.* Adopted at the Fourth Ministerial Conference on the Protection of Forest in Europe (Vienna: *Forest Europe* 28–30 April 2003).

Figure 2: Wooden log-house in the Southern Austrian Alps from the early 18th century. Beside the stonewall-stable the building material is larch, harvested in the close surroundings. The house was part of a hammermill and is inhabited till present day (Photo E. Johann)

of the Intangible Cultural Heritage 2003;[12] and the Declaration on People and Culture of 2006[13] under the Alpine Convention. Second, it examines Austria-wide activities in the field of forest policy such as those developed as part of the Austrian Forest Dialogue and the Austrian National Forest

12 United Nations Educational, Scientific and Cultural Organization, *Convention for the Safeguarding of the Intangible Cultural Heritage* (Paris: UNESCO 2003) http://www.unesco.at/user/texte/docs/conv_saveg_ch.pdf

13 The Convention on the Protection of the Alps, *Ministerial Declaration* AC_IX_11_1_en adopted in November 2006 (Innsbruck: Permanent Secretariat of the Alpine Convention 2006). http://www.alpconv.org/en/convention/protocols/Documents/PopCult_en.pdf.

Programme.[14] This paper also looks at cooperation with the Austrian National Agency for the Immaterial Cultural Heritage of UNESCO and efforts in the field of education (certified course Forest and Culture at the Forest Education Centre Traunkirchen established in 2007).[15] Third, the paper examines the dissemination of knowledge and the dialogue between various stakeholders. Thus, the study is partly based on the outcomes of various local workshops and seminars that have taken place in different regions in Austria since 2003. These meetings link the representatives of scientific, policy and local stakeholders that form the Forest-Culture network. The overall goal is to disseminate information about the status of the presence or absence of traditional forest-related knowledge, to promote strategy implementation in practise, and to provide input to decision-makers in forest policy.[16] To compare the Austrian way with international developments, the results of international conferences dealing with the cultural heritage of forests and traditional knowledge have also been taken into consideration. The most important meetings concerning the socioeconomic values and traditional forest related knowledge were the IUFRO conferences '*Woodlands – Cultural Heritage*' 2004 Vienna, Austria[17], '*Cultural Heritage and Sustainable Forest Management: the Role of Traditional Knowledge*' 2006 Florence, Italy[18] and '*Woodland cultures in Time and Space. Tales from the past messages for the future*' 2007 Thessaloniki, Greece[19] Also, the outcomes of the *International*

14 Federal Ministry of Agriculture, Forestry, Environment and Water Management Department of Forestry (ed.), *The Austrian Forest Dialogue and the Austrian Forest Program* (Vienna: BMLFUW 2007).

15 Grieshofer, A., 'Überblick über den Gesamtlehrgang', in Bundesforschungs- und Ausbildungszentrum für Wald, Naturgefahren und Landschaft (ed.) *Handbuch Forst + Kultur* (Vienna: BFW 2007).

16 Johann, E., 'Treasures in the Forest. – Awareness Rising and Education in Austria', in Amoeda R., Lira, S., Pinheiro C. (eds) *Heritage 2014.* Proceedings of the 4th International Conference on Heritage and Sustainable Development Guimaraes, Portugal 22–25 July, 2 volumes (Barcelos: Green Lines Institute for Sustainable Development), pp 711–720.

17 Johann, E. (ed.), '*Woodlands – Cultural Heritage*'. *Proceedings of the International IUFRO – Conference Vienna*.) *News of Forest History* Nr. III (36/37) 2 volumes (Vienna: Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft 2005).

18 Parrotta, J., Agnoletti, M., Johann, E. (eds), *Cultural Heritage and Sustainable Forest Management: the Role of Traditional Knowledge,* Proceedings of the Conference 8–11 June 2006 Florence, Italy, 2 Vol. (Warszawa: MCPFE 2006).

19 Saratsi, E., Bürgi, M., Johann, E., Kirby, K., Moreno, D, Watkins, C. (eds), *Woodland cultures in Time and Space. Tales from the past messages for the future*. Conference proceedings (Athens: Embryo Publications 2009)

Conference on Heritage and Sustainable Development 2014 Guimaraes, Portugal,[20] *and* 2017 Granada, Spain, have been taken into account[21].

4. Building New Bridges

Although decades of forest history research have demonstrated the deep and profound interrelationships between people and forests, there is little awareness that cultural values are one of the most important issues in forestry. The underestimation of cultural values has often led to policies that pursue a concept of sustainability based on paradigms, such as the idea of achieving 'pristine nature' as a desirable goal, and ignore the fact that people often created higher diversity in nature. The main task of Resolution 3 is to promote and raise awareness about the social and cultural dimensions of SFM as an important asset for education, recreation, the environment, rural development and the economy. Thus, it encourages the maintenance and further development of both the material (e.g., timber, medicinal plants) and the non-material (e.g., knowledge, recreation, health) social and cultural aspects of SFM.[22]

Cultural values are reflected in landscapes; historical sites and monuments; artistic, traditional and linguistic knowledge; values; experience; and traditional practises related to forests and wood use, non-wood goods, and services (see figures 1, 2, 3 and 4). Although systematically developing these cultural and social aspects of forests is a new task for the Austrian forest authorities, the cultural and social dimensions of SFM have already been addressed in the following relevant policy platforms: the Austrian Forest Dialogue, the Austrian National Forest Programme, the Declaration on Population and Culture of the Alpine Convention, and the rural development programme.[23]

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20 Amoêda, R., Lira, S., Pinheiro C. (eds), *Heritage 2014.* Proceedings of the 4th International Conference on Heritage and Sustainable Development Guimaraes, Portugal 22–25 July, 2 volumes (Barcelos: Green Lines Institute for Sustainable Development 2014).

21 Amoêda, R., Lira, , S., Pinheiro, C., Santiago Zaragoza, , J. M., Serrano J.C., Garcia Carilio, F. (eds), *Heritage 2018.* Proceedings of the 6th International Conference on Heritage and Sustainable Development, Granada, Spain 12–15 June, 2 volumes. (Barcelos: Green Lines Institute for Sustainable Development 2018).

22 Ministerial Conference on the Protection of Forest in Europe, *Conference Proceedings 28–30 April 2003 Vienna, Austria* (Vienna: Ferdinand Berger & Söhne), pp. 209–210.

23 Grieshofer, A., 'Forest + Culture in Austria: Basic Principles, Objectives and Ongoing Projects', in Parrotta, J., Agnoletti, M., Johann, E., (eds), *Cultural Heritage and Sustainable Management: The Role of Traditional Knowledge* (Warszawa: MCPFE 2006).

Figure 3: *Ruins of the former glass furnace Neusoboth at 1314 m sea level, established in 1797. (Photo: E. Johann)*

Based on the framework conditions mentioned above, the Forest History working group of the Austrian Forest Association and the Federal Ministry of Sustainability and Tourism (the former Federal Ministry for Agriculture, Forest, Environment and Water Management) began to jointly establish the Austria-wide Forest-Culture Austria network in 2003. The Austrian Forest Association, with 4,000 members, is one of the most important voluntary interest groups in the country besides the Austrian Federation of Forest Owners' Associations. Forest-Culture Austria deals with the multiple interrelationships between forests, forest management and human society that have changed over the course of history. The network's goal is to gain knowledge related to cultural values as essential elements in biocultural diversity and national cultural heritage. Activities include public relations concerning cultural values as well as the implementation of educational programmes about the management of forest-relevant cultural values. The main goals of Forest-Culture Austria are (1) awareness raising, (2) networking, (3) increasing knowledge, and (4) education and training.

(1) Due to enduring forest management traditions, the forest is home to a rich cultural heritage. In recent years interest in safeguarding traditional

Figure 4: *Pollarded mountain ash in the southern mountains of Austria, 2007. The leaves are used as fodder for goats. (Photo: E. Johann)*

forest-related knowledge has increased remarkably in Austria. Interest in cultural heritage tourism is also increasing. Several support strategies offered by EU programmes concern rural revitalisation. The development of projects in rural areas to make heritage visible frequently concern forests, and therefore, forest owners should become involved.

(2) The Forest-Culture Austria network endeavours to build a platform for dialogue between various stakeholders. It intends to serve as a link between European-level commitments and SFM. Thus, it ties together several institutions and stakeholders focusing on sustainable forest and woodland

Figure 5: *Recalling forgotten heritage: the construction and driving of rafts on the upper Drau River. This traditional craft was inscribed on the Austrian national UNESCO heritage list in 2014. (Photo: E. Johann)*

management in a broad sense, such as forest enterprises, forest farmers, and many types of museums. Cooperation has been established with universities and other institutions working in the field of forestry and forest history within the country as part of the Network on Historical Use of Wood, the Environmental History Cluster Austria, the Working Party Forest History of the Austrian Forest Association, and the Forest and Culture Service Association, and abroad as part of the Forest History and Traditional Knowledge research unit of the IUFRO and the European Society of Environmental History. Strong input also comes from institutions and stakeholders not directly involved in forest management. The long-term goal is to establish partnerships in the fields of forest management, culture and tourism. As 85 per cent of Austrian forests are privately owned, landowners are important stakeholders. In this bottom-up process, cooperation within this network is voluntary.

(3) Knowledge concerning the social, economic and political conditions related to the origin and development of landscapes, the distribution of forests, and ownership structures contributes to understanding the ecological, economic and social features forming the basis for future planning and management. Actively exploring one's own history stimulates cultural identity and the relationship to the region. The Austrian National Forest Programme addresses awareness-raising measures related to historical forest experience as important tools for innovation in the field of forest policy. It focuses attention on the contribution of SFM to the cultural landscape and heritage and intends to bridge the presently existing gap between political and societal commitments on the global and European levels and grassroots stakeholders, who have to implement these agreements from which they can also benefit.[24] Cooperation between the Forest-Culture Network and the Austrian National Agency for UNESCO Intangible Cultural Heritage has developed fruitfully since 2006, particularly with regard to nominations for inscription on the national intangible heritage list. About 30 per cent of the nominations are related to traditional craftsmanship (e.g., charcoal burning, tanning, rafting) or knowledge and practices concerning nature and the universe (e.g., local healing knowledge, transhumance) (see figure 5).

(4) To disseminate knowledge about cultural heritage in 2007 a two-year certificate course on forest culture was established by the Federal Ministry of Sustainability and Tourism jointly with the Forest History working group of the Austrian Forest Association. Participants learn not only to recognise the artefacts and remnants of former forest use practices but also to incorporate aspects of forest-related cultural heritage into forest management and tourism activities. The curriculum revolves around issues in forest, environmental and hunting history, and participants examine questions such as the following: What do archaeology and the forest mean? How do people in charge of the conservation of historical monuments and visual artists think and work? How do regional museum networks work? How do I apply for a project grant?[25] Thus far, about 70 graduates have begun putting knowledge they acquired in this course into practice.

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24 Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW (ed.), *Österreichisches Waldprogramm* (Vienna: AV+Astoria Druckzentrum GmbH 2006), pp. 107–113.

25 Grieshofer, A., 'Überblick über den Gesamtlehrgang', in Bundesforschungs- und Ausbildungszentrum für Wald, Naturgefahren und Landschaft (ed.) *Handbuch Forst + Kultur* (Vienna: BFW 2007).

5. Best Practice

Many initiatives supporting and promoting cultural heritage have launched in Austria, and more are planned for the next few years. The Federal Ministry for Sustainability and Tourism is gradually building up the Forest-Culture network in close cooperation with the Austrian Forest Association and a large number of other partners. It currently includes around 500 institutions known as forest museums and forest-culture initiatives, which form an important base for disseminating forest-cultural knowledge. They often rely heavily on volunteers. The Forest-Culture network's work includes motivating such individuals and practical networking. With corresponding services and improved publicity, considerable synergy potentials can be achieved. Through cooperation between administrative, research and educational institutions, knowledge about the history of forest management has grown in importance. Particularly interesting networking possibilities are offered by the forestry advisory bodies and Forest-Culture related educational activities that have recently been promoted in Austria. Shortly after the Ministerial Conference on the Protection of Forests in Europe held in Vienna in 2003, the Forestry Section of the Ministry of Sustainability and Tourism launched several pilot projects based on forest sector plans to promote forest and culture at selected sites. These initiatives will continue in the next few years. As part of the Austrian Forest Dialogue the topic of forest and culture was discussed in detail, particularly its potential and examples of best practice. Appropriate measures were incorporated into the Austrian National Forest Programme.[26]

What does this mean in forestry practice? The Forest-Culture certificate course provides a comprehensive answer to this question and at the same time provides the tools for practical implementation. This educational programme is unique in Europe. Forest-cultural activities in rural areas are increasingly taking advantage of the forestry sector's cultural and tourism potential. The course offers the optimal prerequisites for acquiring adequate expertise. Several activities related to forest culture receive financial support from the government. In addition to practice-oriented educational work on topics that have mostly not been prioritised by forestry in recent decades,

26 Verein wald.zeit Österreich – Plattform für Waldkommunikation, 'Der Österreichische Walddialog', in *Wald in Österreich: Das Portal zu Wald und Holz*. (Wien: Verein wald.zeit Österreich 2015). http://www.wald-in-oesterreich.at/oewad/?context=CS%2310%231%23.

the sustainable use of the cultural landscape for tourism and the added value for the landowners and the partners involved have come to the foreground.[27]

Many heritage-based projects have been implemented so far, such as the reconstruction of an old forest road by a large forest enterprise as a fascinating attraction for visitors to a neighbouring national park, or the establishment of a forest museum where former harvesting and transportation methods are displayed. Other projects focus on educational trails or guided tours that bring the cultural landscape to life. Music and poetry events have also been held in the forest. Other initiatives are related to traditional craftmanship, such as charcoal burning, and thus offer an additional source of tourism income for farmers. The objective of the 'Old Space – New Life' project is the gradual revitalization of a historic wooden barn and its transformation into a cultural space. Another project studies the land tenure history of a mid-sized forest enterprise, the output of which was published recently. Areas that have been explored include forest history, archeology, art history and architecture, folklore, biology, botany and wood research. The 'On the Log Trail' project was implemented by a state-owned forest enterprise and is based on the excavation of an old forest road. In making the history of earlier use visible the enterprise has raised public awareness about the preservation of SFM over the centuries.

6. Discussion

Sustainable development requires reliable, lasting conditions for social systems. The interactions between top-down and bottom-up management must be well coordinated. Forestry is always local, intertemporal and multifunctional. Its task is to protect, care for and design the forest to preserve its versatile potential for future generations. According to Köpf, despite being tested in Europe, SFM is endangered today by a multitude of conflicting economic, social and political interests.[28]

For historical reasons, a significant number of forestry-related sites are located in Europe's rural areas. Developing them is a priority of both Austria and the European Union. Well-funded subsidy programmes aim at

27 Bundesministerium für Nachhaltigkeit und Tourismus Waldschutz, Waldentwicklung und forstliche Förderung (Abteilung III/4), *Österreichs Waldwirtschaft – Basis von Forst + Kultur* (Wien: BMNT 2018). https://www.bmnt.gv.at/forst/wald-gesellschaft/Forstkultur/forstkultur1.html.

28 Köpf, E.U., *Forstpolitik* (Stuttgart: Verlag Eugen Ulmer 2002), p. 286.

systematically strengthening authentic cultural initiatives and should be used meaningfully. Farmers play a traditional role in utilising and managing pastures, forests and alpine pastures as well as in the safeguarding of cultural heritage and traditional knowledge concerning nature and the environment. European commitments stemming from the Alpine Convention, the Convention on the Intangible Cultural Heritage, and Forest Europe address options for maintaining this knowledge. Migration and urbanisation, however, are important driving factors that have the potential to interrupt knowledge transmission from generation to generation.

In 2007 the papers presented on occasion of the conference *Woodland cultures in Time and Space. Tales from the past messages for the future* in Thessaloniki 2007 pointed out that different human relationships with the forest in times past call for different strategies for managing the cultural heritage of the forest for the future.[29] Various measures have been taken in European countries and ecoregions to integrate cultural values and traditional knowledge into management plans.[30]

In global comparison, alpine regions have problems in terms of wood production due to the higher cost of harvesting caused by topographical and climatic conditions. This fact leads to lower revenues despite high wood quality and consequently to the increasing abandonment of rural areas. But there are also great opportunities that should be taken advantage of: beautiful landscapes, environmental quality and high potential in terms of culture and heritage. At the European level, this problem has been recognised, and attempts have been made to counteract it, for example, through rural development programmes. Austria, with its particular way of implementing these international agreements on the national level, is doing something special because it not only analyses and quantitatively assesses the vestiges of former land use in forest areas, but has also initiated a bottom-up process that intends to motivate as many stakeholders as possible in order to fully make use of the forest's cultural and social potential. Such initiatives can only be successful through participation, awareness raising and motivation.

29 Saratsi, E., Bürgi, M., Johann, E., Kirby, K., Moreno, D, Watkins, C. (eds.), *Woodland cultures in Time and Space. Tales from the past messages for the future*. Conference proceedings (Athens: Embryo Publications 2009).

30 Ministerial Conference on the Protection of Forests in Europe, *Forestry and our Cultural Heritage*. Proceedings of the Seminar 13–15 June 2005 Sunne, Sweden (Warsaw: MCPFE 2005).

7. Conclusion

Cultural heritage is the result of environmental conditions and associated economic opportunities. As a source of vitality, dynamism and social development it can be the basis and the driving force of society. In the field of forestry, the advent of new technologies led to a loss of traditional knowledge. One reason for this is that since the eighteenth century, forestry's focus on fuel and energy has been so strong that all other forest products have been declared by-products and thus pushed aside. As a result, they have fallen into oblivion. This development was accelerated by the modern market and by the substitution of wood with plastic, which occurred in the 1950s at the latest. Intangible cultural heritage in the field of forestry is manifested in knowledge of old techniques used for handicrafts, production and transportation, in knowledge about the value of non-wood products such as medicinal plants, and in knowledge concerning nature and the environment. Several European-level agreements have been concluded to ensure that forests are managed sustainably, that is, that economic, ecological and sociocultural aspects of forest management are taken into account. The most important agreements are Forest Europe, the Landscape Convention, the Convention on the Preservation of Biological Diversity, the UNESCO Convention on the Intangible Cultural Heritage and the Alpine Convention. Although these agreements might be seen as a burden, they also provide opportunities for strengthening and diversifying forest farming and management. They also highlight the value of forests for various aspects of life. Thus, they contribute to improving public relations with the non-forest audience.

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Mapping and Preserving Cultural Heritage in Estonia: Best Practices in Presenting Cultural Heritage Sites in Estonia's State Forest

JÜRGEN KUSMIN
State Forest Management Centre, Forest Department

TRIIN KUSMIN
State Forest Management Centre, Visitor Management Department

Abstract: Valuing cultural heritage that does not receive national protection has gained broader attention in Estonia in the last decade. Landowners and local communities should focus on preserving this heritage. The public database produced as a result of nationwide mapping and information-dissemination work about the value of such sites and the possibility of preserving them under conventional forest management are the main measures for the voluntary preservation of cultural heritage. Due to ongoing urbanisation, people are becoming more alienated from nature and the monuments of past generations' life and work in the landscape. In the past, people lived amid cultural heritage; it was a natural part of the living environment. But now the traces of our ancestors' lives and activities are becoming tourist attractions. Cultural heritage sites add value to the landscape, link us to our history and roots, and add to a region's attractiveness.

Keywords: forested landscapes, cultural heritage, inventorying, forest management, forest use

1. Introduction

The aim of the article is to introduce anthropogenic landscape values – the example of cultural heritage inventory in Estonia. The article describes main types of the cultural heritage objects, the methodology of mapping and describing them as well as the principles of preserving these objects during forest management. The principles of maintenance and display of the cultural

heritage objects and the activities of the Estonian State Forest Management Centre regarding cultural heritage are also described.

The description and mapping of non-protected signs of human activity in the landscape, that is, cultural heritage sites, began in Estonia in the early 2000s.[1] Similar studies in the smaller scale can be found in other European countries.[2] At the initiative of the State Forest Management Centre and with support from international cooperation projects, more than 40,000 cultural heritage sites, which have been described independently of ownership and land use type, have been entered into a database in Estonia. The prepared public map layer is in the public domain and is a source of information for both landowners and those that plan various activities affecting the landscape (mainly state and local agencies and companies involved with planning).

As Estonia's forest cover has increased in the last 80 years (covering over 50 per cent of land area now), many signs of human activity that were previously found in the open landscape are now located on forested land.[3] Such sites are better preserved in forest landscapes. At the same time, logging is an important factor affecting their condition, and in order to ensure their survival in commercially managed forests, some basic principles must be considered. Modern harvesting operations are mainly carried out using heavy machinery (harvesters and forwarders), and as such, the risk of damaging cultural heritage is also greater. To avoid this, it is of key importance that

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2 Taivainen, J. *Metsiin kadonneet. Valtion metsien kulttuuriperintökohteiden inventointihanke 2010–2015*, (Metsähallitus, 2016); Ikauniece, S. *Ziemelvidzemes Ainavas. Noklusetie Stasti*, (Valsts Meža Diensts, 2011); Jacobsen, H., Follum, J.-R. *Kulturminner i Norge – Spor etter mennesker giennom 10 000 ar*, (Tun Forlag, 2008); Svensson, E., 'Cultural heritage of the forest and cultural heritage in the forest', in *Forestry and our Cultural Heritage. Proceedings of the seminar 13–15 June, Sweden 2005* (Warzaw: Liaison Unit, 2006), pp 106–110; Johann, E., Latorre, J. G., Klemm, S. *Kostbarkeiten im Wald – Kultur und Geschichte* (Vienna: Österreichischer Forstverein, Fachausschuss Forstgeschichte, 2014).

3 Tarang, L. et al 'Forest landscape cultural heritage inventory: an Estonian model', in Parrotta, J., Agnoletti, M., Johann, E. (eds.) *Cultural heritage and sustainable forest management: the role of traditional knowledge, Volume 1* (Warszawa: Ministerial Conference for the Protection of Forests in Europe, 2006), pp 270–284.

landowners know that such objects and sites exist on their land and are interested in preserving them and that forestry contractors know how to plan their work accordingly. The first risk factor is mitigated by the existence of the public database and the broader social awareness of the value of cultural heritage, and the latter, by appropriate guidelines and training activities. Estonian law covers the preservation of cultural heritage in only a single general point in the Rules of Forest Management that accompany the Forest Act. The National Forest Register has also been established to provide information about cultural heritage sites when registering a forest notification that permits felling in an area that overlaps with records entered into the database. Since 2017 onwards, forest owners have been able to submit an electronic application for a felling permit; if there are no problems, the permit is issued automatically.

2. The Main Types of Cultural Heritage Sites Found in the Forests of Estonia

The most common type of cultural heritage sites comprises human dwellings, such as old farmsteads, settlement farms, cottages, and forest guards' farms. The deportations following World War II and the proliferation of Soviet-era large-scale industrial and agricultural production resulted in tens of thousands of houses being left empty, especially in remote areas. As a rule, these sites are forested, but garden and fruit trees and the foundations of farm buildings and outbuildings can still be found.

Old place names are another vestige of cultural heritage in the landscape. Places or regions that have been named after an event, person, or a specific landscape feature, in particular, have received much attention. Old place names are a special type of cultural heritage objects – they are part of the intangible cultural heritage but still connected with a specific site in the landscape. If there is no clear anthropogenic trace in the landscape with a connection to the place name, these do not require special attention during logging.

The old road network has been better preserved in forested landscapes in the form of ancient forest and winter roads and bog bridges, some of which are still in use.

Many of the dry-stone fences that bounded fields in previous times have also been overgrown by forests. In more rocky areas, dry-stone fences were also built along roads. (Figure 1)

Figure 1: *A dry-stone fence that used to mark the border of a farm*

Lime and tar kilns and charcoal-burning pits are sites directly related to forest use and were built in areas with higher forest cover throughout history. (Figure 2) As a rule, limestone quarries can be found near lime kilns. Today, former peat cutting sites and clay extraction pits used by the brick industry have been swallowed by the forest and melted into the surrounding landscape.

Separate facilities built away from farm buildings, such as windmills, hay barns, cellars, pasture wells, and flax-retting pits, have also disappeared into the forest.

Military structures are also concealed under the cover of forests: trenches and communication trenches from World War I and II, the bunkers of the Forest Brothers (Estonian partisans who waged a guerrilla war against the Soviet occupation), and military buildings from the occupation period.

Figure 2: A lime kiln

Figure 3: A border stone between manors

Small objects with deep meaning make up another type of cultural heritage: ancient trees, cross-trees related to funeral customs, memorial stones, marked burial places, and border and geodetic markers. (Figure 3)

The most common types of forestry-related cultural heritage sites are resin-tapped pine forests and old forest nursery sites. Quite a significant number of structures connected to hunting, such as feeding stations for wild animals, trapping pits, and hunting towers, have also survived in forests.

The forest, as a location containing various traces of human activity and as a natural environment, often includes remnants of heritage communities, that is, semi-natural communities that have been an integral part of both Estonia's landscape and its rural culture for centuries. Modern private forests have largely come into existence because forests have encroached on former wooded meadows and pastures. A forest stand far from a uniform large stand of forest but near an old manor house is most likely a park that has grown into a forest.

3. Methods and the Process of Mapping Cultural Heritage

Before the mapping of cultural heritage began in the early 2000s, the only resource that described cultural values found in forests was the national register of cultural monuments, which contains important immovable and movable monuments protected under the Heritage Conservation Act. Half a century of Soviet power, during which no private property existed, resulted in an intergenerational gap in land ownership and the values that go along with it, including cultural ones. The property reform that began after Estonia regained independence returned land to the descendants of former owners. At the same time the real estate market was born. New landowners were unable to obtain information on the non-protected cultural structures and sites on their land.

Until recently, Estonia's forest cover had been growing steadily, especially at the expense of farmland, much of it abandoned. That is why in today's woodlands we can still see many signs of human activity from different historical periods. While agricultural intensification and technological progress led to the eradication of dry-stone walls and old farmsteads from agricultural land decades ago, in forestry, more intensive felling activities and a sharp increase in use of heavy machinery to harvest trees are trends that have developed over the past few decades in Estonia. Cultural heritage sites in forests

are potentially threatened by felling activities. The main problem here is that contractors lack information about the existence of cultural heritage features and lack the skills to identify what is found during their work.

At the beginning of this century, forest-certification programmes (FSC and PEFC) also reached Estonia. When forest owners apply for either certificate, it is important that they also take measures to preserve cultural values.

Ethnological research has been conducted throughout Estonia for more than 150 years, including on sites found in the landscape. The Estonian Literary Museum has more than 1.5 million pages of different ethnological materials. In the seventeenth century, foreign conquerors – the Germans, Swedes, and Russians – began producing very good maps of Estonia that provide great help in locating and dating various cultural heritage sites and objects. Half a century of Soviet occupation in the second half of the twentieth century was short enough that a multitude of folk traditions from earlier times and landscapes could be preserved in peoples' memories. The above facts were sufficient arguments for finding a modern information technology solution that would combine different sources (oral and written folklore, historical maps, and fieldwork) as spatial data into a single database that would be publicly available for the benefit of both the landowner and the local community, as well as for making landscape planning decisions with wider effects.[4]

A methodology for inventorying cultural heritage was first developed by Lembitu Tarang and Rein Kaljuvee.[5] It was tested and supplemented in 2002–05, and in 2005–12 a nationwide survey (excluding cities) led by the State Forest Management Centre (under project manager Vaike Pommer) was carried out without regard to land ownership and land use type. The European Union funded the project, whose partners included similar forestry organisations from Finland and Latvia. The survey in Estonia was carried out by local governments (160) and was always organised by a person of local origin with an interest in history who knew the landscape. Mappers were trained to follow a common methodology and were supplied with previously collected data from the area and technical tools for mapping. Their task was to present the project and its progress to the local government and stakeholders and to regularly report to the project manager on their progress.

4 *Database of cultural heritage*. https://xgis.maaamet.ee/xgis2/page/app/parandkultuur.

5 Tarang, L. et al. *Väike pärandkultuuri käsiraamat*, (Tartu: Eesti Loodusfoto, 2007).

The mapping process is divided into three stages. In the first stage, materials about the area under investigation are gathered, and the locations of possible cultural heritage sites are marked on the map. This is done by reading literature, examining historical maps, and interviewing natives.

In the next stage, the selected sites are visited in the field. The exact location of each site is determined, and its dimensions, condition, and other features are recorded. All sites are photographed.

In the third step, the collected data, including the ethnological data, is entered into a digital database and linked to the map object and photograph. To date, more than 38,000 sites have been described in the cultural heritage database (Table 1); each year about 500 new sites are added, and the same amount of additions are made to existing ones.

Table 1: *The most common cultural heritage sites on the main land use types*

Site type / land use type	Forest land	Natural grassland	Residential land	Other land use types	Total
Old farmsteads	2,225	1,791	1,677	1,133	6,025
Old place names	1,267	367	167	845	2,602
Forest guards' farms	295	208	929	144	1,476
Manor architecture	337	234	799	194	1,470
School buildings	138	159	837	395	1,228
Windmills	286	419	185	570	1,191
Cultural heritage from Soviet times	146	334	277	361	1,026
Settlement farms	380	272	213	160	957
Houses of cottagers	357	330	163	221	918
Watermills	211	150	293	3,407	807
Other (143 types)	8,957	3,918	4,850	3,254	20,979

4. Taking Cultural Heritage into Account When Planning Forestry Work and The Main Techniques for Preserving Cultural Heritage during Logging Operations

In 2015–16 the methods of preserving cultural heritage applied during felling operations were studied in the forests of Lääne and Rapla counties, and a guide was prepared based on the collected data.[6] The guidelines issued by the Swedish Forest Agency in 2002 were used as a basis for drawing up our guide.[7] In the following, we describe the techniques that can be used during felling to preserve the main types of cultural heritage sites that are common in Estonia (Figure 4).

Several activities precede felling operations: applying for a forest notification, planning routes for machinery, coordinating activities with the owners of neighbouring properties, and, of course, marking the borders of the logging area. This last activity should be performed alongside the marking of cultural heritage features in the harvesting area. Marking paint used in forestry is suitable for this as the paint is slowly destroyed by weather conditions, and thus it will not remain an eyesore for years to come. Comments should also be included in writing on the map of the worksite and explained directly to the actual workers. If cutting rights are transferred, the owner of the forest can set conditions in the transfer deed, for example, 'to preserve access to the forest with light vehicles on the road going through the plot', 'to make the collection roads parallel to the stacked stone fence on the plot and to avoid going over the stacked stone fence with heavy machinery', or 'to preserve the garden and fruit trees of the old farmstead'.

Since all types of logging essentially involve the removal of trees, either all at once or selectively, either by machine or by hand, there is no reason to distinguish between management methods based on logging. Instead management efforts should focus on the types of objects most commonly found in forest landscapes. Of course, suggestions can only be given for objects of which noticeable traces have remained in the land, and work must be carried out within the bounds of existing laws and regulations; for example, the maintenance of a cultural heritage site cannot involve thinning the forest below the minimum density requirements. As a general rule, logging waste

6 Kusmin, J. *Pärandkultuur ja metsamajandus*, (Tallinn: Erametsakeskus, 2016).

7 Hill, Ö. *Skogens kulturarv – hänsyn och skötsel*, (Skogforsk, 2002).

Figure 4: An overview of the techniques used for preserving cultural heritage during forestry operations

1. The foundation that has remained from the farmstead has been cleared of thin brush; ancient trees and fruit trees have been preserved; and forest trees have not been planted in the yard.
2. A roadside cross-tree has been left as an old crop tree (connected to funeral ceremonies in Southern Estonia).
3. A logging trail has been constructed parallel to the dry-stone wall, and a bed of branches has been set up at the crossing.
4. There is a gap in the row of branches where the ancient road crosses the logging trail.
5. A burial place has been marked with a group of old crop trees for locating it after felling.
6. The foundation of the building was cleared during the maintenance of the young forest stand or forest crop.
7. A buffer zone of old crop trees has been left around the spring.
8. Combat trenches were preserved during ground preparations.
9. All the trees and scrub have been cut from the lime kiln to prevent damage from tree roots.

should not be stored on cultural heritage sites, and logging trails should not be planned over them. At present, regeneration cutting is predominantly carried out with machinery. On the one hand, it is difficult to work with large machinery near cultural heritage sites in danger of collapsing; on the other hand, harvesters can cut down trees and move them without damaging sites. The best result is achieved with a combined approach, where, in addition to work done with machinery, a logger first removes the finer brush from the site and later cuts tall stumps.

In the case of reforestation, the main rule is that the preparation of the ground with a disc trencher must not damage cultural heritage structures, such as stacked stone fences or preserved stone masonry. This ties in with the suggestion to leave a buffer zone around cultural heritage sites when establishing a forest. Planting in the yards of old farmsteads and on ancient forest roads must be avoided. When workers are conducting crop maintenance and cleaning cutting areas with string trimmers or brush cutters, they should clear the area around cultural heritage sites as well.

The use of ancient forest roads for transporting timber is understandable and unavoidable. There are generally two ways of preserving these roads: either by filling wet sections in with branches collected from the cutting area or by later levelling ruts with an excavator. At first glance, using branches for fill may seem like a cheaper and easier solution, but it can cause problems in the future because the branches will be pushed deep into the soil and the ends sticking out will make the road impassable to light vehicles during dry weather. For the same reason, rows formed from stacking left-over branches must have a gap in places where they intersect with roads. Forward-looking forest owners will not plant trees on such roads during forest regeneration to guarantee access to their and their neighbours' forests in the future and to preserve ancient roads.

If stacked stone fences are located at the felling site, logging trails should be built parallel to such fences if possible, and certain places should be designated for crossing them and secured with a bed of branches. All trees and scrub should be cut from the fence, except for ancient trees. The biggest enemy of all stone masonry is the root system of trees. If a stacked stone fence is located on the border between open land and forest, maintaining a hedgerow near the fence would be worthwhile; this buffer zone has nature conservation and landscaping effects.

Ancient trees (including cross-trees) of cultural value should be allowed to die a natural death. Therefore, during felling, such trees are preserved along with a buffer, if necessary. Changes in light conditions do not have

as large an impact on trees growing in the canopy layer as they do on those located in the shade. To preserve the viability of the latter, logging should be carried out in stages over the course of several years.

Although in general the existence of cultural heritage sites in a forest does not prevent its management as the forest owner's awareness and attentive attitude are usually enough for preserving cultural heritage, if **remarkable historical forest stands** (related to a historical person or event) occur there is reason for more serious consideration. In the absence of nature conservation and planning constraints, a stand that is a cultural heritage site can be managed like any other commercial forest stand. However, when a stand is declared a cultural heritage site, the owner's private interest in the stand becomes to a small extent shared with the public. Therefore, it is recommended to put some effort into mapping the interests of stakeholders before starting to manage such forests.

Less intensive felling that occurs more frequently is usually suitable for forest areas of cultural-historical value. Here, too, the aim of improvement cutting is to ensure the health of the stand and to shape the future stand. There is more reason than usual to pay special attention to the quality of logging operations to ensure the stability of the stand and to try to highlight the aspects that make it special. Of course, much depends on the condition of the stand and its location, but ideally a forest section that is a cultural heritage site should be visually distinct from the rest of the forest. Theoretically, the most suitable type of regeneration cutting for a forest stand that is a cultural heritage site is shelterwood cutting because this method ensures that old forest generation is not taken down all at once and also ensures continuity of the stand. Unfortunately, shelterwood cutting is only suitable from a silvicultural perspective for a small number of tree species that occur in Estonia (mainly pine) and in a limited number of habitats (drier and less fertile).

When it comes to clear-cutting, it is advisable to clear-cut larger (approx. from 2 ha) forest stands that are cultural heritage sites in sections and to leave individual old crop trees and seed trees or groups of these as a reminder of the old stand. In order to preserve cultural history after clear-cutting, the best solution would be to establish new forest generation through volunteer events.

Before cutting down a remarkable forest stand, documenting it in detail should be considered, whether in the form of a forest management document, photos, or a drone video. When one stands at the edge of the cutting area after clear-cutting, the irreversibility of the change that has taken place really sinks in.

Natural springs related to old stories are also important natural features, and established practices must be followed with these. A buffer zone a few metres in radius must be left around a spring; it should be wider in the direction of discharge.

Farmyards should also be treated respectfully during logging operations. It is essential to avoid damaging preserved parts of buildings; felling preserved yard, fruit, and ornamental trees; and spreading logging waste in the yard. Brush control is also important, for example, when false spirea, damson, or lilac are encroaching on such sites. The most viable valuable broadleaved trees should also be kept so that yard tree species are not be lost.

Cellars should be cleared of growth as trees destroy the cellar vaults, often only as the result of gravity. For safety reasons, open wells should be covered during work. Smaller wells should be topped with a hard plate made of a material that does not rot, and for large wells it is worth considering restoring simple well casings and tops.

Individual buildings and facilities deserve special attention. These include all cultural heritage sites with a diameter of up to ten metres: lime kilns, bunkers of the Forest Brothers, burial places and memorials, burial mounds, historical border markers, flax-retting pits, and others. It is recommended to cut all the trees from such sites. If the area is clear-cut, leaving a crop tree or a group of such trees near the site will help identify it in the young forest stand in the future. Swedish instructional materials also suggest leaving a stump the height of a person. High stumps, however, are not visually pleasing and will soon be covered by young forest stands.

At sacred natural sites, forestry work is forbidden for ethical reasons. Although it is easy to leave a buffer zone around a single tree or stone that is considered a sacred site, defining the extent of a sacred grove is more difficult. Where necessary, experts should be involved, and decisions should be based on local natural conditions, especially the existence of ancient trees.

Forests that have emerged as a result of forests encroaching on heritage communities are found mostly in northern and western Estonia and on the islands. This type of forest can be managed by conventional forest management techniques, but management leading to the restoration of a wooded meadow may also be considered for creating greater ecological yet less economic value. Only a century ago, wooded meadows covered one-fifth of Estonia, so it would be a very gratifying job to preserve this ancient landscape element that was typical of the land. Wooded meadows are visually appealing, so it would be a good idea to start restoring them in the proximity of human settlements and roads. After a wooded meadow has been restored it needs to

be maintained annually by mowing or grazing, otherwise trees will encroach on the area again. Thus, the capacity to maintain such a meadow is also a key consideration when conducting restoration work.

Restoration work is the most appropriate management measure for afforested parks. This work requires more in-depth preparation, specific knowledge, and skills, and it makes little sense if the park is not maintained in the future. If there is no plan to restore an afforested park, then deciduous trees and alien tree species should be preserved as much as possible when carrying out logging operations.

5. Cultural Heritage's Added Value to the Landowner: Maintaining and Exhibiting Sites

Whether or not to make cultural heritage sites accessible to the public is the personal choice of the landowner. If the decision is made to present a cultural heritage site to others, the site needs to be constantly maintained: the access path and area surrounding the site should be mown a few times a year. If the site is located near a road or there are other points of interest in the area, the landowner might also consider erecting a road sign with the name of the site (for example, 'Aru Farm's lime kiln') or an information board and signposts. Experience from Estonia has shown that sites marked in such a way do not become mass tourism attractions, and landowner concerns that opening sites up to the public will result in littering are unfounded. Consent must be received from landowners (preferably in writing) whose lands must be crossed to reach a site from a public road. It is also worthwhile to inform professionals, local museums and local governments, and other interest groups who are engaged in researching and presenting the history of the region more widely (people studying local history and guides) about the site, whether it is restored or in need of restoration, and allow it to be used in information material.

6. The Visitor Management Department of the State Forest Management Centre and Presenting Cultural Heritage

In addition to documenting cultural heritage sites, the State Forest Management Centre (RMK) has also committed itself to preserving forestry-related cultural heritage and presenting it to the wider public through visitor management methods. The task of the RMK's Visitor Management Department is to organise sustainable recreational use of nature in state forests and protected areas that respects the limits of nature and does not harm biodiversity. Since 2004, cultural heritage sites located at the RMK's recreational areas and the folklore associated with these sites have been investigated more thoroughly. The acquired data has been used for informing visitors and for nature study activities.

The cultural heritage database is a valuable first source for further research. For example, the 100th anniversary of the Republic of Estonia was celebrated with the opening of a network of 1,800 km of hiking trails across Estonia. To commemorate this event, 100 stories were posted along the trails. These stories have shaped people's well-being at state, community and individual level. Every story is related to a specific year in the one-hundred-year history of the Republic of Estonia. Visible traces of some of these stories remain in the land for hikers to see, while others are preserved only in memory and knowledge. In addition to providing hikers with experiences, these stories that have now been recorded on information boards help to celebrate the importance and role of Estonia's forests in its cultural history. The source of many of these stories was the cultural heritage database.[8]

RMK's information points and visitor centres provide information about spending time in nature. They also contribute to improving people's knowledge about nature and forests. Exciting nature study programmes and practical activities are offered for children, young people, and adults alike. In 2017, 2,667 nature study programmes were carried out in the RMK's 15 visitor centres and the Sagadi Nature School with a total of over 52,000 participants. Knowledge of local cultural heritage helps to make recreational information materials, expositions, and the activities of nature centres more attractive for visitors. This is the reason that heritage sites that are close to the RMK's recreational areas, protected areas, and visitor centres have been more thoroughly

8 *One hundred stories described along the hiking route*. https://rmk100.ee/100-stories.

investigated. In addition to mapping and evaluating cultural heritage sites, oral heritage, historical photographs and written materials have also been collected from people. Former foresters and older locals have been interviewed about the forest, forest work, and forestry traditions and practices. Information gathered on cultural heritage is valuable additional information that can be used for creating new nature trails and routes as well as for upgrading existing ones. If necessary, actions are taken to either maintain the condition of cultural heritage sites or to restore them.

7. RMK's Oandu Visitor Centre: A Cultural Heritage Demonstration Site

RMK's Oandu Visitor Centre is located in Lahemaa National Park in Haljala Parish, Lääne-Viru County, northern Estonia. Oandu Visitor Centre has excellent prerequisites for introducing cultural heritage. The visitor centre is housed in a historic building built in 1860 for the head forester of the former estate. The forest centre's building was home to a forest district for nearly 140 years. This has certainly contributed to the abundance of interesting signs of forest history in the area – an abundance of introduced tree species, various experimental forestry areas, and resin-collection areas in the forests. Oandu is surrounded by large tracts of state forests, and thanks to continuous long-term forest management, Oandu's forests are rich in forestry-related cultural heritage sites.

When people who had worked in the former forest district were interviewed as part of a local cultural heritage study, it was discovered that a cone-drying facility had been in one part of an old barn. One room in the building was for the cone drier, and two women worked there throughout the winter drying and shelling cones. The old barn belonging to the current visitor centre was renamed the Cone House, and an exhibition presenting the drying of cones and reforestation was placed there. Besides the creation of the exposition, an environmental education programme titled 'How the seed gave a tree', which presents traditional working methods such as collecting cones and planting forest from seed, was established. A large part of the visitor centre's exposition is related to forest cultural heritage – the main building houses 'The Story of the Forest District', an interactive exposition that presents the history of the forest district through the ages. An exhibition connected to cultural heritage called 'Trees and People' is located in the hay-barn, and a study programme with the same name also exists. In the 1920s

Figure 5: Cultural heritage study programme at Oandu Nature Centre

and 1930s, several temporary sawmills operated around Oandu. As proof that there is still much to discover about cultural heritage in areas that have already been studied, the foundation of one of these provisional sawmills was discovered next to an existing RMK hiking trail. There are plans to open an exhibition about historic sawmills to visitors in the future.

Cultural heritage sites near Oandu Visitor Centre have been marked with information boards resembling old block posts. Marked cultural heritage sites are used in the daily work of the nature centre – as part of various educational programmes, a 3.5-kilometre trail of Oandu's cultural heritage is completed with a guide (Figure 5). The trail largely follows one cultural heritage feature – a 9.5-kilometre-long network of stacked stone fences located in Oandu's forests. Several forestry sites, such as an old forest nursery, a cage trap for wolves, a resin-collection area, and a test stand established in 1939 can be seen during the excursion.

Cultural heritage has become the central theme of all activities organised by the Oandu Visitor Centre. This theme helps link environmental education with forestry traditions, local history, and the people who lived and worked here. As the visitor centre is in Lahemaa National Park and the centre also houses an information point presenting the national park's natural and cultural heritage, the thematic exhibitions, trails, and cultural heritage sites

marked with information boards play an important role in presenting the work and cultural heritage of our ancestors to both domestic and foreign tourists. The information boards presenting cultural heritage on the trails are available in both Estonian and English, which allows visitors to explore them using a map. In 2018, nearly 13,000 people visited Oandu. Involving cultural heritage in visitor management helps introduce a special area to visitors and highlight its specific features.

8. Summary

The objects of cultural heritage should be taken into account in all the activities that affect the landscape. In Estonian case the biggest factor affecting the cultural heritage in the landscape is forest management. For preserving cultural heritage objects it is important that landowners know that such sites exist on their land and are interested in safeguarding them. To ensure the preservation of the cultural heritage objects by spreading the information, they have been described in the public digital database and recommendations for maintaining the objects have been prepared. Cultural heritage also plays an important role in the nature education and enriches the opportunities for recreation.

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The Mediterranean Forest as a Resource in the Eleventh–Fourteenth Centuries: Mapping Medieval Catalan Forests

MARIA SOLER-SALA, MARTA SANCHO I PLANAS,
ROSA LLUCH-BRAMON, University of Barcelona

Abstract The paper highlights the importance of forest exploitation in Catalonia during the medieval times. An interdisciplinary approach is essential considering that written sources are very limited. Accurate archaeological data available can help to fill in the gaps where textual sources remain silent. Medieval iconography is another source because it depicts a variety of objects and products made from forest resources, many of which are still used in rural areas today. The methodological framework includes document analysis, cartographic and toponymic work, archaeological data, and a comparison with ethnologic and iconographic data together with georeferenced data. The result proves a variety of activities, which exploited forest resources and reveal the existence of a certain balance with farming and livestock breeding. Our GIS study of medieval forests in Catalonia aims to fill the information gaps of written sources and to assess the economic role of woodland spaces in the Middle Ages.

Keywords: Forest exploitation, medieval territory, medieval rural production, rural economy, High Middle Ages

1. Introduction: The State of the Art

Research on the uses of forestland in the Middle Ages is admittedly scarce. Several researchers have emphasised the importance of such studies while lamenting not being able to delve deeper into the subject due to the lack of information provided by written sources.[1] Notwithstanding the foregoing,

1 Guilaine, J. (dir.), *Pour Une Archéologie Agraire; a La Croisée Des Sciences de l'homme et de La Nature,* (Paris: Armand Colin, 1991); Clemente, J. (ed.), *El Medio Natural En La España Medieval,* (Cáceres: Universidad de Extremadura, 2001).

several works have been produced based on the limited data that can be extracted from textual sources.[2]

The 'Settimane di Studi del Centro Italiano di Studi sull'Alto Medioevo' Study Week, held in Spoleto, Italy, in 1990, focused on '*l'ambiente vegetale nell'alto medioevo*'. Its proceedings included papers on archaeology, climate, and the exploitation of forest resources.[3]

The proceedings of the '1er Congreso sobre ecohistoria e historia medieval' demonstrate efforts to 'make texts speak'[4]. However, they also evince the lack of specialization in this historiographic approach in Spain and the need for new methodological frameworks capable of producing unprecedented insights into the interactions between medieval society and its environment.

Archaeology and landscape-history studies focus on issues such as the distribution and organisation of territories in relation to resource exploitation, applied techniques, the perception of the environment, and resource optimisation.[5]

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2 Amouric, H. 'Practiques et Usages de La Forêt Provençale Au Moyen Age', in *Actes Del 1er i 2on Curs d'Arqueologia d'Andorra,* (Andorra: Patrimoni Artístic Nacional, 1990), pp. 77–89; Bonhote, J., Vernet, J. 'La Mémoire Des Charbonnières. Essai de Reconstitution Des Milieux Forestiers Dans Una Vallée Marué Par La Métallurgie', *Revue Forestière Française*, **40** (1988): 197–210; Higounet, C. 'Les Forêts de l'Europe Occidentale de V a XI Siècles', in *Agricoltura e Mondo Rurale in Occidente Nell'alto Medioevo,* (Spoleto, 1966); Wickham, Ch. 'European Forest in the Early Middle Ages: Landscape and Land Clearance', in *L'ambiente Vegetale Nell'alto Medioevo,* (Spoleto: Fondazione Centro italiano di studi sull'alto medioevo, 1990).

3 N.N. *L'ambiente vegetale nell'alto Medioevo,* (Spoleto: Centro Italiano di Studi sull'Alto Medioevo, 1990); Wickham, Ch. 'European Forest in the Early Middle Ages: Landscape and Land Clearance', in *L'ambiente Vegetale Nell'alto Medioevo,* (Spoleto: Fondazione Centro italiano di studi sull'alto medioevo, 1990); Nöel, R. 'Pour Une Archéologie de La Nature Dans Le Nord de La France', in *L'ambiente vegetale nell'alto Medioevo,* (Spoleto: Centro Italiano di Studi sull'Alto Medioevo, 1990), pp. 763–821.

4 Clemente, J. (ed.), *El Medio Natural En La España Medieval,* (Cáceres: Universidad de Extremadura, 2001).

5 Bolòs, J. 'Anàlisi pol·línica i Història Medieval. Aportació al coneixement del paisatge pirinenc durant l'Edat Mitjana', *Quaderns d'Estudis Medievals* **10** (1982): 635–38; Camiade, M., Fontaine, D. 'Appropriation et Exploitation Du Milieu Forestier Dans La Montagne de l'Albera: Le Cas de La Verriere Du Mas d'en Bonet Du Vilar de 1538 à 1666', in A. Catafau (ed.), *Les Ressources Naturelles Des Pyrénées Du Moyen Âge à l'Èpoque Moderne. 2*, (Font-Romeu: Presses Universitaires de Perpignan, 2005), pp. 373–422; Davasse, A., Galop, B. 'Le Charbon de Bois et Le Pollen: Elements Pour Une Approche a de l'evolution Historique Du Paysage Forestier Des Pyrenées Ariégeoise', *Actes Du Colloque Ecosystemes d'altitude,* (Pau: Centre pyrénéen de biologie et anthropologie des montagnes, 1990); Rendu, Ch., Campmajor, P., Davasse, B., Galop, D. 'Habitat, Environement et Systemes Pastoraux En Montagne: Acquis et Perspectives de Recherches a Partir de l'étude Du Territoire d'Enveig', in *X Col.loqui Internacional d'Arqueologia de Puigcerdà,* (Puigcerdà, 1994); Riera, S., Esteban, A. 'Vegetation

Comparison with ethnological (ethnoarchaeological) and iconographical studies allows us to establish continuities and to understand the traces of the past fossilised in the landscape.[6] Moreover, paleoenvironmental findings can be examined against data derived from other sources, which reveal the advance or decline of certain economic activities and the evolution of the landscape.

Important ethnological contributions to this area of study have been made by Ramon Violant i Simorra (1949)[7] and Julio Caro Baroja (1983)[8]. Both scholars highlighted the relationship between the Middle Ages and traditional economic activities, and their work served as the basis for more recent studies by authors such as J. L. Mingote[9] and for the elaboration of the IPEC (Inventari del Patrimoni Etnològic de Catalunya).

Finally, iconography provides data related to material culture that has disappeared from the archaeological record. The contribution of this type of source, while modest, is a reminder of its possibilities.

Recently, there has been a resurgence of interest in studies on the exploitation of forest resources, perhaps because of the need to find viable alternatives to the synthetic materials that are causing so many environmental problems. For instance, the 'XXXIIIes Journées internationales d'histoire et d'archéologie d'Antibes' event (2012) was devoted to the tools used in working with plant materials.[10]

At the international meeting Wood and Charcoal: Approaches from

History and Human Activity during the Last 6.000 Years on the Central Catalan Coast', *Vegetation History and Archaeobotany,* (Berlin: Springer-Verlag, 1994), pp. 7–23.

6 Riera, S., Wansard, G., Julià, R. '2000-Year Environmental History of a Karstic Lake in the Mediterranean Pre-Pyrenees: The Estanya Lakes (Spain)', *Catena* **55** (2004): 293–324; Palet, J.M., Ejarque, A., Miras, Y., Riera, S., Euba, I., Orengo, H. 'Formas de paisaje de montaña y ocupación del territorio en los Pirineos orientales en época romana: estudios pluridisciplinares en el valle del Madriu-Perafita-Claror (Andorra) y en la Sierra del Cadí (Cataluña)', *Bollettino Di Archeologia On-Line. Proceedings of the XVII International Congress of Classical Archaeology Speciale,* (2011), pp. 67–79.

7 Violant i Simorra, R. *El Pirineo Español. Vida, usos y constumbres,* (Madrid: Plus Ultra, 1949).

8 Caro Baroja, J. *Tecnología Popular Española,* (Madrid: Editora Nacional, 1983).

9 Mingote Calderon, J.L. *Tecnología Agrícola Medieval En España,* (Madrid: Ministerio de Agricultura, Pesca y Alimentación, 1996).

10 Burri, S., Durand, A., Vaschalde. C. 'Les Outils Pour Acquérir et Transformer La Matière Ligneuse Dans Les Chaînes Opératoires Techniques Des Artisanats Forestiers En Provence et Haut-Dauphiné Au Moyen Âge', in *Regards Croisés Sur Les Outils Liés Au Travail Des Végétaux: Actes Des Rencontres 23–25 Octobre 2012,* (Antibes: APDCA, 2013), pp. 397–414.

Archaeology, Archaeobotany, Ethnography and History held in Braga, Portugual, in 2016, Aline Durand, in her paper 'Wood and Forest during the Middle Ages: Interweaving of Diverse Sources', proposed using diverse sources to study the exploitation of forestland in the Middle Ages.[11]

2. Our Approach: Objectives and Methodology

Our methodological approach is based on a dialogue between different sources. For example, in some cases, medieval texts hint at specific activities for which archaeology and landscape studies provide evidence in the form of data on the presence of objects and materials related to these activities or in the form of the fossilised traces of these activities in the landscape. On other occasions, iconography depicts scenes full of spaces, objects, and attitudes from which we can infer the existence of hitherto poorly documented economic activities.

These materials, which are difficult to systematise due to their diversity, contain a wealth of knowledge that is sometimes dispersed, but of great value, and which allows us to understand, identify, and interpret the living conditions of our medieval ancestors in greater depth. In our research we try to find evidence that is backed by at least two types of sources, and we use data from ethnological studies to corroborate or reinforce data from historical sources.

In addition, the fact that the information provided by this wide range of sources can be linked to specific places makes it possible to georeference and represent it through a Geographic Information System (GIS), which allows us to map the data (Mauri 2006). The resulting maps constitute elaborate sources that help us interpret the historical importance of forests based on a holistic landscape perspective.

Catalonia is characterised by a Mediterranean climate and features rather rugged relief with altitudes ranging from sea level to almost 4,000 metres in the Pyrenees within an area of less than 32,000 km^2. Catalan landscapes were densely populated in the medieval era, when there was a significant number

11 The proceedings of this meeting are not available; only the abstract-book can be accessed; see *Wood and Charcoal. Approaches from Archaeology, Archaeobotany, Ethnography and History International Meeting.* https://archwoodcharcoal.files.wordpress.com/2016/04/abstract-book-complete.pdf (accessed 18 Feb. 2019).

of high-altitude settlements located halfway between mountain valleys and peaks.

Therefore, we put forward this paper as an open window into time and space and as an examination of a sampling of activities from which we intend to deduce a model of resource exploitation that can serve as a comparative case study for other situations. At the same time, we are testing a methodology capable of overcoming the silence of documentary sources and the scarcity of archaeological data suitable for studying production activities centred on the use of wildland vegetation.

3. Uses and Exploitation of Forest Resources in the Middle Ages

In the Middle Ages the greatest amount of plant resources was consumed as firewood. Good management strategies advised against using certain types or sizes of firewood unless it was necessary. In the Middle Ages charcoal was only used for iron and steel production, and large logs and high-quality firewood were reserved for industries that required high temperatures. Firewood was used for heating, cooking, and lighting in domestic settings, and wood in the form of charcoal fuelled the production of iron, steel, ceramics, glass, lime, and gypsum, and all other activities in which heat was needed to transform certain materials.[12]

Large amounts of timber were required for the construction of buildings

12 *Codex Granatensis. Siglo XIV*, (Granada: Repositorio Institucional de la Universidad de Granada, 1400). http://hdl.handle.net/10481/6525 (accessed 18 Feb. 2019); Bonhote, J., Davasse, B., Dubois, C., Izard, V., Métailié, J.P. 'Charcoal Kilns and Environmental History in the Eastern Pyrenees (France). A Methodological Approach', in *Charcoal Analysis. Methodological Approaches, Palaeoecological Results and Wood Uses. Procedings to the Second International Meeting of Anthracology*, (Oxford: Archaeopress, 2002), 220–221; Euba, I. 'La Vegetación Leñosa y El Uso de La Madera En Tres Valles de Los Pirineos Orientales Desde El Neolítico Hasta Época Moderna: Análisis Antracológico, Dendrológico y Tafonómico', *Pyrenae: Revista de Prehistoria i Antiguitat de La Mediterrània Occidental* **40** (2) (2009), 26–27; Pèlachs, A. *Deu mil anys de geohistòria ambiental al Pirineu central català. Aplicació de tècniques paleogeogràfiques per a l'estudi del territori i el paisatge a la Coma de Burg i Vallferrera*, (Bellaterra: Universitat Autònoma de Barcelona, 2004); Sancho i Planas, M. *Homes, Fargues, Ferro i Foc. Arqueologia i documentació per a l'estudi de la producció de ferro en Època Medieval,* (Barcelona: Associació/Col·legi d'enginyers Industrials de Catalunya-Marcombo, 1999), 191–195; Palet, J.M., Ejarque, A., Miras, Y., Riera, S., Euba, I., Orengo, H. 'Formes d'ocupació d'alta muntanya a la Vall de La Vansa (Serra Del Cadí-Alt Urgell) i a la Vall del Madriu-Perafita-Claror (Andorra). Estudi Diacrònic de Paisatges Culturals Pirinencs', *Tri-*

and fittings, including roofs, doors, windows, ladders, walkways, and benches. The extensive use of wood for products has been well documented through archaeological excavations.[13] Saw mills appear in documents from the fifteenth century onwards and are depicted in thirteenth-century iconography.[14]

The shipbuilding industry, which is linked to the development of trade from the thirteenth century onwards, became another major consumer of timber. In this case, data mostly come from underwater archaeology.[15]

Wood was used as a material for the manufacture of a wide variety of domestic items: bowls, plates, knife handles, containers, stools, tables, benches, trunks, boxes, spoons, mortars, and so forth.[16] Wooden containers such as iron-hooped barrels and buckets—identifiable in the archaeological record[17]—were used to store liquids such as water and wine. Today, many wooden medieval objects, such as small wooden caskets decorated with ivory plates, are held in the collections of museums.[18]

The manufacture of certain tools used for agriculture and livestock breeding, such as pitchforks, handles, plough frames, and yokes, required a significant amount of quality wood, which was also needed to make large wine vats and to construct hydropowered machines such as *norias* and watermills. Flexible wood was used to make the collars from which cowbells

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*buna d'Arqueolo*gia 2006–2007, (2007), 243–245; Castells, J. *Records de Quan Feia de Pagès,* (Tremp: Garsineu, 1999), 103–107.

13 See the cutting of planks depicted in the *Codex Granatensis*, fol. 93v and ethnological evidence preserved in the *Museu de la Vida Rural de l'Espluga de Francolí.* Ollich, I. 'Arqueologia i vida quotidiana a l'època medieval. L'excavació i interpretació d'una casa del segle XIII al jaciment de l'Esquerda', *Acta Historica et Arachaeologica Mediaevalia* **23/24** (2003): 145–165; Riu, M. 'La arqueología medieval en España', in Bouard, M.d., Riu, M. (eds.), *Manual de Arqueología Medieval. De la prospección a la Historia,* (Barcelona: Teide, 1975), pp. 376–490.

14 Villard de Honnecourt, *Livre de portraiture (1220–1240)*. See a reproduction of this drawing at http://facstaff.uww.edu/henigec/avista/engines.htm (accessed 18 Feb. 2019). Bolòs, J. *Els orígens medievals del paisatge català. L'arqueologia del paisatge com a font per a conèixer la història de Catalunya,* (Barcelona: Institut d'Estudis Catalans, 2004), 344.

15 Nieto, X., Raurich, X. *Culip VI. Exacvacions Arqueològiques Subaquàtiques a Cala Culi*p. (Girona: Monografies CASC, núm. 1. Museu d'Arquelogia de Catalunya, 1998).

16 Some of these objects can be seen in representations of the Last Supper or in the banquet scene in the Bayeux tapestry, http://clioweb.free.fr/peda/tapisserie-bayeux.htm (accessed 18 Feb. 2019). See *Codex Granatensis*, fol. 90v.

17 These types of barrels correspond with those depicted being loaded onto the ships in the Bayeux tapestry. http://clioweb.free.fr/peda/tapisserie-bayeux.htm (accessed 18 Feb. 2019).

18 Treasures of the Archaeological Museum, Catalogue number 57371, casket of Abderrahman ben Zeiyan. http://ceres.mcu.es (accessed 18 Feb. 2019).

and mangers hung, and troughs were made out of hollowed trunks (Ocaña 1998; Sancho i Planas 1993; Guilaine 1991; Castells 1999, 73).[19]

In food processing, timber was essential for producing the containers in which grapes were crushed and the machinery of flour mills (drive wheels, axles, millstone covers, and chutes) and wine and oil presses (beams, supports, and screws). It was also needed for industries that required mechanisms such as forges and fulling mills. The iconography of the period depicts magnificent images of such equipment.[20]

Wood was used in the production of salt because it is the only material that resists salt corrosion. Non-timber forest products included resins, oils, and tars; pitch, for example, was used to waterproof boots, leather skins, and especially ships. Archaeology, the examination of documentary sources, and ethnology provide us with data on these forest products.[21]

Vegetable fibres such as flax and hemp were used in the textile industry to make espadrilles and ropes. They were also used for basket weaving. Iconography and archaeology provide interesting data on this matter.[22]

Wood was necessary for waging warfare; we find this material in the

19 Ocaña, M. *El Món Agrari i Els Cicles Agrícoles a La Catalunya Vella (s. IX–XIII),* (Barcelona: Universitat de Barcelona, 1998); Sancho i Planas, M. 'Utillaje agrario en la Cataluña medieval', in *I Jornadas Internacionales sobre Tecnología Agraria Tradicional,* (Madrid, 1993), pp. 109–118; Guilaine, J. (dir.), *Pour Une Archéologie Agraire; a La Croisée Des Sciences de l'homme et de La Nature,* (Paris: Armand Colin, 1991); Clemente, J. (ed.), *El Medio Natural En La España Medieval,* (Cáceres: Universidad de Extremadura, 2001), 73.

20 See the exhibition 'El lagar de la ira de Dios. La prensa de viga en los Beatos medievales' held at the Museum of the University of Valladolid in 2013. https://demucientes.wordpress.com/category/exposicion-%CB%86el-lagar-de-la-ira-de-dios (accessed 18 Feb. 2019). See Oxford, Bodleian, Bodl 764, fol. 44: *Bestiaire* (thirteenth-century miniature, England). https://iiif.bodleian.ox.ac.uk/iiif/viewer/e6ad6426–6ff5–4c33-a078-ca518b-36ca49#?c=0&m=0&s=0&cv=0&r=0&xywh=-7400%2C-512%2C21385%2C10227 (accessed 18 Feb. 2019).

21 *…de decimis Andorrensis pagi ferri et picis* (any 860) (Abadal 1926, doc. IV); Orengo, H. *Arqueología de un paisaje cultural pirenaico de alta montaña. Dinámicas de ocupación del valle del Madriu-Perafita-Claror (Andorra),* (Tarragona: ICAC, 2010), 264–276; Fàbrega, À. 'La Pega Vegetal. Producció i Pluriactivitat Pagesa', *Estudis d'Història Agrària* **19** (2006), 89–94; Ferrer, M.T. 'Emprius i Béns Comunals a l'Edat Mitjana', in *Béns Comunals a l'Edat Mitjana. Béns Comunals Als Països Catalans i a l'Europa Contemporània,* (Lleida: Pagès, 1996), 46–47; Benavente, J.A. 'Los Petroglifos de Alloza (Teruel) y Los Hornos de Aceite de Enebro: Un Enigma Resuelto', *Historias del Bajo Aragón*. (2013).

22 Mingote Calderon, J.L. *Tecnología Agrícola Medieval En España,* (Madrid: Ministerio de Agricultura, Pesca y Alimentación, 1996), 303–312; Riera, S., Wansard, G., Julià, R. '2000-Year Environmental History of a Karstic Lake in the Mediterranean Pre-Pyrenees: The Estanya Lakes (Spain)', *Catena* **55** (2004), 317–319.

handles of all types of weapons; in spear shafts; in the internal structure of shields; in bows, crossbows, and arrow shafts; and in siege engines such as catapults, trebuchets, and battering rams. Timber was also instrumental in making defensive structures, such as palisades and box-machicolations.[23]

Wood was also used to make leisure items, for example, the boards and game pieces that we see reproduced in the *Libro de juegos* of King Alfonso X the Wise, but also in street games where pins and sticks were required. High-quality wood was also used to manufacture musical instruments.[24]

The limited space available here does not allow us to delve into the use of other forest resources such as flowers, fruits, leaves, and roots for culinary, medicinal, and animal-feed purposes. Non-timber products, however, were unquestionably of major relevance to the domestic economies of the medieval rural world.[25]

4. Mapping Medieval Catalan Forests

We will now present an example of interdisciplinary work carried out on the tenth- through twelfth-century territory of the County of Barcelona (Figure 1). The county's area of almost 4,000 km^2 served as the basis for implementing a mapping process using a GIS, which aims to fill the information gaps present in written sources and to assess the economic role of woodland spaces in the Middle Ages before and after the introduction of feudalism.

We took an interdisciplinary approach to this research project, working with information provided by written documentation,[26] archaeological

23 Hernández Cardona, X. *Història Militar de Catalunya. Vols 1 i 2*, (Barcelona: Rafael Dalmau Ed, 2001).

24 For more information on this matter, see the websites Brassy. Ch. *Instruments pour jouer les musiques du Moyen Âge.* http://www.instrumentsmedievaux.org (accessed 17 March 2014) and *La música Antigua Española*. http://recursos.educarex.es/escuela2.0/Educacion_Artistica/Musica/musica_antigua_espanola (accessed 18 Feb. 2019); Calvet, A. *De La Pierre Au Son. Archéologie Musicale Du Tympan de Moissac*, (Moissac: Accord, 1999) ; Castellet, L.d. *Paisatge Sonor, Arqueologia Del so. Codis, Espais i Instruments Sonors a La Catalunya Rural Medieval,* (Barcelona: Universitat de Barcelona, 2012).

25 *Dioscórides Interactivo, Sobre Los Remedios Medicinales – Manuscrito de Salamanca*, (2017). http://dioscorides.usal.es/p2.php?numero=767; Font i Quer, P. *El Dioscórides Renovado,* (Barcelona: Península, 1961).

26 The unpublished written sources consulted are kept in the Archive of the Crown of Aragon, the Diocesan Archive of Barcelona, the Historical Archive of the Library of Catalonia, the Regional Historical Archive of Terrassa, and the Regional Historical Archive of

Figure 1: The County of Barcelona.

data,[27] geographical data,[28] and paleoenvironmental data (carpology, palynology, anthracology, and sedimentology). Combining an analysis of the

Alt Penedès. As for published written sources, the following documentary compilations have been used: Alturo 1985, Bach 1987, Fàbrega 1995, Feliu et al. 1999, Fernández i Trabal, Fernández i Trabal 1989, Font i Rius 1969–83, Mas 1914, Miquel 1945–47, Pardo 1994, Pérez 1988, Pons i Guri 1984, Puig 1995, Rius 1945–81, Udina i Abelló 1947, Udina i Abelló 1984. Part of the data collection process was performed jointly by Alfred Mauri and Maria Soler as part of their doctoral research projects (Mauri 2006; Soler 2006).

27 The collection of archaeological data was based on the analysis of the Archaeological Registry of the Archaeological Service of the Generalitat de Catalunya and on the analysis of relevant published and unpublished archaeological reports resulting from archaeological excavations.

28 The topographic and hydrographic data and the digital orthophotomaps used in the GIS mapping process come from the Cartographic and Geological Institute of Catalonia (ICGC), http://www.icgc.cat (accessed 18 Feb. 2019).

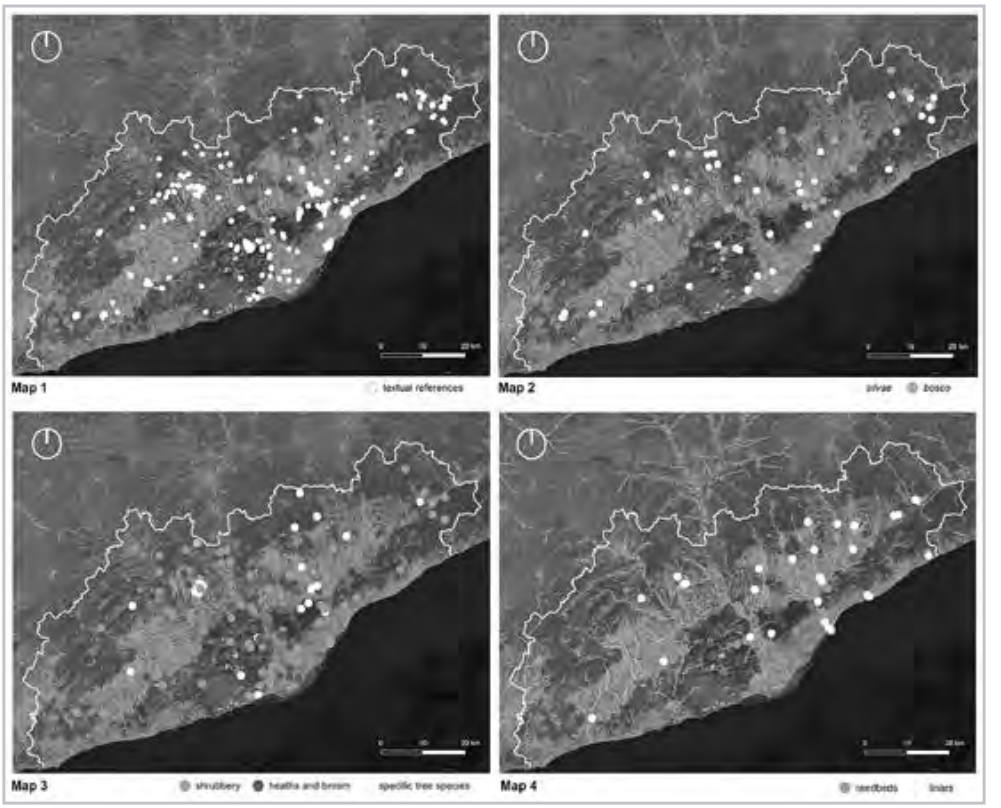

Figure 2: Mapping medieval forests in the County of Barcelona (tenth–twelfth centuries)

information extracted from this wide range of historical sources with georeferenced data in a GIS afforded us the opportunity to study forests and the use of forest-based resources in the Middle Ages.

From a theoretical point of view, our analysis is based on the notion of landscape understood as a holistic space in which the diverse subsystems that form the reality of the past are interrelated.[29] The use of forest resources is part of the relationships established between human actions (comprising the anthropic subsystem) and biotic and abiotic subsystems, all of which are parts of the historical landscape.

Georeferencing information about forests and other plant cover contained in historical documents from the County of Barcelona dating from between the tenth and twelfth centuries has resulted in Map 1 of Figure 2, where

29 Bolòs, M.d. *Manual de ciencia del paisaje. Teoría, métodos y aplicaciones,* (Barcelona: Masson, 1992); Mauri, A. *La configuració del paisatge medieval: el comtat de Barcelona fins el segle XI,* (Barcelona: Universidad de Barcelona, 2006).

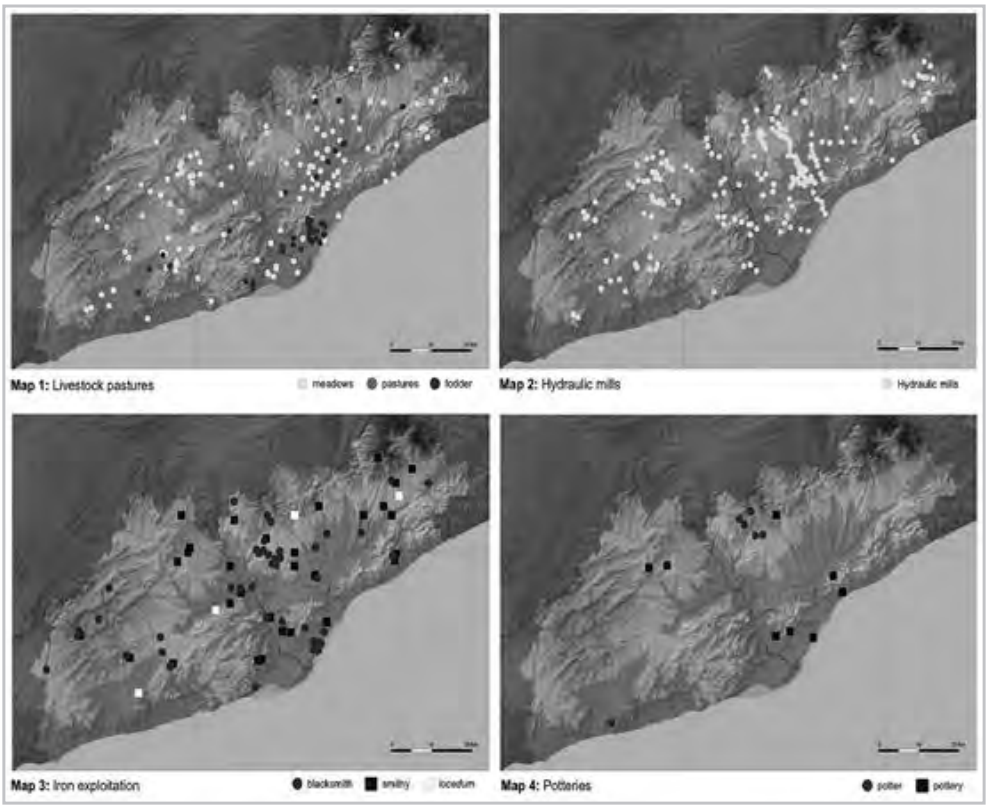

Figure 3: Forest resources in the County of Barcelona (tenth–twelfth centuries)

white dots indicate forest areas documented in textual sources. In these texts forests are referred to by different names: *Silvis* (62% of the references), *Bosco* (35%), *Foreste*, and the Latin *Nemoribus* (Figure 2: Map 2). Written sources also allow us to appreciate the existence of large areas covered by different species of shrubs (Figure 2: Map 3), which were known by different names, such as *Garricis* (scrubland), *Brugarios* (heather), and *Genestaris* (brooms). Palynological data confirms that shrubland increased in the tenth and eleventh centuries as a result of the abandonment of agricultural land (possibly stretching back to Roman times) and deforestation for livestock grazing.[30]

30 Riera, S., Palet, J.M. 'Evolució del sector de Montjuïc – el Port entre l'època romana i altmedieval (s. III–X): una contribució a l'estudi diacrònic del paisatge', in *Actes del III Congrés d'Història del Pla de Barcelona. Vol. I*, (Barcelona: Institut Municipal d'Història, 1993), pp. 49–70; Esteban, A., Riera, S., Miret, M., Miret, X. 'Transformacions del paisatge i ramaderia a la costa catalana del Penedès i Garraf (Barcelona) a l'Alta Edat Mitjana', in *IV Congrés Nacional d'Arqueologia Medieval. Vol. III.* (Alacant: Asociación Española de Arqueología Medieval, 1994), pp. 647–655; Riera, S. 'Canvis ambientals i modelació antròpica

Historical documents also contain terms that indicate the presence of specific tree species: *Glaners* (which refers to both oaks and holm oaks, both producers of acorns), *Roviras* (oak forests), *Quercos* and *Olzinas* (holm oaks), *Salices* (willows), *Olmos* (elms), *Nogueras* (walnut trees), and *Ficulneas* (fig trees).

Texts note an abundance of reedbeds and flax (Figure 2: Map 4) in the wetlands near the rivers and streams of the county. As we have already mentioned, vegetable fibres were extracted in these areas to craft baskets, ropes, and sacks.

We also find abundant references to forest uses connected with livestock grazing (Figure 3: Map 1), the exploitation of hydraulic resources (Figure 3: Map 2, with the presence of watermills), iron production (Figure 3: Map 3), and ceramic production (Figure 3: Map 4).

5. The Role of Forests in the Middle Ages

The information presented above shows that forests were an important source of resources for rural medieval communities, especially during the High Middle Ages, when these communities could hunt freely. A study of eighth-century bone fragments found at the archaeological site of Santa Margarita de Martorell,[31] already documents wildlife species such as rabbit, hare, and deer, which were hunted for food.

Following the introduction of feudalism and the expansion of cultivated land, livestock breeding and hunting were restricted to the nobility. From the second half of the twelfth century onwards, feudal lords began to heavily regulate forest management, which prevented peasant communities from using forest resources. For example, in the County of Barcelona restrictions on the collection of firewood were imposed, taxes for the use of forestland were established, and partridge hunting was prohibited.[32]

In the late medieval period forests were indispensable for the economic functioning of farms (*mansus* or *mas*, in Catalan). Some farms were obliged

del territori entre l'època ibèrica i l'altmedieval a Catalunya: Aportacions de la palinologia', *Cota Zero* **20** (2005): 99–107.

31 Valenzuela, S., Navarro, R. 'Un conjunt faunístic de finals de l'Antiguitat tardana al jaciment de Santa Margarida (Martorell, Baix Llobregat)', *Pyrenae: 38/1*, (2007), pp. 105–127.

32 Soler, M. *Els espais d'intercanvi. El mercat en el procés de gènesi i consolidació del feudalisme al comtat de Barcelona (segles IX a XIII)*, (Barcelona: Universitat de Barcelona, 2006), 424.

to make annual payments in the form of firewood, acorns, or wax. In some cases, we have records of certain forest uses that were allowed, such as the collection of acorns and felling of trees to make casks and boats. Normally, only the tenants of these *mansus* could exploit common or nobly held forestland, but only for their own personal use. If they wanted to make a profit, they had to compensate their lords with money. Furthermore, forest resources did not only benefit the rural domain. Charcoal and wood were transported to medieval cities, where the latter was used for heating, cooking, and construction. Most of the timber used in the shipyards of Barcelona came from the mountains of Girona.

During the twelfth and thirteenth centuries the expansion of arable land and the increase in population led to two simultaneous, albeit conflicting processes. On one hand, forests were cleared, and, on the other, forests were protected as a communal resource. Thus, from the fourteenth century onwards, the use of forests became a point of conflict between peasants and lords in Catalan feudal lands.

6. Conclusion

The study of textual, archaeological, geographical, iconographic, and ethnographic sources helps us understand the ways in which forest resources were exploited in the Middle Ages. The representation and analysis of data using a GIS allows us to overcome the fragmentation of historical information and to interpret it in a global way through the concept of landscape. Forests offered important resources, and although feudalism imposed certain restrictions on their use, they continued to be an essential space for medieval peasants. This interdisciplinary approach allows us to redefine the role of forests in the economy of rural medieval communities.

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Afforestation: UK Forestry Policy in Response to Changing Resource Needs

SUSANNE RAUM, Imperial College London

Abstract: Forestry in the United Kingdom (UK) has been subject to a series of policy changes since the early 1900s. At the time, the country's forest cover was down to an estimated 4.7%, which created dangerous dependencies on the timber supply of other countries, especially during World War I. In response, the UK government embarked on an intensive afforestation programme. The aim of this chapter is to provide a better understanding of the challenges involved in re-storing a key natural resource, using forests in the UK as a case study example. Through a comprehensive review of scholarly literature, documents, and reports, this work examines the UK Government's afforestation programme, which began in 1919 and held sway until the 1970s. This has since been overlain with ideas about multi-functionality and sustainable forest management and, more recently, a renewed emphasis on forest expansion. The findings offer important insights into the long-standing impact of natural resource depletion and the efforts needed to undo, at least some of the damage.

Keywords: forestry policy; paradigms; sustainable forest management; plantations; colonialism

1. Introduction

In the United Kingdom (UK), the importance of forestry changed considerably over time. Until the early 20th Century despite, at times, considerable timber shortages government action was only taken ad hoc, in response to specific problems either in relation to the provision of oak for naval purposes or the royal forests.[1] Forestry was mainly practised in the context of estates owned by the aristocracy, wealthy individuals, and the crown estate.[2]

1 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

2 Forbes, A.C. *English Estate Forestry,* (London: Edward Arnold, 1904); Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80.

The general view was that forestry was mainly the responsibility of private individuals, rather than of the state; successive governments and most landowners did not feel the necessity to increase timber production.[3] Importing timber from abroad was much cheaper than to produce it at home.[4] In the early 20th century, the forest cover in the UK was down to about 4.7%,[5] lower than any other European country.[6] Ninety percent of the country's timber needs were met by imports – hardwoods came mainly from tropical areas, and softwoods from the Baltic States, Russia and North America.[7]

The extent of the UK's dependence on timber imports and the dangers that accompany it were only fully realised in the 1914–18 war.[8] During World War I, the UK was mostly cut off from its overseas timber supplies and had to rely on its own forests for timber. Its dependence on foreign timber supplies became a major national security issue.[9] The mining industry, for instance, struggled to get hold of the pit props it needed for the production of coal, which in turn was needed for the manufacture of steel used for armaments and shipbuilding.[10] In response to the timber crisis, a Forestry Sub-committee known as the Acland Committee was set up in 1916 under the War Reconstruction Committee.[11] The Acland Committee looked at the best ways of increasing timber supplies and recommended a state organisation as being the most effective way of co-ordinating re-afforestation to meet future timber needs.[12] The committee

3 Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80; Robinson, R.L. 'British Forestry', *Forestry* **1** (1927): 1–5.

4 Zuckerman, S. *Forestry, Agriculture and Marginal Land. A Report by the Natural Resources Committee*, (London: Her Majesty's Stationery Office, 1957); Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

5 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

6 Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80.

7 Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80.

8 Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80.

9 Griffith, 'The Forestry Commission', *Political Quarterly* **22** (1951): 194–197.

10 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

11 Acland. *Final Report of the Forestry Sub-Committee of the Reconstruction Committee. Cd 8881*, (London, 1918).

12 Acland. *Final Report of the Forestry Sub-Committee of the Reconstruction Committee. Cd 8881*, (London, 1918).

further suggested to increase forest cover from three million acres to four and three quarter million acres over an eighty-year period; this would have made the UK independent from foreign timber supplies for up to three years.[13] It recommended that over the first ten years, 150,000 acres should be planted by the Forestry Commission and 50,000 by private landowners with government assistance.[14] At the time, 97 per cent of the wooded land was privately owned with the remainder being royal forests, belonging to the crown estate; broadleaved trees dominated these woodlands.[15]

During the following 100 years, forestry in the UK was subject to a series of policy changes, initially focusing on afforestation and timber production but gradually widening the objectives for forest expansion and management. The aim of this chapter is to provide a better understanding of the challenges involved in re-storing a natural resource, using forests in the UK as a case study example. Through a comprehensive review of scholarly literature, documents, and reports, this work examines afforestation efforts in the UK between 1919 and 2018. Further attention is given to the gradual shift of forestry objectives and factors that have driven these changes. It should be noted that due to the devolution of political administration, which began in 1998, it is not always possible to keep a clear UK focus in the historic overview presented in this chapter. In recent years, the articulation of forestry policy has increasingly been delegated to the country level – England, Scotland, and Wales; Northern Ireland has had a special status throughout the last hundreds of years.

2. State-run Afforestation – Land Acquisition and Tree Planting

In 1919, the first Forestry Act was passed in response to the recommendation of the Acland Committee. The act established the Forestry Commission, a semi-independent board of Commissioners[16], as the Forest Authority for

13 Acland. *Final Report of the Forestry Sub-Committee of the Reconstruction Committee. Cd 8881*, (London, 1918).

14 Acland. *Final Report of the Forestry Sub-Committee of the Reconstruction Committee. Cd 8881*, (London, 1918).

15 Coppock, J.T. 'A decade of post-war forestry in Great Britain', *Economic Geography,* **36** (1960): 127–138.

16 One of which had to be a Member of Parliament to respond to questions in the House

Figure 1: Forestry Commission Newton Nursery, Morayshire, 1936.
© Crown Copyright Forestry Commission, Alan Duncan and Forestry Memories.

Great Britain.[17] It was given wide powers to promote afforestation, the production and supply of timber, and timber industries, to acquire and plant land, make grants, and to undertake research and education in Great Britain.[18] In Northern Ireland, forestry was placed under the responsibility of the Ministry of Agriculture.[19] During the 1920s and 30s, the Forestry Commission, under the on-going direction of the Treasury, focused on acquiring inexpensive land.[20] This included poor-quality agricultural land and later

of Commons. Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

17 Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80.

18 *Forestry Act 1919.* (London: Her Majesty's Stationery Office, 1919).

19 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

20 In 1922, the Treasury had set the ceiling on what the Commission could pay for land at

Figure 2: *Planting squad at Hobseat, Fetteresso Forest, 1952.*
© Crown Copyright Forestry Commission, David Anderson and Forestry Memories.

on moor- and heathland.[21] Land had become particularly cheap during the Great Recession (1929–1933).[22] At the time, landowners felt that capital invested in forestry or farming was money wasted and therefore frequently sold their land.[23]

In the early 1930's, in response to the growing interest in the countryside, due to growing car ownership and enhanced rail links, the Forestry Commission began to open up some of its less productive forests to the public,

£3 per acre and later at £4 per acre. Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

21 Rackham, O. *Woodlands,* (London: Collins, 2006).

22 Griffith, 'The Forestry Commission', *Political Quarterly* **22** (1951): 194–197; Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

23 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

giving birth to National Forest Parks.[24] The first Forest Park was established in Argyll, Scotland in 1935. Still, several more decades were to elapse before recreation became a formal objective for the Forestry Commission's estate under the Countryside Act 1968.[25] By 1939, the Commission had acquired 263000 ha (650000 acres) of land of which it had planted 150000 ha (370000 acres) in 230 new forests; it had become the largest landowner in the UK.[26] The Commission's landholdings included the royal forests, hitherto part of the crown estate, and local council woods that had been placed under the responsibility of the Commission as part of the 1923 Forestry (Transfer and Woods) Act.[27] The royal forests, especially, were largely established semi-natural broadleaved woodlands; some had existed for hundreds of years.[28] The new plantations, on the other hand, consisted of even-aged, non-native, and fast growing conifer species, mainly Sitka spruce, Norway spruce, and Lodgepole pine.[29] In the same period, 51000 ha (125000 acres) were replanted in private forests with the aid of grants.[30] Apart from the visual differences, the ecological differences between existing woodlands and exotic conifer plantations were considerable, including their level of diversity and their soil and understorey composition.[31]

During World War II, UK forests took another serious blow, particularly former Royal Forests, such as the New Forest and the Forest of Dean, and privately owned forests.[32] In fact, the felling of trees in the south of England was so ferocious that the War Office demanded a complete stop because it needed woodlands to hide the build-up of its supplies and troops for the invasion of occupied Continental Europe.[33] As the Forestry Commission had few plantations over twenty years old other than those it had taken over

24 Nail, S. *Forest Policies and Social Change in England,* (Dordrecht; London:, Springer, 2010).

25 Mather, A.S. 'Pressures on British forest policy: prologue to the post-industrial forest?', *Area* **23** (1991): 245–253.

26 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

27 *The Forestry (Transfer of Woods) Act 1923*, (London: Her Majesty's Stationery Office, 1923).

28 Stewart, P. 'British forestry policy: time for a change?', *Land Use Policy* **2**(1985): 16–29.

29 Coppock, J.T. 'A decade of post-war forestry in Great Britain', *Economic Geography,* **36** (1960): 127–138.

30 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

31 Peterken, G.F. *Natural Woodland*, (Cambridge: Cambridge University Press, 1996).

32 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

33 Meiggs, R. *Home Timber Production 1939–1945,* (London: Crosby Lockwood, 1949).

from the Crown Estate, private forests once again had to shoulder the bulk of the burden put on forests by the war.[34] In 1943, the Forestry Commission responded to the renewed timber crisis with the publication of a Post-war Forest Policy,[35] supplemented by a report on Private Woodlands.[36] In view of an anticipated increase in world timber consumption, highlighted in the latter of the two reports, the total area of woodland planned under the original Acland report's was increased to four and three quarter million acres to five million acres (2.024 million hectares) over the next fifty years.[37] Almost half of this was meant to be planted by private landowners with the help of governmental financial incentives.[38] To make tree felling more difficult, licences for timber felling were introduced through the 1947 Town and Country Planning Act.[39]

3. Intensification of Timber Production

The Forestry Act 1951 placed even more emphasis on timber production. It requested the Forestry Commission *to "promote the establishment and maintenance of adequate reserves of growing trees"*.[40] This included substantial investments in wood processing industries, such as sawmills and the particleboard industry.[41] During the challenging post-war years, particularly the 1950s, food self-sufficiency and rural development were main areas of concern.[42] In line with the intensification of agriculture, the focus in UK forestry shifted from re-afforestation and expansion to intensification of timber

34 Anon. 'Editorial: Post-War Forestry in Great Britain', *Nature* **154** (1944): 683–715.

35 *Post-war Forest Policy of Great Britain. Cmd 6447*, (London: Her Majesty's Stationery Office, 1943).

36 *Post-war forest policy. Private Woodlands. Cmd 6500*, (London: Her Majesty's Stationery Office, 1944).

37 *Post-war Forest Policy of Great Britain. Cmd 6447*, (London: Her Majesty's Stationery Office, 1943).

38 *Post-war Forest Policy of Great Britain. Cmd 6447*, (London: Her Majesty's Stationery Office, 1943).

39 *The Forestry Act 1947*, (London: Her Majesty's Stationery Office, 1947).

40 *The Forestry Act 1951*, (London: Her Majesty's Stationery Office, 1951).

41 Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B,* Biological Sciences, 271 (1975): 69–80.

42 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

production. This approach, however, resulted in severe land manipulation,[43] including through the use of heavy machinery, fertilisers, herbicides, and pesticides.[44] The visual effects of the industrialisation of forestry and the increasingly harsh treatment of the trees and their wider surroundings resulted in environmental protests in the Lake District and later on in Cumbria and north-west England.[45] The prime objection was to the "*extensive, monotonous exotic conifer plantations – the goose-stepping monocultures*".[46] Whereas established forests, especially royal forests, tended to be closely linked to the rest of the landscape,[47] new plantations were mainly planted in geometrical blocks on open ground.[48] There was also "*widespread demand for greater access into state forests*".[49]

In the following years, the industrialisation of forestry even intensified. The Forestry Commission, due to pressure of the Treasury and a growing domestic wood processing industry, was forced to become more efficient and to supply large amounts of timber.[50] In particular, the demand for pulp and board wood[51] had risen in the 1950s, as a result of the increasing circulation of newspapers, magazines, and books.[52] This growing demand led to renewed concerns of possible future timber shortages, and was followed by new planting programmes on a grand scale.[53] The Forestry Commission,

43 Mason, W.L. 'Changes in the management of British forests between 1945 and 2000 and possible future trends', *Ibis* **149** (2007), 45.

44 Tsouvalis, J. *Critical Geography of Britain's State Forests,* (Oxford: Oxford University Press, 2000).

45 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

46 Edwardson, T.E. 'Amenity and forestry', *Forestry,* **29** (1) (1956), 44.

47 Peterken, G.F. *Natural Woodland*, (Cambridge: Cambridge University Press, 1996).

48 Coppock, J.T. 'A decade of post-war forestry in Great Britain', *Economic Geography,* **36** (1960): 127–138.

49 Yarrow, C. 'A preliminary survey of the public's concepts of amenity in British Forestry', *Forestry,* **39** (1) (1966), 59.

50 Oosthoek, K.J. 'Chapter 4. Origins and Development of State Forestry in the United Kingdom', in Oosthoek, K.J., Hölzl, R. (eds.), *Managing Northern Europe's Forests. Histories from the Age of Enlightenment to the Age of Ecology,* (Oxford: Berghahn Books, 2018); Oosthoek, K.J. *Conquering the Highlands: A History of the Afforestation of the Scottish Uplands,* (Sidney: ANU E Press, 2013).

51 This was due to technical advances in the use of wood in new forms and on a large scale, such as fibre board and plywood, particularly boards and cartons. Scott, C.W. 'The Changing Aims of Forestry', *Forestry* **39** (1966): 10–16.

52 Scott, C.W. 'The Changing Aims of Forestry', *Forestry* **39** (1966): 10–16.

53 Scott, C.W. 'The Changing Aims of Forestry', *Forestry* **39** (1966): 10–16.

Figure 3: Early plough and D2 Caterpillar Tractor, 1946.
© Crown Copyright Forestry Commission, Jim Christie and Forestry Memories.

helped by further technological advances, rationalised and mechanised its operations and increasingly planted shorter rotation species.[54] The Forestry Act 1967[55], which consolidated the Forestry Acts 1919 to 1963, reinforced this development by reiterating the importance of afforestation and timber production; it also kept the clause on "*maintaining adequate reserves of trees*". The 1960s also saw the beginning of large-scale afforestation by private forest investment companies[56] which had been stimulated by a favourable tax system.[57] Generous tax advantages allowed individuals on high incomes to

54 For more information on the forestry industry and the Forestry Commission timber sales policy: Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010), 143–149.

55 *The Forestry Act 1967*, (London: Her Majesty's Stationery Office, 1967).

56 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

57 Tompkins, S. *Forestry in Crisis. The Battle for the Hills,* (London: Christopher Helm, 1989); Tsouvalis, J. *Critical Geography of Britain's State Forests,* (Oxford: Oxford University Press, 2000).

offset their taxable income against expenditure on new forest plantations.[58] This had led to the creation of, mainly privately-owned large-scale conifer plantations in the Scottish uplands.[59]

4. The Widening of Forestry Objectives – Timber, Recreation, and Conservation

In the 1960s, changes in perception began to influence forestry policy, gradually leading to the widening of forestry objectives.[60] Various non-governmental organisations and statutory bodies discussed the need to make the wider countryside, including forests, more attractive and more accessible to the general public. At the time, "*recognised rights of way were few and their use was actively discouraged*".[61] The Council for the Protection of Rural England (CPRE) also mobilised a campaign against tree planting on open land.[62] In response to the growing influence of the environmental movement, the Forestry Commission began to plant and manage its lands increasingly for amenity purposes.[63] In 1964, for instance, the Commission appointed landscape consultant Sylvia Crowe to introduce more aesthetic treatments of afforestation schemes, including contour planting and the use of broadleaved trees in sensitive and edge locations.[64] The Countryside Act 1968,[65] a further product of these debates, strengthened this development. The Act created the Countryside Commission with the remit to cater for recreation in the countryside. It also required public bodies, including the Forestry Com-

58 Tompkins, S. *Forestry in Crisis. The Battle for the Hills,* (London: Christopher Helm, 1989).

59 Tsouvalis, J. *Critical Geography of Britain's State Forests,* (Oxford: Oxford University Press, 2000).

60 Raum, S., Potter, A. 'Forestry paradigms and policy change: the evolution of forestry policy in Britain in relation to the ecosystem approach', *Land Use Policy* **49** (2015): 462–470.

61 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010), 64.

62 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010); *Growing against the grain*, (Council for the Protection of Rural England, 1987).

63 Nail, S. *Forest Policies and Social Change in England,* (Dordrecht; London:, Springer, 2010).

64 Crowe, S. *The landscape of forests and woods,* (London: Her Majesty's Stationery Office, 1978).

65 *Countryside Act 1968*, (London: Her Majesty's Stationery Office, 1968).

mission, *"to have regard to the desirability of conserving the natural beauty and amenity*[66] *of the countryside*".[67] The Forestry Commission, thereafter, provided recreational facilities, including forest holiday cabins.[68]

A key review of forestry in 1972, undertaken by the Treasury,[69] considered, for the first time, the costs and benefits of forestry in the UK. Its main aim was "*to clarify what the nation*' was '*getting in return for accepting the low financial rates of profit … achieved, and expected on new plantations*", by quantifying the non-timber objectives of landscape amenity and recreation.[70] Interestingly, the analysis concluded that even though afforestation failed to produce the 10% return on investment expected from public sector investment, it became economically viable when recreation and amenity were taken into account.[71] The study estimated that some 1.5 million visits to public forests were undertaken annually (in 1968) and expected this figure to increase substantially by up to 10% each year.[72] The outcome of this review, arguably, brought about a major shift towards the widening of forestry objectives.[73]

The 1979 EC Convention on the Conservation of European Wildlife and Natural Habitat[74] added the protection of wild plants, animal species, and their habitats to this list of objectives. The Convention was implemented into UK law through the Wildlife and Countryside Act 1981.[75] In the

66 In the Town and Country Planning Act 1974, the term amenity was defined as '*that element in the appearance and layout of town and country which makes for a comfortable and pleasant life rather than a mere existence*'.

67 *Countryside Act 1968*, (London: Her Majesty's Stationery Office, 1968).

68 Nail, S. *Forest Policies and Social Change in England,* (Dordrecht; London:, Springer, 2010).

69 *Forestry in Great Britain: an Interdepartmental Cost/Benefit Study*, (London: Her Majesty's Stationery Office, 1972).

70 *Forestry in Great Britain: an Interdepartmental Cost/Benefit Study*, (London: Her Majesty's Stationery Office, 1972), 1.

71 Nail, S. *Forest Policies and Social Change in England,* (Dordrecht; London:, Springer, 2010); Holmes, G.D. 'History of Forestry and Forest Management', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **271** (1975): 69–80.

72 *Forestry in Great Britain: an Interdepartmental Cost/Benefit Study*, (London: Her Majesty's Stationery Office, 1972).

73 *Review of Forestry Commission Objectives and Achievements*, (London: Her Majesty's Stationery Office, 1986).

74 *The Convention on the Conservation of European Wildlife and Natural Habitat (Bern Convention)*, (Bern: Council of Europe, 1979).

75 *The Forestry Act 1981*, (London: Her Majesty's Stationery Office, 1981).

same year, John Morton Boyd, the newly retired head of the Scottish Nature Conservancy Council (NCC) was appointed by the Forestry Commission to encourage more nature conservation on the Commission's estate.[76] Also in 1981, the Nature Conservancy Council began to identify and compile a list of ancient woodlands[77]. The Ancient Woodland Inventory was a first step towards protecting woodlands in the wider countryside.[78] Still, timber production remained the main focus throughout this period.[79]

5. The Balancing of Different Forestry Objectives

The 1985 Wildlife and Countryside Amendment Act[80] not only strengthened nature conservation, but also instructed the Forestry Commission to keep a *"reasonable balance"* between the *"development of afforestation, the management of forests and the production and supply of timber, and the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographic features of special interest"*.[81] The Forestry Commission responded by introducing a Policy and Guidance on Broadleaved Woodlands in the same year.[82] In the following years, more emphasis was placed on forest conservation, and the quality and health of water and soil, emphasising the importance of the regulative capacity of natural forests, and evidenced through a range of guidelines produced by the Forestry Commission.[83] Interestingly, around the same time, the Commission had achieved

76 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

77 The term 'ancient' refers to woodlands that have been continuously present at a site since 1600, irrelevant of the management methods used.

78 Thomas, R.C. 'The Conservation of a Fragmented Ecosystem within a Cultural Landscape – The Case of Ancient Woodland in England', *Biological Conservation* **82** (1997): 243–252.

79 Raum, S., Potter, A. 'Forestry paradigms and policy change: the evolution of forestry policy in Britain in relation to the ecosystem approach', *Land Use Policy* 49 (2015): 462–470.

80 *Wildlife and Countryside (Amendment) Act 1985*, (London: Her Majesty's Stationery Office, 1985).

81 *Wildlife and Countryside (Amendment) Act 1985*, (London: Her Majesty's Stationery Office, 1985).

82 *The Policy for Broadleaved Woodland*. (Edinburgh: Forestry Commission, 1985b); *Management Guidelines for Broadleaved Woodland*, (Edinburgh: Forestry Commission, 1985a).

83 *Forest Landscape Design Guidelines,* (London: HMSO, 1989); *Forest Nature Conservation Guidelines,* (London: HMSO, 1990); *Forests and Water Guidelines 2nd edn*, (London: HMSO, 1991b).

its 1943 target of 5 million acres of forest cover in the UK (2.024 million hectares);[84] approximately 9% of land cover[85] which, arguably, has led to a relaxation of its focus on timber production.

In the late 1980s, there were also calls for more public involvement in forestry,[86] leading to the idea of community forests. The Countryside Commission, the then Government body responsible for the enjoyment of the countryside, took up this idea and launched a community forest programme in 1989.[87] Community forests were subsequently established on the edges of major UK cities to revitalise urban fringes and to contribute to the quality of life of city dwellers.[88] This frequently consisted of tree planting and management activities on redundant industrial land by volunteers to encouraged a sense of community ownership.[89] The National Forest scheme, inaugurated in 1990, was conceived to create a new large scale forest in the heart of England as a major recreational and tourism resource.[90] The scheme helped regenerate industrial areas, namely the defunct coalfields in South Leicestershire and South Derbyshire.[91] The new forest was also intended to make a major contribution to carbon sequestration.[92] By the early 1990s, plantation forest expansion had slowed considerably and the focus had shifted towards balancing multiple social, economic and environmental forestry objectives.[93]

84 Mather, A.S. 'Pressures on British forest policy: prologue to the post-industrial forest?', *Area* **23** (1991): 245–253.

85 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

86 Richards, E.G. *British Forestry in the 20th century. Policy and Achievements,* (Leiden–Boston: Brill, 2003).

87 Countryside Commission. *Forests for the Community, CCP 270*, (Cheltenham: Countryside Commission, 1989).

88 Nail, S. *Forest Policies and Social Change in England,* (Dordrecht; London: Springer, 2010).

89 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

90 Countryside Commission. *A New National Forest, CCP 328*, (Cheltenham: Countryside Commission, 1990).

91 Foot, D. *Woods & People. Putting Forests on the Map,* (Stroud: The History Press, 2010).

92 Countryside Commission. *A New National Forest, CCP 328*, (Cheltenham: Countryside Commission, 1990).

93 Raum, S., Potter, A. 'Forestry paradigms and policy change: the evolution of forestry policy in Britain in relation to the ecosystem approach', *Land Use Policy* 49 (2015): 462–470.

6. A Renewed Focus on Afforestation

Forests also played a prominent role at the United Nations Conference on the Environment and Development (UNCED) in 1992 in Rio de Janeiro.[94] As part of the Rio summit process, the significance of forests for society was acknowledged in various international agreements, including the Convention on Climate Change,[95] the Convention on Biological Diversity,[96] the Convention to Combat Desertification,[97] and the UN Rio Forest Principles.[98]

The 1992 UN Convention on Climate Change[99] added a new objective for tree planting – carbon sequestration. In the UK, in anticipation of the international Rio commitments on climate change, afforestation had already been put back on the agenda by the 1991 Forestry Policy. The policy aimed to increase forest cover by an indicative 33 000 ha annually over the next 50 years.[100] At the time, the UK's forest cover was around 11% and the Forestry Commission owned or leased 35% of the woodland area in Great Britain.[101] However, whereas afforestation in the past was directed towards the production of timber,[102] the reason for woodland expansion in the 1990s was primarily to fulfil wider international objectives linked to climate change, but also biodiversity. Following the 1997 Kyoto Protocol which came into force in the UK in 2005, the 2008 Climate Change Act[103] and the 2009 Carbon

94 Bill, S. 'Social indicators of multifunctional rural land use: The case of forestry in the UK', *Agriculture, Ecosystems & Environment,* **120** (2007): 31–40.

95 *United Nations Framework Convention on Climate Change*, (United Nations, 1992a).

96 *UN Convention on Biological Diversity. Montreal Secretariat of the Convention on Biological Diversity*, (1992). https://www.cbd.int/doc/legal/cbd-en.pdf (accessed 22 July 2016).

97 *United Nations Framework Convention to Combat Desertification*, (United Nations, 1992b).

98 The full title is 'The Non-Legally Binding Authoritative Statement on Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forest'. *Non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests*, (Rio de Janeiro: United Nations, 1992).

99 *United Nations Framework Convention on Climate Change*, (United Nations, 1992a).

100 *Forestry Policy for Great Britain,* (Edinburgh: Forestry Commission, 1991a).

101 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

102 Weldon, S. *Public participation and partnership: a review of Forestry Commission practice and governance in a changing political and economic context*. (Edinburgh: Forestry Commission, 2004).

103 *The Climate Change Act 2008*, (London: Her Majesty's Stationery Office, 2008a).

Figure 4: Forest Cover Map in the UK.
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Transition Plan[104] encouraged afforestation as a cost-effective way to mitigate climate change.

There were also increasing calls for the development of renewable energy as a way of replacing carbon intensive fossil fuel. The 2006 Natural Environment and Rural Communities Act,[105] for instance, introduced an Energy Crops Grant Scheme in 2007, which provided grants for the establishment of approved energy crops, including short rotation coppice trees. The UK Biomass Strategy,[106] the Woodfuel Strategy for England,[107] the Energy Act 2008,[108] the 2009 EU Renewable Energy Directive,[109] the 2009 UK Renewable

104 *UK Low Carbon Transition Plan*, (London: Department for Energy and Climate Change, 2009).

105 *The Natural Environment and Rural Communities Act 2006*, (London: Her Majesty's Stationery Office, 2006).

106 *The UK Biomass Strategy*, (London: Department for Environment, Food and Rural Affairs, 2007).

107 *A Woodfuel Strategy for England*, (London: Forestry Commission, 2007).

108 *The Energy Act 2008*, (London: Her Majesty's Stationery Office, 2008b).

109 *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources. EU RED, 2009/28/EC*, (Brussels, 2009).

Energy Strategy,[110] and the Renewable Heat Incentive[111] were all driving increased demand for home grown timber[112]. The Woodfuel Implementation Plan 2011–2014 which aimed at ensuring sufficient quantities of wood fuel production to meet the increased demand that the 2011 Renewable Heat Incentive was likely to stimulate, required to bring "*an additional 2 million tonnes of wood to energy markets in England, each year by 2020*".[113] However, the still low woodland cover of then 13% of the total land area in the UK[114] challenged these rather ambitious biomass goals.

7. UK Forestry Today

Today, the total woodland area in the UK is estimated to be 3.17 million hectares.[115] This represents 13% of the total land area in the UK, 10% in England, 15% in Wales, 19% in Scotland, and 8% in Northern Ireland.[116] Home-grown timber supply accounted for approximately 20% of timber, paper and pulp consumption in 2013; it was 4% in 1945.[117] Of the total UK woodland area, 0.86 million hectares (27%) is owned or managed by the Forestry Commission (in England and Scotland), Natural Resources Wales (in Wales) or the Forest Service (in Northern Ireland), ranging from 16% in England to 55% in Northern Ireland.[118] The other forest owners comprise of approximately 43.6% private owners, 12% businesses, 3.6% charities, and

110 *The UK Renewable Energy Strategy*, (London: The Stationery Office, 2009).

111 *UK Low Carbon Transition Plan*, (London: Department for Energy and Climate Change, 2009).

112 *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. (Cambridge: UNEP-WCMC, 2011).

113 *Woodfuel Implementation Plan 2011–2014*, (Edinburgh: Forestry Commission, 2011).

114 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

115 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

116 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

117 Quine, C.P., Bailey, S.A., Watts, K. 'Practitioners perspective: Sustainable forest management in a time of ecosystem services frameworks: common ground and consequences', *Journal of Applied Ecology* **50** (2013): 863–867.

118 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

4.9% local authorities and other public owners in 2001.[119] However, all of these forest owners tend to have different objectives for their forest management that need to be taken into account.[120] The increasing fragmentation of private forest owners adds to the diversity of forest management objectives. Moreover, due to the devolution of public administration in 1998, today, each of the four countries operates its own forestry policy, adding to this complexity.[121]

Table 1: Changes in Woodland Coverage and Management Objectives in the UK

Year	**Hectares** (000 ha)	**Percentage** of land cover	Main Forest Resource Objectives*
1905	1140	4,7%	Timber
1924	1272	5,00%	Timber
1947	1481	5,9%	Timber, landscape amenity
1965	1740	7,40%	Timber, landscape amenity, recreation
1980	2108	9,00%	Timber, recreation, conservation
1998	2506	12,00%	Timber, recreation, carbon sequestration, biodiversity
2018	3173	13,10%	Timber, recreation, carbon sequestration, biodiversity, woody biomass

*These are formally supported by law. Source: Forestry Commission (2018)

8. Conclusion

Over the last 100 years, successive governments have had shifting priorities for forestry in the UK, with significant impacts on tree planting and management. It evolved from a focus on re-afforestation, to provide an adequate supply of timber, to consideration of the multiple public benefits associated with forest ecosystems. Between 1919 and 1939, there was only a small net change in the gross woodland area in the UK and the net area of privately owned woodland did not increase until after 1956. The net area of state forests

119 This is the last publication of this type of data. Smith, S., Gilbert, J., Coppock, R. 'Great Britain: new forecast of softwood availability', *Forestry & British Timber* **30** (2001): 20–25.

120 Raum, S. 'A framework for integrating systematic stakeholder analysis in ecosystem services research: Stakeholder mapping for forest ecosystem services in the UK', *Ecosystem Services* **29** (2018): 170–184.

121 Raum, S. 'A framework for integrating systematic stakeholder analysis in ecosystem services research: Stakeholder mapping for forest ecosystem services in the UK', *Ecosystem Services* **29** (2018): 170–184.

nearly doubled between the mid-1940s and 1980, after which planting slowed considerably.[122] Yet, new plantation forests differed markedly, both visually and ecologically from established woodlands. Policy mechanisms have been based throughout on a combination of statutory controls, including felling licenses, planting and management grants, and tax concessions, which became increasingly supplemented by guidelines, education, and certification.

To conclude, despite a hundred year-long effort to re-afforest the country and an increase of forest cover from initially 4.7% to 13.1%, forestry policy in the UK continues to be influenced by its low forest cover. Today, the UK is still one of the least densely forested countries in Europe, which has an average of 38% of forest cover as a whole; the world wide average is 31%.[123] Comparable countries, such as Sweden (68%), Germany (33%), Italy (32%), and France (31%) have much higher forest cover.[124] Moreover, the UK is the second largest importer of timber in the world.[125] It therefore continues to strongly dependent on the timber supplies of other countries. New forestry objectives have added to the pressure on the important forest resource, involving an ever-widening group of stakeholders, and requiring increasingly complex trade-off decisions between their varying needs. Future attempts to regulate, incentivise and persuade further planting and the provision of the required benefits mix from forests must also address the interests of an increasingly diverse group of forest owners, including scattered small scale private owners. At the same time, it will be increasingly challenging to make more land available for tree planting and to align multiple forestry objectives. The findings offer import insights into the long-standing impact of natural resource depletion and the efforts needed to undo, at least some of the damage.

122 Aldhous, J.R. 'British forestry: 70 years of achievement', *Forestry* **70** (1997): 283–291.

123 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

124 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

125 *Forestry Statistics 2018. A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom*, (Edinburgh: Forest Research, 2018).

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Common Forest Ownership in Austria

PETER HERBST,
Expert at Forestry and Lawyer, Villach, Austria
www.waldrecht.at

Abstract: Common ownership in Austrian forests can be traced back for more than 2,000 years and has been one of the most prevalent tenurial regimes in Central and Eastern European forests for more than 160 years now – such structures have survived practically untouched everywhere on the territory of the former Austro-Hungarian Empire. In the mountainous parts of Austria commonly owned forests are a major factor in land use planning and policy. Administration of these joint ownership structures was institutionalised in 1853, and since 1950 they have been legally classified as public law corporations (*Agrargemeinschaften*). This paper shows how rural common property in Austria was established and how it has been successfully managed under the same regulatory and institutional regime for the last 150 years.

Keywords: forest policy, forest history, agrarian reform legislation, commonly owned forests, *Agrargemeinschaften*, Austria

1. Introduction

The common ownership of rural land, mainly of forests and pastures, in contemporary Austria can be traced back as far as Germanic times, more than 2,000 years ago; and it has been one of the most prevalent tenurial regimes in Central and Eastern European forests for more than 150 years now. Even after 1919, these structures survived on vast parts of the territory of the former Austro-Hungarian Empire, remaining practically unmodified on the territories of nowadays Austria, Slovenia, Croatia[1], Slovak Republic[2], northern

1 Nonic, D., Tomic, N., Markovic, J., Herbst, P. and Krajcic, D. 'Organization of Private Forest Owners in Serbia Compared to Austria, Slovenia and Other Central European Countries', paper presented at the IASCP Europe Regional Meeting *Building the European Commons: From Open Fields to Open Source*, Brescia, Italy, (Brescia: 2006).

2 Šulek, R. 'Common-pool resources in Central Europe: Case study of forestry in the Slo-

Figure 1: Location of the study area in the south-eastern Alps

parts of Romania[3], and northern Italy, although they frequently were constricted under considerably unfavourable political framing conditions[4].

One of the most typical areas of the former empire, in terms of historical socioeconomic development and ecological features, is the western half of the Austrian province of Kärnten (Map 1), and therefore I have chosen it for a case study. It has a total area of 471,600 hectares, of which 272,700 hectares (57.8%) are forested.[5]

Approximately 30 per cent of the total area of this part of Austria (more than one-third of alpine pastures and one-quarter, or 65.000 hectares, of forest land) belongs to more than 1,400 corporations in joint ownership.[6]

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vak Republic', paper presented at the IASCP Europe Regional Meeting *Building the European Commons: From Open Fields to Open Source*, Brescia, Italy (Bescia: 2006).

3 Minca, V.; Mantescu, L. 'Local interests and individual belonging in village forest commons in Vrancea Mountains of Romania', paper presented at the IASCP Europe Regional Meeting *Building the European Commons: From Open Fields to Open Source* Brescia, Italy (Brescia: 2006).

4 Csóka, P. 'Forest Policy Activities in the Countries in Transition in Their Preparation for the EU' Forest Policy in the Countries with Economies in Transition – Ready for the European Union', *EFI Proceedings 21* (Joensuu: 1998)

5 Ergebnisse der österreichischen Waldinventur 2007–09 (Vienna: BFW 2018) http://bfw.ac.at/rz/wi.home.

6 Herbst, P. 'Rural 'Common Property in Austria', paper presented at the *International Association for the Study of Common Property* Oaxaca City, Mexico (Oaxaca City: 2004).

In the mountain valleys of the South-Eastern Alps, where the Province of Kärnten is located, common tenure is one of the most prevalent categories of rural land ownership and is therefore a major factor in land use planning and policy. Administration of these joint ownership structures was institutionalised here in 1853, and since 1950 they have been legally classified as public law corporations (*Agrargemeinschaften*, rural common property). A special supervising authority (*Agrarbehörde*) was established in 1883 to safeguard the sustainable management of these commons.

Politically, modern Austria is a federal republic; agrarian reform legislation is regulated through federal framework laws and the more detailed legislation of provinces (also known as federal states) based on them. Due to the high variety of ecological, social, and historical conditions present in the federal provinces, the portion of commonly owned forest in each differs considerably. For example, in the provinces of east Austria, where the terrain is predominately flat, commonly owned forests were largely distributed amongst private owners whenever possible, whereas in the mountainous western provinces the government transformed public forests into commonly owned forests under *Agrargemeinschaften* to safeguard the survival of the local population.[7] By the end of the nineteenth century, the distribution of commonly owned forests in the provinces was already quite inhomogeneous, ranging from only 1 per cent of the total forest area in the province of Upper Austria to 54 per cent in Tyrol and Vorarlberg.[8] Remarkably enough, the eastern-most Austrian province of Burgenland, having belonged to the Hungarian part of the empire before 1921, shares the traditions of the corporations in joint ownership, which there are called *Urbarialgemeinden*.[9]

2. Historical Origins

Historically, rural common property in Austria can be traced back to either settlement-related origins or easement-related origins.

7 Johann, E. 'Zur Entstehung des Waldeigentums', in: *Österreichs Wald in Vergangenheit und Gegenwart* (Wien: Österreichischer Agrarverlag 1983).

8 Dimitz, L. 'Österreichs Wald und Waldwesen vor dem Jahre 1848', in *Österreichs Forstwesen 1848–1888* (Wien: Frick 1890).

9 Šulek, R. 'Common-pool resources in Central Europe: Case study of forestry in the Slovak Republic', paper presented at the IASCP Europe Regional Meeting *Building the European Commons: From Open Fields to Open Source*, Brescia, Italy (Brescia: 2006).

2.1. Settlement-related Origins

Common management and use of rural property in modern Austria date back more than 2,000 years to Germanic times. Forests, meadows, and alpine pastures were commonly owned by all, or groups of, inhabitants of adjacent villages (*Allmende*). The legal basis for maintaining internal order under common land ownership was customary law.

In 1871, when land records were rearranged in Austria, it was necessary to formally establish ownership rights and attribute them to specific bodies. Wherever it was favourable, the commons were divided and distributed to all co-owners, according to their shares of rights; wherever this was unfeasible for ecological or economic reasons, the commons were regulated and became *Agrargemeinschaften*. Regulations specified the rights and duties of all members (shareholders) and the organisational structure of each *Agrargemeinschaft*, and clearly distinguished the scope of the duties of local communities (political self-governing bodies) on the one hand and of the *Agrargemeinschaften* on the other.[10]

In the Austrian part of the Austro-Hungarian Empire, the legal basis was the Imperial Act on the Division or Regulation of Rural Common Property (1883). This act was a framework law that guided the creation of detailed regional legislation.

In the Hungarian part of the empire, however, the act specifying the legal status of common property was issued later, in 1898. In Slovakia it was valid until 1995, when the new Act on Land Associations was introduced.[11] Remarkably enough, this land-ownership-related law survived through several political systems (monarchy, democracy, and communism).

The settlement-related origins of rural common property are still reflected in the names of *Agrargemeinschaften*, which in addition to the local place name also include the term *Nachbarschaft* (neighbourhood), a medieval administrative unit.

10 Greif, F. 'Organisationsstrukturen in der österreichischen Landwirtschaft', in *Aktuelle Tendenzen der Agrargeographie* (Wien: 2002).

11 Šulek, R. 'Common-pool resources in Central Europe: Case study of forestry in the Slovak Republic', paper presented at the IASCP Europe Regional Meeting *Building the European Commons: From Open Fields to Open Source*', Brescia, Italy (Brescia: 2006).

2.2. Easement-related Origins

Before 1848 most Austrian farmers were landless serfs under local nobles. These serfs had to cover their timber, fuel wood, hay, and other needs from easements on lands that belonged to their masters. One of the consequences of emancipation in 1848 was that such easements had to be converted into landed property to meet the annual demands of each peasant.[12] In mountainous areas, mainly because of the rough terrain, it was impossible to cover the timber and fuel wood demands of each entitled farm by allocating an undivided, specific patch of forest (for calculations regarding allocated areas);[13] the solution was to allocate large forest areas for common use. These commonly owned areas, also known as *Agrargemeinschaften*, were regulated on the very same basis as the former *Allmende* (see section 3.1).

In almost all mountain settlements in southern Austria, both types of commons exist in parallel. *Nachbarschaften*, being the former *Allmende*, are usually small and located adjacent to settlements, whereas holdings derived from former easements include large forests and alpine pasturelands.

3. Managing the Commons

In the alpine valleys of southern Austria farms that own shares in *Agrargemeinschaften* do not additionally own private forests. Sustainable common land use is therefore an essential precondition for the survival of a considerable portion of the rural population in this area.

Although the regulations and structures of these *Agrargemeinschaften* are in most cases over 100 years old (but have been modified over time), the macro- and microeconomic and cultural importance of such commons is indisputable. On the one hand, huge areas of land that would be otherwise unmanaged because of their low economic value are managed thanks to common ownership. On the other hand, common management results in multiple synergetic effects (such as saving time, labour and resources).

The idea of sustainable forest and pasture management has a centuries-long tradition in the Austrian Alps. It was first officially laid down in commons-related legislation, some of which reaches back to thirteenth-century

12 Schiff, W. *Grundriß des Österreichischen Rechts: Agrarrecht* (Leipzig: Verlag von Duncker und Humblot 1903).

13 Baur, F. *Handbuch der Waldwertberechnung* (Berlin: Verlag Paul Parey 1886).

regulations.[14] Today's clear legal basis and strict law enforcement system reflect the overall significance attributed to the appropriate management of Austrian *Agrargemeinschaften*.

3.1. Legal Basis

All regulations related to *Agrargemeinschaften* are laid out in federal framework laws and related detailed provincial legislation. They regulate the appropriate and orderly management and use of commons by a majority of owners, as well as the procedure for dissolving *Agrargemeinschaften*.

According to Austrian public law, *Agrargemeinschaften* are legal entities. An *Agrargemeinschaft* is legally defined as the collective body of owners of common land in which the owners possess fractional shares of the commonly owned land (tenancy in common or *Stammsitzliegenschaften*). Direct personal ownership of shares is a second option, however, very uncommon.

In the study area there are 1,431 *Agrargemeinschaften* with 19,852 entitled estates (*Stammsitzliegenschaften*) holding a total a 210,686 shares.[15]

Legally, there is a reciprocal connection between the land and the owners: commonly owned land is considered to be the passive component in the management system governing Austrian commons, whereas the public law corporation is the active element. Each part is directly dependent on the other, as no corporation can exist without land, and vice versa no land of that specific legal form can exist without being related to a corporation.

3.2. Internal Administration

Agrargemeinschaften are decentralised public law corporations and thus self-governing. They are legally obliged to sustainably manage their commonly owned lands. The administration and management of *Agrargemeinschaften* are performed through their executive bodies, which include a plenary assembly, a management committee, and a chairman.

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14 Johann, E. 'What we can learn from history: The present role of commons in managing the environment: The case study of Austria', paper presented at the IASCP Europe Regional Meeting *'Building the European Commons: From Open Fields to Open Source'*, Brescia, Italy (Brescia: 2006.

15 Liskounig, R. *Agrargemeinschaften in Kärnten – Analyseinstrumente und Werkzeuge zur Strukturerfassung,* Masters Thesis, Institut für Raumplanung und Ländliche Neuordnung (Wien: BOKU, 2003).

3.2.1. The Plenary Assembly

All shareholders (owners of *Stammsitzliegenschaften*) are members of the plenary assembly, the central body of each *Agrargemeinschaft*. Plenary assemblies are legally obliged to hold regular meetings at least annually. Decisions are usually taken by open votes; shareholders can cast as many votes as they have shares. In a few cases, however, each shareholder gets only one vote, no matter how many shares they may hold (see section 4.1; statistically, each entitled estate holds a mean of 10.6 shares). The voting system – like all other issues governing each *Agrargemeinschaft*'s internal administration – is laid down in each entity's regulatory instrument (*Generalakt*, see section 4.1).

The rights and duties of the plenary assembly include

- electing and dismissing the chairman, the deputy chairman, the treasurer and other members of the management committee, and the two auditors;
- alienating, leasing or encumbering commonly owned parcels;
- mortgaging commonly owned parcels;
- admitting new shareholders by approving the alienation of shares to non-members;
- proposing motions for amending the regulatory instrument; and
- making decisions on all issues that are not explicitly assigned to the management committee or the chairman.

An overruled minority has the right to file an appeal to the supervising authority within a short statutory period (usually eight days). If the authority judges the appeal to be well founded, the decision is quashed.

3.2.2. The Management Committee

The management committee typically consists of a chairman, a deputy chairman, a treasurer, a secretary and other members (depending on the total number of shareholders and the special requirements of the *Agrargemeinschaft*).

The management committee is responsible for the proper business management of the *Agrargemeinschaft*. Proper business management includes conserving and sustainably managing commonly owned assets.

3.2.3. The Chairman

The rights and duties of the chairman (or deputy chairman) include

- possessing the authority to represent the *Agrargemeinschaft* (even if only ostensibly);
- directing business management;

- enforcing orders and directives as well as internal decisions (made by the plenary assembly or the management committee);
- drawing up annual reports, in cooperation with the management committee; and
- taking all necessary measures to ensure shareholders timely contribute according to and within the range of their duties (fee payments, non-cash contributions, unpaid community labour).

3.3. Regulatory Enforcement

Agrargemeinschaften are self-governing bodies; they are entitled to decide all internal matters autonomously and self-responsibly. Still, they are subject to supervision by a special supervising authority, the *Agrarbehörde*, to safeguard sustainable management of the commons.

This special supervising authority was established in 1883, when over-exploitation and even devastation of commonly owned lands had become intolerable.

The competencies of this authority include

- making declaratory decisions on the existence of a certain *Agrargemeinschaft*, on shares and on ownership relations;
- implementing regulatory procedures or procedures for dividing *Agrargemeinschaften*;
- settling disputes among shareholders or among an *Agrargemeinschaft* and individual shareholders;
- examining the legality of decisions taken by an *Agrargemeinschaft*, with the possibility of cancelling illegal decisions;
- approving the alienation or encumbrance of commonly owned parcels;
- approving the mortgaging of commonly owned parcels; and
- approving the alienation of shares.

The supervising authority will typically intervene to notify shareholders who have violated management plans about the suspension of their rights for a limited period; any illegally harvested goods remain the property of the *Agrargemeinschaft*.

In commonly owned forests, there are two authorities responsible for sustainable forest management: the State Forest Inspection and the provincial *Agrarbehörde*. What are their roles? A high portion of commonly owned forests is located in steep terrain and is therefore classified as protected forest; the State Forest Inspection enforces the Forest Act to safeguard proper

silvicultural practices and the protection of forest sites. *Agrarbehörde* enforce agrarian reform legislation, which – much more than forest legislation – takes into account the social, economic, ecological and cultural dimensions of general land use planning.[16]

The sustainable use of key resources such as commonly owned forests must therefore specifically focus on balancing more or less conflicting interests, emphasising in particular the limited availability of resources and the irreversibility of their utilisation.

4. Regulatory Procedures and Procedures for Dividing Commons

The sustainable management of commons is preconditioned on clearly determining the legal and economic relations both within and without an *Agrargemeinschaft*.

To achieve the necessary level of clarification with respect to commons, Austrian law provides two main instruments: regulation and division. The principles of these procedures, formulated in the nineteenth century, are still applicable today.[17]

4.1. Regulating Commons

The goal of regulation is to clarify and determine – in a legally binding way – how common property is administered and used in keeping with the overall principle of sustainability.

Regulations necessarily take into account the basic right of all shareholders to sustainably use their common property, which is, however, limited by the number of shares they hold. Because of their historical origins, *Agrargemeinschaften* have to fulfil a variety of functions; foremost they must enable farmers to subsist in the harsh conditions of Alpine mountain valleys. Forest and pasture management plans must cover the basic needs of each shareholder's farm.[18] Each regulation must grant shareholders the right to

16 Hellbart, S. 'Nachhaltigkeit und Zeitgemäßheit von Agrarverfahren' in *Der Alm- und Bergbauer* ***8–9/99*** (1999): 12–14.

17 Schiff, W. *Grundriß des Österreichischen Rechts: Agrarrecht* (Leipzig: Verlag von Duncker und Humblot, 1903).

18 Herbst, P. 'Waldwirtschaftspläne für Agrargemeinschaften', in *Kärntner Landwirtschaftsbericht 2014* (2015): 75.

use (jointly or independently from other users) their common property in a sustainable way, that is, within the framework of annual allowable harvesting and bearing capacities.

The regulatory procedure of a certain *Agrargemeinschaft* is opened by the supervising authority by official notification, either ex officio or following an application by at least one-tenth of the shareholders (the minimum requirements differ in each provincial regulation). The initial step is to estimate the sustainable yield of all parcels commonly owned by the *Agrargemeinschaft* under revision, followed by the determination of shares and holders. After that, management plans are established and approved.

Regulatory procedures are closed by the supervising authority with the official notification of the adoption of the regulatory instrument (*Generalakt*), which generally consists of regulation documents, maps of parcels and catalogues of assets, a list of shareholders and their shares, evaluation and management plans, and the charter of the *Agrargemeinschaft*.

The management and administration of each *Agrargemeinschaft* is based entirely on its regulatory instrument.

4.2. The Division of Commonly Owned Forests

The division of commonly owned forests by distributing commons or parts thereof among all or some shareholders has typically been an issue in times of low tenure security. In Austria from the fourteenth century onwards an ever-increasing population combined with a shortage of available cultivated land led to social controversies and caused remarkable changes within the ownership structure. Uncertainty amongst shareholders concerning forest ownership and utilisation rights led to large-scale forest devastation.[19]

The breaking up of commonly owned forests was expected to create the necessary tenure security. Consequently, Austrian legislation provides for two possible procedures for dividing *Agrargemeinschaften*, namely, the total dissolution of an *Agrargemeinschaft*, or the separation of one or more shareholders from an *Agrargemeinschaft*, which continues to exist amongst the remaining shareholders.

19 Johann, E. 'What we can learn from history: The present role of commons in managing the environment: The case study of Austria', paper presented at the IASCP Europe Regional Meeting *Building the European Commons: From Open Fields to Open Source*, Brescia, Italy (Brescia 2006).

Dividing commons is inadmissible in cases when practical management would be jeopardised by such a move or when the supervising authority objects on macroeconomic, microeconomic, or cultural grounds. The fragmentation of holdings, particularly in a forest-management context, might contradict protection provisions.[20]

In any case, commonly held land is broken up by the allotment of part of commonly owned land to the leaving parties based on the relative value of their shares. Compensatory payments are permissible in exceptional cases only.

Now that Austria is a constitutional state in which the protection of property and usage rights is secured not only by the constitution, the civil code and agrarian reform legislation but also through Austria's international commitments, the division of commonly owned forests is no longer high on the agenda.

The EU Council Resolution on a Forest Strategy of 1998 established a framework for forest-related actions that support sustainable forest management. It maintains that forest policy lies in the competence of Member States, but the EU can contribute based on the principle of subsidiarity.[21] While Austria's accession to the EU therefore had no real impact on the Austrian forestry sector, in general, the role of commonly owned forests was considerably strengthened. Not only in the context of the EU has the fragmentation of forest holdings, especially small-scale private forests, been identified as one of the core risks regarding wood mobilization and the provision of other forest functions, especially public goods and services. *Agrargemeinschaften*, therefore, received strong support under the 1999–2004 EU Forest Strategy as well as the 2007–2013 EU Forest Action Plan.[22]

20 Herbst, P. 'Waldwirtschaftspläne für Agrargemeinschaften', in *Kärntner Landwirtschaftsbericht 2014* (2015): 75.

21 Lazdinis, M., Herbst, P. and Szedlak, T. 'EU Forest Action Plan: An emerging opportunity', paper presented at the *8th International Symposium on Legal Aspects of European Forest Sustainable Development*, Istanbul, Turkey (Istanbul: 2006).

22 Birot, Y., Päivinen, R., Angelstam, P., Herbst, P., Marchetti, M., Orlando, B., Papageorgiou, A., Schenkel, Y., Schmidt, W. and Torsen, B.J. *Report from the expert group on the vision and strategic objectives for the EU Forest Action Plan*, October 4, 2005 (Brussels: European Commission 2005); Herbst, P. 'EU-Aktionsplan für nachhaltige Waldbewirtschaftung', *Österreichische Forstzeitung 116 (12)* (2005): 12.

5. Use of Income

As mentioned above, *Agrargemeinschaften* are an important economic factor in the rural areas of the Austrian Alps. It is therefore only logical that considerable income is generated from commonly owned areas – not only from primary production, but also from the use of such areas as tourism facilities (ski slopes, hiking and mountain biking trails, etc.)

Any income generated from managing commons has to be re-invested in conservation and improvement of the commonly held property (*Agrargemeinschaft*). According to standardised statutes, necessary managerial as well as manual labour has to be provided by all shareholders commensurate with the number of shares held; today sufficiently qualified workers are no longer available locally because many mountain farms are abandoned or have absentee owners. Consequently, a considerable portion of income has to be spent on wages.

The plenary assembly may, however, distribute income to shareholders based on shares held. The recent introduction of a 25-per cent capital gains tax (a federal tax in Austria), however, has caused serious problems in this respect.

The issue of liability when commonly owned land is used for recreational activities has also become a relevant limiting factor.[23]

6. Conclusions

Rural common property in Austria has been managed under the same regulatory and institutional regime, based on continuously adapted legislation, for almost 150 years now. Over the decades, it has been possible to identify and to learn from many undesirable developments and to (re-)act accordingly.

The Austrian experience has proven replicable in many Central and Eastern European countries, mainly because of similar long-standing forest management systems (stretching from Germany and Austria to the former Soviet Union) and a shared political history (within the Austro-Hungarian Empire). It might not be applicable as a kind of blueprint solution for community forest management in other parts of the world, however.

23 Herbst, P. 'Liabilities resulting from Public Access to Forests in Austria', in Sulek, R., Hrib, M., Sodkova, M. (eds.), *Legal Aspects of European Forest Sustainable Development* (Prague: Faculty of Forestry and Wood Sciences, Czech University of Life Sciences, 2016).

Bray et al. (2006) refer to the Mexican model of community forest management, and when comparing it to other Latin American countries (such as Guatemala and Bolivia), suggest that 'experience shows that communities, with appropriate legislative and programmatic support, and with endowments of social and natural capital, can deliver significant social, economic and ecological benefit locally, nationally and globally'.

There is not much to be added – except perhaps that in the community forest management context, besides appropriate legislation, enforcement plays an eminent role. Regulations therefore need to be clear and consequently enforceable.

The results of Austrian national forest inventories[24] have shown that – because of such proper management – commonly owned forests in southern Austria have never been in better ecological or economic conditions than today.

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24 Ergebnisse der österreichischen Waldinventur 2007–09 (Vienna: BFW 2018) http://bfw.ac.at/rz/wi.home.

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The Politics of Trees: The Logging Of Białowieża Forest and the Debate Over Poland's Political Identity

TATYANA BAKHMETYEVA, University of Rochester

Abstract: Białowieża Forest, located at the border of Poland and Belarus and used in the past as hunting grounds by kings, as a place of refuge for rebels against Russia, and as a hide-out for WWII partisans, has furnished the nation with cultural markers that contribute to its collective sense of self. This rich cultural heritage makes Białowieza a site where competing visions of Polish national identity come together turning the forest into contested grounds that political groups use to negotiate Poland's place and role in the EU. Relying on historical imagery, the supporters of the current conservative government advocate a more independent position vis-à-vis the EU while claiming for Poland a leading role in preserving traditional conservative values. The environmentalists see Białowieża as an important symbol of shared European heritage. This debate illustrates that at a political crossroads, conflicting cultural visions of national landscapes become strategies that political actors enlist in their struggle for power at the local and national level.

Keywords: forest use, national landscapes, environmentalist movement, tradition, nature protection

1. Introduction

Białowieża Forest, located at the border of Poland and Belarus, holds an important place in the Polish national imagination. Used as hunting grounds by kings, a place of refuge for rebels against Russia, and as a hide-out for WWII partisans, the forest has furnished the nation with cultural markers that contribute to its collective sense of self. This rich cultural heritage makes Białowieza a site where competing visions of Polish national identity come together in a complex interplay of symbols, stories, and images, turning the forest into a contested ground that various groups use to negotiate Poland's place and role in the European Union and to test their power to shape the

country's identity. Relying on historical imagery, the supporters of the current conservative government advocate a more independent position vis-à-vis the EU while claiming for Poland a leading role in preserving traditional conservative values. Their opponents, including the environmentalists, on the other hand, see Białowieża as an important symbol of shared European heritage. This debate illustrates that at those moments when a nation finds itself at a political crossroads, conflicting cultural visions of national landscapes become strategies that various political actors enlist in their struggle for power at the local and national level. Białowieża forest is a case in point.

2. The logging controversy in Białowieża forest

A large temperate mixed forest, Białowieża forest (*puszcza* in Polish) is a place of remarkable biodiversity and home to many unique species, including the European bison. The uniqueness of Białowieża has long been recognized, and protection measures have gradually been put in place. In 1979, the Białowieża National Park in Poland was added to the World Heritage List, becoming a UNESCO World Heritage Site in 1979 and then in 2004 – a *Nature 2000* site (a European network of protected sites, habitats for rare and threatened species),[1] and a place of an outstanding universal value. Administratively, the Polish side of the *puszcza* is managed by two institutions: 17% is the National Park, an area under strict protection, with entry permitted only with a guide, and the remaining 83% is managed by Lasy Państwowe/State Forests, where some logging is permitted but under a strict quota and only in designated areas with the rest identified as protected. Starting in 2015, however, these protected areas were opened to logging. Citing the safety of walkers and cyclists on the *puszcza* roads and the ongoing bark beetle outbreak, the former Minister of Environment Jan Szyszko defended logging as part of Poland's wider legal obligations to protect both the people and the forest. "We are acting in line with the EU laws," he told a news conference in July 2017 as Konrad Tomaszewski, a representative of the state forest management agency added, "We have to fulfill the protective measures plan and this is what we are doing."[2] While some scientists sided with the governmental position, others

1 Pabian, O., Jaroszewicz, B. *Assessing Socio-Economic Benefits of Nature 2000: a Case Study on the Ecosystem Services Provided by Białowieża Forest (Poland) Output of the project Financing Natura 2000: Cost estimate and benefits of Natura 2000,* (2007).

2 Barteczko, A., Baczynska, G. 'Poland continues logging venerable state forest, defying EU reforms', *The Christian Science Monitor*, (31 July 2017). https://www.csmonitor.com/En-

suggested that it was logistically impossible to stop the outbreak by cutting down trees and insisted that to be effective, at least 80 % of trees attacked by beetles needed to be eliminated.[3] The weakening of the trees, they argued, was caused by drought, making logging a misguided attempt to address the problem and noting that this excuse for logging also ignored the fact that "bark beetle outbreaks occur in Białowieża every 8–10 years and should be viewed as a natural factor shaping changes in the forest composition, especially, in an era of rapid climate change."[4] In addition, the scientists also insisted that bark beetles and rotten trees benefitted forest ecosystems, creating important eco habitats for various species and helping the forest adapt to climate change.[5] In fact, as stated in the complaint submitted by *Client Earth* in April 2016 to the European Commission, the "removal of dead and dying trees is one of the basic threats to different protected habitats and species, including those of conservation priority."[6]

In April 2018, the European Court of Justice, in a rebuke of the Polish

vironment/2017/0731/Poland-continues-logging-venerable-state-forest-defying-EU-reforms (accessed 10 December 2017).

3 Fahse, L., Heurich, M. 'Simulation and Analysis of Outbreaks of Bark Beetle Infestations and Their Management at the Stand Level', *Ecological Modelling* **222** (11) (2011): 1833–1846.

4 *Complaint to the European Commission Concerning Alleged Breach of Union Law*, 6. http://d2ouvy59p0dg6k.cloudfront.net/downloads/2016_04_19_complaint_to_ec_alleged_breach_eu_law_over_logging_bialowieza_en.pdf (accessed 20 April 2018); Kowalczyk, R., Tryjanowski, P., Żmihorski, M. *30 pytań o kornika, leśników i ekologów w Puszczy Białowieskiej – naukowcy odpowiadają na najczęstsze pytania i wyjaśniają jak jest naprawdę* (a leaflet) (2017). https://otop.org.pl/wp-content/uploads/2017/06/Naukowcy-o-Puszczy.pdf (accessed 14 March 2018).

5 *The position of the Board of the Faculty of Biology and Environmental Protection of the University of Silesia in Katowice on the planned increase of logging in Białowieża Forest adopted on 22 January 2016*, (2016) http://d2ouvy59p0dg6k.cloudfront.net/downloads/council_faculty_biology_environmental_protection_university_of_silesia_eng.pdf (accessed March 10 2018); Bobiec, A., Gutowski, J.M., Laudenslayer, W.F., Rawlaczyk, P., Zub, K. *The Afterlife of a Tree,* (Warszawa – Hajnówka: WWF Poland, 2005); Czeszczewik, D., Walankiewicz, W. 'Ecology and Biology of Birds in the Białowieża Forest: a 40-Year Perspective', *Leśne Prace Badawcze/Forest Research Papers* **77** (4) (2016): 332–340; Kajzer, K., Sobociński, W. *Raport końcowy podsumowujący temat badawczy: „Określenie czynników determinujących populacje dzięcioła białogrzbietego Dendrocopos leucotos i dzięcioła trójpalczastego Picoides tridactylus w Puszczy Białowieskiej", wykonany w ramach umowy nr OR-2717–24/11, zawartej w dniu 5 kwietnia 2011 roku z Dyrekcją Generalną Lasów Państwowych,* (Warszawa–Białowieża, 2012).

6 *Complaint to the European Commission Concerning Alleged Breach of Union Law*, 6. http://d2ouvy59p0dg6k.cloudfront.net/downloads/2016_04_19_complaint_to_ec_alleged_breach_eu_law_over_logging_bialowieza_en.pdf (accessed 20 April 2018).

government, ruled that the ongoing logging was a breach of European Union law and had to stop immediately (although the ruling allowed the removal of dead trees in areas where they threated the safety of passersby).[7] In contrast to earlier episodes of this dispute when Poland stood defiantly against the EU, in this case, Henryk Kowalczyk, the new Minister of the Environment, stated that Poland would adhere to the ruling.[8] Thus, it appeared that the battle for Białowieża was over – but probably only for the moment, because if history tells us anything, the battle will sooner or later resume as debates about Białowieża's past, present, and future flare up with almost predictable frequency, intensifying at moments when Poland attempts to chart a new political course.

Białowieża and Poland's place in the European Union

A similarly intensive public and political debate about Białowieża in the early 1990s – 2000s, for example, coincided with the period of Polish European integration, as Poland sought admission into both NATO (granted in 1999) and the EU (Poland submitted its application for membership in 1994 and became a member in 2004). The current round of tensions, on the other hand, took place in the aftermath of the electoral victory of the conservative Christian democratic political party *Law and Justice* (*Prawo i Sprawiedliwość*, PiS) that won the 2015 parliamentary elections with an outright majority. After taking power, the new government swiftly unleashed strongly nationalist and conservative rhetoric, launching an attack on the Polish judiciary system and women's reproductive rights among other things – actions that suggested that the new government had a vision of Poland as a bulwark of traditional conservative values that were perceived as being under assault from the liberal EU leadership. Just as in the 1990s, these tensions indicated that the discussions about what seemed exclusively environmental issues served as a platform to debate models of national identity, citizenship, and the place and status of Poland in Europe.

In the 1990s and early 2000s, for example, the environmental debates

7 Case C-441/17. *European Commission against the defendant, the Republic of Poland, represented by the Minister of the Environment J. Szyszko, B. Majczyna and D. Krawczyk, acting as Agents, assisted by K. Tomaszewski.* http://curia.europa.eu/juris/liste.jsf?num=C-441/17&language=EN (accessed 1 May 2018).

8 Stokstad, E. 'Logging in Europe's Primeval Forest Ruled Illegal', *Science*, (18 April 2018). http://www.sciencemag.org/news/2018/04/logging-europe-s-primeval-forest-ruled-illegal (accessed 18 April 2018).

in Poland helped the country to strengthen its bid for EU membership as Poland was positioning itself as a country with an active environmentalist movement and a government that looked favorably on such a movement. In 1996, the territory of the Białowieża National Park was enlarged to about 10,000 hectares with a network of forest reserves being established at the same time, one reason for such an expansion being the need for the Polish government "to atone for pollution elsewhere in Poland at a time when Poland [was] attempting to meet the Copenhagen Criteria for European accession." In these circumstances "[n]ational parks ma[de] valuable 'green visiting cards."[9] As Eunice Blavascunas notes "With European reunification came new opportunities for Poland to show that it was not only part of Europe, but in some case superior to it. Successful nature protection became a strategy for highlighting Polish culture"[10] and an opportunity for Poland to reassure its Western European neighbors that it had fully embraced democracy as it sought membership in the EU and NATO. In the current political context, on the other hand, as Poland increasingly sees itself at odds with the EU, continuous logging became for the new Polish government a mark of their independence, a stand against what they saw as patronizing pressure from the EU and therefore for Polish political, cultural, and economic autonomy; it also became a justification for Poland to claim a leading role in Europe in protecting traditional conservative values.

3. Białowieża and Polish national identity

Białowieża, then, is central to both Poland's experience of its national identity as unique and separate from other European countries, and to its claim to membership in the larger European family. This coexistence of conflicting purposes confirms the observations of historian Jeffrey Wilson who argues that historically nature has frequently been used as a repository of national symbols and ideas, often contradictory ones.[11] Furthermore, the ability of

9 Wagstyl, S. 'Greening moves proves a drain on resources', *Financial Times Special Report – Poland,* (17 April 2000), 6; Franklin, S. 'Białowieża Forest, Poland: Representation, Myth, and the Politics of Dispossession', *Environment and Planning* **34** (8) (2002), 1480.

10 Blavascunas, E. 'When Foresters Reterritorialize the Periphery: Post-socialist Forest Politics in Białowieża, Poland', *Journal of Political Ecology* **21** (1) (2014), 483.

11 Wilson, J. *The German Forest: Nature, Identity, and the Contestation of a National Symbol, 1871 – 1914,* (Toronto: University of Toronto Press, 2012), 215. See also Roderick Nash, *Wilderness and the American Mind* (New Haven: Yale University Press, 2014). And, for specific

the landscape to serve as repository of symbols that bind a nation together and the presence of a variety of meanings that exist simultaneously suggests that at times when the nation explores new political and cultural directions, natural landscapes might emerge as sites used by different groups to articulate their visions of the nation's past and future as well as new concepts of national identity. At moments when a nation finds itself at a crossroads, conflicting interpretations and visions of national landscapes become "strategies of political actors that enlist such representations as tools in the struggle for power at the local and national scale"[12] as these actors "structure the landscape and invest it with the meaning that is appropriate with respect to their identities."[13] In that process, they often rely on heavily imagined ideas of national landscapes.

In the case of Białowieża, these ideas ranged from seeing the forest as primeval, virgin, untouched by human activity[14] to those that saw it as product of a purposeful and consistent management policy. This view of the forest as a man-made landscape, one constructed and used by those who lived in and near it partially coincided with that of the proponents of logging, who imagined the forest as indispensable to and inseparable from the local communities that relied on it for timber and food and, in turn, largely shaped it. Representing ongoing logging operations as traditional local subsistence livelihood activities, proponents of that idea of the *puszcza* attempted to extract the forest from the sphere of European concern and deny it a universal value – moves necessary to justifying their continuing the logging operations

examples, see Patrick McGreevy, *Imagining Niagara: The Meaning and Making of Niagara Falls* (Amherst: University of Massachusetts Press, 1994); Elizabeth McKinsey, *Niagara Falls: Icon of the American Sublime* (New York: Cambridge University Press, 1985), and D. Lowenthal, "European and English landscapes as national symbols", in D. Hooson, ed., *Geography and National Identity* (Oxford: Blackwell, 1994): 15–38.

12 Franklin, S. 'Białowieża Forest, Poland: Representation, Myth, and the Politics of Dispossession', *Environment and Planning* **34** (8) (2002), 1459.

13 Kapralski, S. 'Battlefields of Memory: Landscape and Identity in Polish-Jewish Relationships', *History and Memory* **13** (2) (2001), 37.

14 Kartsev, G. *Belovezhskaya Pushcha. Ee istoricheskii ocherk, sovremennoe okhotnich'e khozajstvo i vysochaishie okhoty v Pushche,* (Sankt-Petersburg: A. Marks, 1903); Faliński, J.B. 'Vegetation Dynamics in Temperate Lowland Primeval Forests, Ecological Studies in Białowieża Forest', in Faliński, J.B. (ed.), *Geobotany* (Dordecht, Netherlands: Dr. W. Junk Publishers, 1986), pp. 39–111; Bobiec, A. 'Białowieża Primeval Forest as a Remnant of Culturally Modified Ancient Forest', *European Journal of Forest Research* **131** (5) (2012): 1269–1285; Samojlik, T., Rotherham, I. D., & Jędrzejewska, B. 'Quantifying historic human impacts on forest environments: a case study in Białowieża Forest, Poland,' *Environmental History* **18** (2013): 576–602.

uninterrupted. Thus, the former Minister of Environment Szyszko stressed the status of the forest as not primeval but both man-made and a traditional source of livelihood for local people. In December 4, 2017, in his meeting with local people supporting the felling, Szyszko complained about the lack of understanding of what was going on in Białowieża and placed the debate about the *puszcza* in realm of traditional people's use rights. In one of his speeches he suggested that logging in Białowieża started before Christ while another Polish official stressed that "Białowieża is not the last primeval forest because it was made by local people, and we have facts and books that show that people were there from the beginning."[15] As an example, he cited an inscription on a tombstone of a 101 year old Anastazja Pańko in the Orthodox cemetery (died in 2010), which read "I planted this forest."[16]

These discrepancies in imagining the forest express the ontological difference between two visions of nature, a difference articulated so well by James Proctor in his influential article "Whose Nature? The Contested Moral Terrain of Ancient Forests," which ultimately comes down to the debate between the advocates of an anthropocentric ethic who "value nature instrumentally, as a means to human material, aesthetic, or other ends" and the non-anthropocentric ethic "in which people primarily value nature intrinsically, without reference to human ends."[17] The proponents of logging viewed the forest as primarily a business object, in which "various operations are carried out in order to achieve the best effect." For the proponents of this model, not all trees were created equal because different tree species had different market value, with the most profitable (oaks, pines, spruces) having preference at the expense of those that were perceived as lower economic value (aspens, lindens). In this model, "protection of the forest is understood as consisting in preventing anything that can reduce future yields… Achieving economic goals requires controlling the process taking place in the forest and constant interferences in their course." This utilitarian vision of nature is largely

15 Neslen, A. 'Poland faces €100,000-a-day fines over illegal logging in Białowieża forest', *The Guardian* (21 November 2017). https://www.theguardian.com/environment/2017/nov/21/poland-faces-100000-a-day-fines-over-illegal-logging-in-biaowieza-forest (accessed 3 December 2017).

16 Davies, C. 'My worst nightmares are coming true': last major primeval forest in Europe on 'brink of collapse', *The Guardian* (23 May 2017). https://www.theguardian.com/environment/2017/may/23/worst-nightmare-europes-last-primeval-forest-brink-collapse-logging (accessed 20 June 2018).

17 Proctor, J. 'Whose Nature? The Contested Moral Terrain of Ancient Forests', in Cronon, W. (ed.), *Uncommon Ground: Rethinking the Human Place in Nature* (New York: W.W. Norton, 1996), pp. 269–297.

endorsed by the locals who often see rotting wood as a wasted resource, both in terms of the loss of potential value as timber and as a tourist attraction – the sentiment expressed by Jerzy Sirak, the major of Hainowka who wonders how many visitors would be interested in seeing dead trees.

For the advocates of nature protection, on the other hand, the forest, as formulated in the 1950s by Professor of Forestry Sciences Jan J. Karpiński, was „a dynamic creation of nature, in which the system of dependencies, connections and mutual influences are combined into an indivisible whole: specific vegetation with the predominant share of woody forms, associated animals and the geological substrate used by plants and animals, soil, water and climate." In that model, all organisms were perceived as equal with no species identified as more or less „valuable" – or useful or harmful. Forest development in this respect was the result of natural phenomena and did not require human intervention. [18] For the proponents of this vision, the value of the *puszcza* "lies in being a laboratory for natural processes, not a museum stacked with a preordained mix of species, much less a source of wood." [19]

This ontological conflict was apparent to some participants of the dispute, who **noted: "**One perspective is rooted in an exploitative view of managing environmental resources to be used by people. This is, typically, the approach of the foresters. According to the second perspective, what is taking place in the forest are all natural processes, which are valuable in themselves, and are worth protecting because this forest is one of the last spots where human intervention has not yet been strong enough to interfere with these natural processes. According to this approach, the forest does not have to be useful for humans in order to have value: it is valuable in itself. This is why it is so hard to find a common ground between the two perspectives, because the basic difference in understanding is rooted in fundamentally different principles and values." [20]

18 Wesołowski, T., et al. 'Spór o przyszłość Puszczy Białowieskiej: mity i fakty. Głos w dyskusji', *Chrońmy Przyrodę Ojczystą* **72** (2) (2016), 84.

19 *The Economist,* 'Into the Trees: Preserving Białowieża', (5 October 2017). https://www.economist.com/europe/2017/10/05/preserving-bialowieza (accessed 20 February 2019).

20 Azarova, A. 'So Why is This Forest so Important? Resisting the Logging of Białowieża', *Politicalcritique.org,* (2017). http://politicalcritique.org/cee/poland/2017/azarova-bialowieza-interview-activism-environment-democracy (accessed 10 October 2017).

4. The Politics of the Polish environmental movement

The tension between the proponents of these two visions reflects more, however, than disagreement over how they imagine the forest. Rather, this tension became increasingly politicized as the government interpreted the growing environmental protest as political dissent, a site of resistance to all of the policies of the new ruling party. At a panel organized by a right-wing news group, Szyszko suggested that Białowieża forest had become "some kind of a flagship for the left-wing-libertine movement of Western Europe."[21] As Michael Marder succinctly put it, "Political management reverberates, as though in an echo chamber, with forest management."[22]

The use of forests and environmental discussions as a tool of political control and a strategy to establish a new political and social order during a period of transition, of course, is not a new phenomenon. As James Scott observes, to control societies, state needs to make it "legible" [23] by introducing an ideology that "equates functional order and progress with real order."[24] In that ideology, "rational or scientific planning"[25] becomes "a central part of a larger hegemonic project to rewrite history and to formulate new ground rules of how to perceive reality" with forestry appearing as "a prime example of such rationalising and modernising efforts."[26] Anna Lawrence describes this process when she discusses how foresters imposed new mathematical models on the woods, turning the forest into statistical data that could be manipulated for greatest output and transforming it from an ecosystem into an abstract natural resource, imposing in the process, as Henry Lowood notes, "the neatly arranged constructs of science" on "disorderly nature."[27]

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21 Berendt, J. 'In Poland, a Battle for the Fate of Europe's Last Ancient Forest', *The New York Times*, (11 July 2017). https://www.nytimes.com/2017/07/11/world/europe/poland-bialowieza-forest-logging.html (accessed 3 March 2018).

22 Marder, M. 'Poland's Bialowieza: Losing the Forest and the Trees', *Aljazeera* (30 March 2017). https://www.aljazeera.com/indepth/opinion/2017/05/poland-bialowieza-losing-forest-trees-170528104004463.html (accessed 15 December 2017).

23 Scott, J. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed,* (New Haven: Yale University Press, 1998).

24 Lawrence, A. 'Forestry in Transition: Imperial Legacy and Negotiated Expertise in Romania and Poland', *Forest Policy and Economics* **11** (5–6) (2009), 429.

25 Brandtstadter, S. 'Transitional Spaces: Postsocialism as a Cultural Process: Introduction', *Critique of Anthropology* **27** (2) (2007): 131–145.

26 Lawrence, A. 'Forestry in Transition: Imperial Legacy and Negotiated Expertise in Romania and Poland', *Forest Policy and Economics* **11** (5–6) (2009), 429.

27 Lowood, H. 'The Calculating Forester: Quantification, Cameral Science, and the Emer-

As a result, "[w]ith a greater knowledge of which trees provided the greatest amount of timber in the shortest amount of time under specific conditions, forestry experts began to reshape the woods" – and societies, one might add.[28] These observations suggest, however, that when environmental protests disrupt the ordering of woods and their use for state-identified purposes, they have the potential to challenge the state itself as they begin to undermine its ability to rationalize and modernize societies.

In the aftermath of the election year in Poland, environmental protests did, in fact, acquired political significance, emerging as both places of resistance and sites where people learned about and practiced democracy and self-organizing.[29] According to Joanna Pawluśkiewicz, from *Obóz dla Puszczy*, "the situation became strongly connected to the political events … [T]he Ministry of Environment officially stated that organizations and individuals who participate in the protest in Białowieża will be treated as a so-called 'total opposition.'"[30] The suspicion on the part of the government that environmental protest became a site of political resistance – and larger, for offering an alternative vision of Poland's place in the EU and of Polish citizenry and national identity was, in fact, justified. Just as the ordering of the society can be partially achieved by ordering its nature, especially forests, so can environmental protests challenge dominant political systems and offer alternative visions of social organizations.

Obóz dla Puszczy, for example, became a gathering place that attracted not only experienced activists "who chain[ed] themselves to the harvesters," but also visitors who showed up just to drop off food supplies and that included students, families, teachers, even foreigners.[31] For all of them, the camp became a place of learning politics, learning democracy. Echoing Manuel Castells' claim that "grassroots democracy is the political model implicit in

gence of Scientific Forestry Management in Germany', in Frängsmyr, T. et al. (eds.), *The Quantifying Spirit in the 18th Century,* (Berkeley: University of California Press, 1990), 341.

28 Wilson, J. *The German Forest: Nature, Identity, and the Contestation of a National Symbol, 1871 – 1914,* (Toronto: University of Toronto Press, 2012), 55.

29 Similar to D. Weiner's description of Soviet environmentalism. See Douglas Weiner, *A Little Corner of Freedom: Russian Nature Protection from Stalin to Gorbachev* (Berkeley: University of California Press, 2002).

30 Azarova, A. 'So Why is This Forest so Important? Resisting the Logging of Białowieża', *Politicalcritique.org,* (2017). http://politicalcritique.org/cee/poland/2017/azarova-bialowieza-interview-activism-environment-democracy (accessed 10 October 2017).

31 Azarova, A. 'So Why is This Forest so Important? Resisting the Logging of Białowieża', *Politicalcritique.org,* (2017). http://politicalcritique.org/cee/poland/2017/azarova-bialowieza-interview-activism-environment-democracy (accessed 10 October 2017).

most environmental movements,"[32] Jakub Rok observed "how the democratic institutions in the camp are becoming more and more established… how people are entering this way of decision-making."[33] The environmentalists and nature protectors, thus, used the logging debate as way to express their vision of Poland's political future, as that of a democratic liberal state with citizens actively shaping it, juxtaposing their vision to that of the government that saw Poland as a bastion of conservative values with a heavily controlled media and judiciary. In short, the forest once again became a site to negotiate and debate ideas about the country's political and cultural identity.

5. Natural landscapes as cultural symbols

What ascribes to natural landscapes this power to answer questions about national identity is the fact that almost all European nations historically "invest[ed] the landscape with national significance"[34] as the concepts of nature and those of homeland become "ultimately intertwined, lending a national meaning to the landscape."[35] As a result, forests and other landscape forms can serve "as … symbolic green band[s] that tied that nation's splintered geography, history, and society together. … An excursion to the woods could … transform the abstract and artificial concept of nation into a tangible and 'natural' experience."[36] Recognizing this potential of nature to transmit national ideals, the Polish poet Czesław Miłosz in a much-cited article insisted that young people should be brought on field trips not only to Wawel castle in Krakow, the political symbol of Polish statehood and national identity, but also to Białowieża, where presumably they could also learn much about their national history and identity.[37] Peter Daszkiewicz too compared the forest to Wawel Castle in his attempts to emphasize its significance and advocate

32 Castells, M. *The Power of Identity* (Oxford: Blackwell, 1997), 1459.

33 Azarova, A. 'So Why is This Forest so Important? Resisting the Logging of Białowieża', *Politicalcritique.org,* (2017). http://politicalcritique.org/cee/poland/2017/azarova-bialowieza-interview-activism-environment-democracy (accessed 10 October 2017).

34 Wilson, J. *The German Forest: Nature, Identity, and the Contestation of a National Symbol, 1871 – 1914,* (Toronto: University of Toronto Press, 2012), 10.

35 Wilson, J. *The German Forest: Nature, Identity, and the Contestation of a National Symbol, 1871 – 1914,* (Toronto: University of Toronto Press, 2012), 225.

36 Wilson, J. *The German Forest: Nature, Identity, and the Contestation of a National Symbol, 1871 – 1914,* (Toronto: University of Toronto Press, 2012), 215.

37 Miłocz, C. 'Rozebrać Wawel na cegłe?' *Tygodnik Powszechny* (18 February 1996), 1.

its preservation.[38] More recently, Agnieszka Mandziuk and Emilia Janeczko have argued that Polish forests are places of not only natural but also cultural values that are transmitted through various historical and cultural sites and artefacts located in them. To preserve and increase their potential, these sites, they stressed, need to be identified, described, and made available to tourists[39] – in short, ordered and interpreted to convey the appropriate messages.

One reason why national landscapes, such as forests, possess the ability to bring the nation together as they emerge as common destination for people to explore is that they also can create "an enduring record of – and testimony to – the lives and works of past generations who have dwelt within it, and in doing so, have left there something of themselves." In Ingold's words, landscapes can turn into living stories.[40] Similarly, Inglis tells us that because the landscape is "a living process; it makes men; it is made by them," it therefore is "the most solid appearance in which a history can declare itself."[41] Speaking about landscape as a genre of art but in a way that allows us to apply his reflections to landscapes in general, Olwig sees it as a "nexus of community, justice, nature, and environmental equity, contested territory" that has "contained meanings of great important to the construction of personal, political, and place identity." It is imbued, he argues, with "meanings, etched by custom in the land, that were at the heart of the major political, legal and cultural issues of the time."[42] In short, "the construction of a landscape and the construction of identity are inseparable parts of one process, as a result of which landscape becomes incorporated into the group's identity, being one of the symbolic representations of the latter."[43] Wlodzimierz Cimoszewicz, prime minister in 1995–99 who doubled the national park's size to its current 10,500 hectares, stressed that potential of the *puszcza* to serve as a site where country's political futures are debated and charted when he observed, "Whoever controls it, controls the country."[44]

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38 Daszkiewicz, P. 'Puszcza Bialowieska nie może zginać', *Kultura* **579** (12) (1995): 71–72.

39 Mandziuk, A., Janeczko, E. 'Walory turystyczne a atrakcyjność turystyczna obszarów leśnych', *Studia i Materiay CEPL w Rogowie* zeszyt **28** (3) (2011): 96–100.

40 Ingold, T. 'The Temporality of the Landscape', *World Archaeology* **25** (2) (1993), 152.

41 Inglis, F. 'Nation and Community: a Landscape and Its Morality', *Sociological Review* **25** (1977), 489.

42 Olwig, K. 'Recovering the Substantive Nature of Landscape', *Annals of the Association of American Geographers* **86** (4) (1996), 630–631, 635.

43 Kapralski, S. 'Battlefields of Memory: Landscape and Identity in Polish-Jewish Relationships', *History and Memory* **13** (2) (2001), 35.

44 *The Economist,* 'Into the Trees: Preserving Białowieża', (5 October 2017). https://www.economist.com/europe/2017/10/05/preserving-bialowieza (accessed 20 February 2019).

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Close-To-Nature Forest Structure in the Vicinity of the Žiče Charterhouse as an Indispensable Pattern Criterion of a Heritage Landscape

JANEZ PIRNAT, MILAN KOBAL; University of Ljubljana,
Biotechnical Faculty, Department of Forestry

Abstract: The Žiče Charterhouse is famed for being one of the most significant examples of cultural heritage dotting the forested Slovene landscape. Consequently, it is necessary to ensure the indispensable pattern of the pristine landscape structure by protecting the neighbouring close-to-nature structured forests, which were determined with a visibility analysis. As the basic spatial layer, we used a digital elevation model based on the data provided by airborne laser scanning of Slovenia. The most visible stands in the charterhouse's vicinity have emphasized heritage and aesthetic functions. Increasing the share of deciduous trees and reducing the share of spruce in the stands should take priority in the future also in the context of climate change. By implementing the close-to-nature principle, forestry will become the comanager of the cultural heritage landscape around the Žiče Charterhouse.

Keywords: Žiče Charterhouse, historic landscape, indispensable pattern, visibility model, Lidar

1. Introduction

The year 2018 marked the European Year of Cultural Heritage. In Slovenia the Cultural Heritage Protection Act (ZVKD – 1, Official Gazette of the Republic of Slovenia, no. 16/08) establishes the most important cultural heritage. It defines the cultural landscape as immobile heritage consisting of an open space with natural and manmade components shaped by human intervention and activities that determine the landscape's structure, development, and use. In Europe and around the world there is a broad awareness of the necessity of considering cultural heritage within forested landscapes in everyday forest management. All countries that have ratified the European Landscape Convention, including Slovenia, are required to consider and maintain cultural

landscape characteristics that contribute to the landscape's exceptional cultural significance.[1]

At their core, forestry and forest management in Slovenia strive to maintain close-to-nature forest structure and multifunctionality, while considering the needs of other users of the forested landscape in managing and planning. The current forest matrix is the result of not only economic resource use and the demands of past generations, but also respect for the spiritual needs accompanying settling and living patterns. In this way, unique forms of cultural landscape emerged.[2]

Many landscape ecologists have stressed the importance of characteristic landscape patterns. Richard Forman even took things a step further and introduced the concept of indispensable landscape pattern. Although this notion is mainly associated with maintaining the proper combination of natural resources to ensure a high level of biodiversity, it can also be applied in certain cases of heritage landscape protection. One such case is that of the Žiče Charterhouse, which is located in a forested landscape. The natural forest structure here is indispensable for integrally preserving the historic cultural landscape surrounding the charterhouse and, consequently, for maintaining the authenticity of the area sought by cultural heritage preservation professionals.[3]

The Žiče Charterhouse falls into the category of inhabited cultural heritage. This site is characterised by the surrounding forested landscape, an indispensable resource and a source of identity of the charterhouse. This 'wilderness', or preserved forested landscape as we would call it today, was one of the key factors in choosing the location of the charterhouse. Consequently, according to Forman, the charterhouse and the forested landscape in its vicinity comprise an indispensable cultural landscape pattern, even though its structure has changed over time and the concept of 'wilderness' is now mostly considered a theoretical construct.[4]

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1 Jansen, P., Benthem, M.v., Groot, C.d., Boosten, M. *Cultural Heritage in Sustainable Forest Management* (Netherland: Stichting Probos, 2012), p. 88.

2 Dèjeant-Pons, M. 'The European Landscape Convention and Forests', in *Forestry and Our Cultural Heritage. Ministerial Conference on the Protection of Forests in Europe* (Warsaw: Liaison Unit, 2005), pp. 23–30.

3 Forman, R. *Land Mosaics – The Ecology of Landscape and Regions* (Cambridge: Cambridge University Press, 1995), pp. 449, 452–4, 516.

4 Cronon, W. 'The Trouble with Wilderness; or, Getting Back to the Wrong Nature', in W. Cronon (ed.), *Uncommon Ground. Rethinking the Human Place in Nature* (New York: W.W Norton & Company, 1996), pp. 69–90.

In the process of spatially delineating the (forested) area forming the identity of the environment surrounding the charterhouse, it therefore seems reasonable to make use of geographic information systems and conduct a visibility analysis. Although such analyses have been an important part of geoinformation system applications since the very beginning,[5] visibility analyses in Slovenia are still rare. They are most frequently used to evaluate visible landscape qualities, such as those of the forested landscape around the Žiče Charterhouse.[6]

Based on data on the location of the Žiče Charterhouse (more precisely data on the roads and paths around the charterhouse) and data from a Lidar digital surface model, we conducted a visibility analysis and delineated the close-to-nature structured forests in the vicinity of the charterhouse that are of key importance for preserving the indispensable pattern of the 'pristine forest structure'. Visibility is defined as a distant neighbourhood operation enabling the determination of areas visible from a specific location. In addition, we analysed the visibility of powerlines (towers and conductors) above the charterhouse to determine the part of the powerline route most visible from the charterhouse area, as it represents a visually obtrusive element that strongly detracts from the perception of a pristine landscape. In their guidelines for preserving visible spatial qualities, Jakl and Marušič state that powerlines should avoid important cultural objects (e.g., the charterhouse) and landscape features (e.g., mountain peaks, rivers, lakes).[7]

2. Methods

The visibility of structures in natural settings depends heavily on the physical attributes of the observed structure, observation distance, and the contrast between the structure and the background. Another important factor

5 Zakšek, K. 'Analiza vidnosti s prostorskim kotom odprtega neba', *Geografski vestnik* **78** (2) (2006): 97–109.

6 Mišič, T. *Analiza vidnosti širšega območja ČHE Kozjak ter vizualizacija izbrane vedute – dopolnitev študije za optimizirano traso DV ČHE Kozjak – RTP Maribor* (Expertise. Maribor: Vodnogospodarski biro Maribor d. o. o., 2010), p. 26.

7 Jakl, F., Marušič, J. *Načrtovanje in krajinsko oblikovanje koridorjev daljnovodov in cevnih vodov*: *priročnik*, (Ljubljana: Ministrstvo za okolje in prostor, Urad Republike Slovenije za prostorsko planiranje, 1998), p. 124.

is vegetation cover. Visibility is also influenced by atmospheric conditions, and, in the case of long distances, by the Earth's curvature and refraction.[8]

2.1. Used Data Layers

We calculated visibility using a Lidar digital elevation model (DEM) with a cell size of 1 × 1 m. Based on the shaded DEM, we created two layers using ArcGIS 10.4: a layer of roads and paths that pass the charterhouse and a powerline layer. The points in the roads and paths layer (n = 1081) represent visitor standing locations, whereas the points (n = 1153) in the powerline layer represent a horizontal projection of the powerline on the ground. We obtained forest-structure data from the Slovenia Forest Service (SFS) website, where data on the tree structure of polygons and stands are available from the following source: the Forest Management and Silvicultural Planning Viewer online portal of the Slovenia Forest Service.[9]

2.2. Stand Visibility

For stand visibility analysis, we determined the area visible from each of the observers' standing locations along road and path sections. This is referred to as active stand visibility. We used the *Viewshed* tool in ArcMap 10.4, specifying viewer height (OFFSETA = 1.70 m) and search radius (RADIUS2 = 500 m). We displayed the results with a visibility chart detailing the areas visible from none of the observation points (visibility = 0) as well as from visibly exposed areas (visibility > 0). In the end, we calculated the portion of visibly exposed surfaces (visibility > 0) in each of the analysed stands (Figures 1a, 1b).[10]

2.3. Calculating Powerline Visibility

For the powerline visibility analysis we calculated the areas from which the points representing the powerline are visible and, by inference, determined

8 Zakšek, K. 'Analiza vidnosti s prostorskim kotom odprtega neba', *Geografski vestnik* **78** (2) (2006): 97–109.

9 Bric, V., Berk, S., Oven, K., Triglav, M. *Aerofotografiranje in aerolasersko skeniranje Slovenije* (Ljubljana: Geodetski inštitut Slovenije, 2015), pp. 57–71.

10 Pirnat, J., Kobal, M. 'Vidnost gozdov v okolici Žičke kartuzije kot merilo njihove dediščinske in estetske vloge. Visibility of forests in the vicinity of the Žiče Charterhouse as a criterion of their heritage and aesthetic function', *Geodetski vestnik* **61** (4) (2018): 28–38.

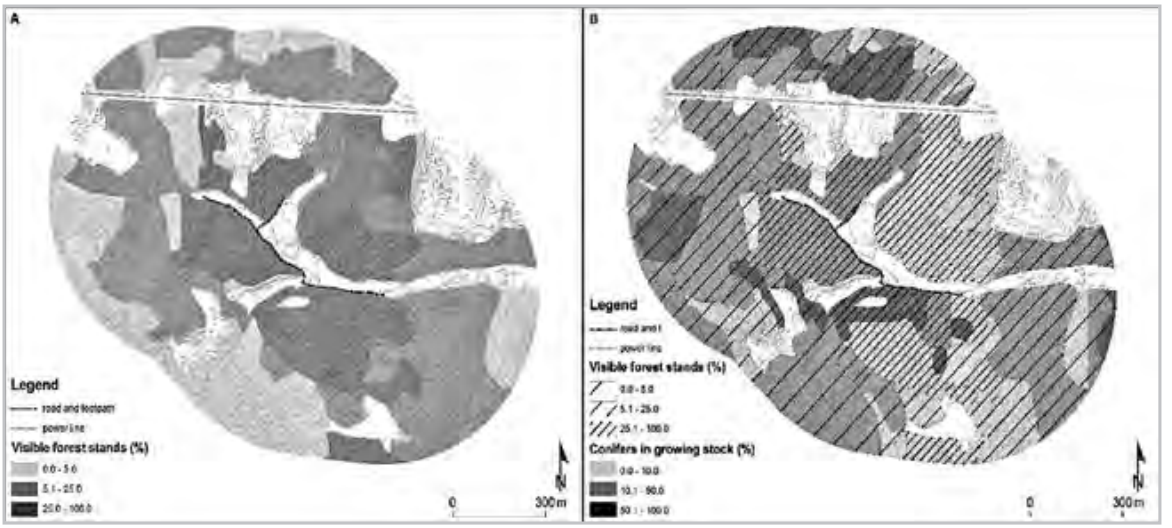

Figure 1: A – The percentage of stand surfaces visible from the road. B – The percentage of coniferous trees in the growing stock visible from the road and the path. The figures are based on the shaded DEM.[11]

the parts of the actual powerline that are visible (Figure 2a), that is, passive powerline visibility. We took into consideration the curving of power conductors between towers by calculating the height of each point above the DEM (OFFSETA). Once again, we used the DEM as the basis for the stand visibility calculation and set viewer height at 1.70 m (OFFSETB). Thus, we determined the area from which the powerline is visible as well as calculated the number of powerline points visible from each point along the road and the path, which we refer to as the intensity of active powerline visibility from the road and the path (Figure 2b). Again, we used the basic *Viewshed* tool. Because it is impossible to use this visibility analysis to conclude which part of the powerline is the most visible from locations along the road and the path, we repeated the powerline visibility calculation but only for locations on the section of path section visible from the powerline. Thus, we determined from which locations along the path and road each point of the powerline route is visible. We refer to this phenomenon as the intensity of passive powerline visibility (Figure 2b). We created a model for calculating the intensity of passive powerline visibility in ArcGIS 10.4 using the *ModelBuilder* tool.[11]

11 Pirnat, J., Kobal, M. 'Vidnost gozdov v okolici Žičke kartuzije kot merilo njihove dediščinske in estetske vloge. Visibility of forests in the vicinity of the Žiče Charterhouse as a criterion of their heritage and aesthetic function', *Geodetski vestnik* **61** (4) (2018): 28–38.

3. Results

As Table 1 demonstrates, stands in which the share of coniferous trees in the growing stock exceeds 10 per cent are prevalent in the analysed area. Almost 13 per cent of these stands consist of more than 50 per cent coniferous trees. Considering the fact that the cultivation of Norway spruce became widespread in the nineteenth century, these stands play the most significant role in the changed image of the cultural heritage landscape.

Table 1: *Stand surface according to the visibility share and the percentage of coniferous trees in the growing stock*[12]

Percentage of coniferous trees in the growing stock	Percentage of stand surfaces visible from the road and the path along the charterhouse							
	above 25 %		25 to 5 %		under 5 %		Total	
	ha	%	ha	%	ha	%	ha	%
above 50 %	3.5	3.0	7.6	6.4	3.9	3.3	15.0	12.7
50 to 10 %	11.2	9.4	30.8	26.0	22.0	18.5	64.0	53.9
under 10 %	20.8	17.5	11.8	9.9	7.1	6.0	39.6	33.4
Total	35.5	**29.9**	50.2	42.3	32.9	27.8	118.6	100.0

The most visible stands surrounding the charterhouse have an emphasized heritage and aesthetic function; these stands amount to slightly less than 30 per cent. In 41.4 per cent of these stands, the percentage of coniferous trees in the growing stock exceeds 10 per cent. Coniferous trees make up the majority of 9.9 per cent of these stands. In the future, increasing the percentage of deciduous trees in these stands should take priority, as in the cultural landscape of the past, forests consisted of deciduous trees that made them stabler and the landscape more natural.[13]

Along the entire length of the road and the path, 30 to 60 m of the powerline conductor can be seen from most standing locations. The longest 178 m section of the powerline conductor can be seen from a location on the road along the western side of the charterhouse (Figure 2b).

12 Pirnat, J., Kobal, M. 'Vidnost gozdov v okolici Žičke kartuzije kot merilo njihove dediščinske in estetske vloge. Visibility of forests in the vicinity of the Žiče Charterhouse as a criterion of their heritage and aesthetic function', *Geodetski vestnik* **61** (4) (2018): 28–38.

13 Pirnat, J., Kobal, M. 'Vidnost gozdov v okolici Žičke kartuzije kot merilo njihove dediščinske in estetske vloge. Visibility of forests in the vicinity of the Žiče Charterhouse as a criterion of their heritage and aesthetic function', *Geodetski vestnik* **61** (4) (2018): 28–38.

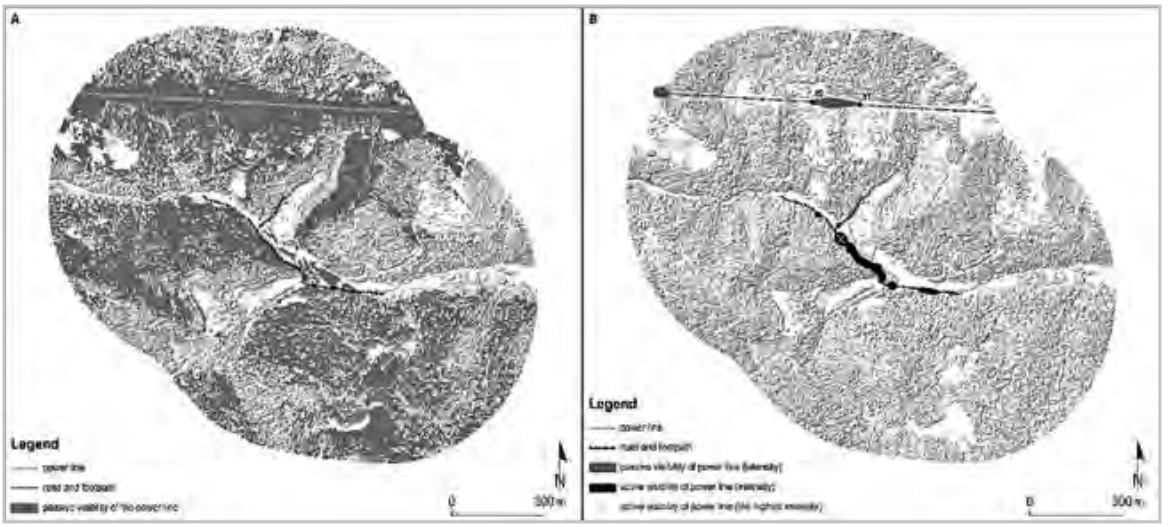

Figure 2: A – The calculated passive powerline visibility in the vicinity of the Žiče Charterhouse. B – The calculated intensity of active powerline visibility from the road and the calculated intensity of the passive powerline visibility.[14]

The entire powerline route in the analysed area measures 1,095 m. The prevailing powerline section is visible from 90 to 120 m of the road and the path; the most visibly exposed powerline section, visible from 111 m of the road and the path, measures 144 m.[14]

The forests near attractive cultural heritage sites often have an increased recreational function as well. The same is true for the forests of the Žiče Charterhouse, as the network of paths surrounding it invites visitors to explore. Due to the aforementioned professional prioritisation of close-to-nature forest structure, we deem it important that all visitors are offered the experience of a pristine forest. Consequently, our aim was to determine the share of the altered forests in the immediate vicinity of the roads and paths around the charterhouse, as these areas have a direct impact on the perception of the beneficial recreation effects. Verlič et al.[15] and Heywood and Murdock[16] have observed the existence of a strong environmental norm

14 Pirnat, J., Kobal, M. 'Vidnost gozdov v okolici Žičke kartuzije kot merilo njihove dediščinske in estetske vloge. Visibility of forests in the vicinity of the Žiče Charterhouse as a criterion of their heritage and aesthetic function', *Geodetski vestnik* **61** (4) (2018): 28–38.

15 Verlič, A., Arnberger, A., Japelj, A., Simončič, P., Pirnat, J. 'Perceptions of recreational trail impacts on an urban forest walk: A controlled field experiment', *Urban forestry & Urban greening* **14** (1) (2015): 89–98.

16 Heywood, J.L., Murdock, W.E. 'Social norms in outdoor recreation: Searching for the behavior-condition link', *Leisure Sciences* **24** (3–4) (2002): 283–295.

related to the ideal appearance of environments (a conditional norm) that influences how recreational areas are perceived. In keeping with this idea, we estimated the percentages of altered stands in the area bordering the path to the charterhouse from two distances: within 100 m and 200 m of the path.

Table 2: Stands according to the share of coniferous trees along the road and paths at the charterhouse

	Stands according to the share of coniferous trees along the road and paths at the charterhouse		
	above 25 % coniferous trees	25–5 % coniferous trees	under 5 % coniferous trees
Buffer 0–100 m	0.14 ha	3.48 ha	1.59 ha
Buffer 100–200 m	1.98 ha	4.71 ha	3.53 ha
Buffer 0–200 m	2.12 ha	8.19 ha	5.12 ha

Only 0.14 ha of forested area within 100 m of the path is made up of more than 25 per cent coniferous trees. However, 3.48 ha of forests in this area comprise 5 to 25 per cent conifers.

Furthermore, according to our findings from earlier research (Pirnat and Hladnik, 2009), forests dominated by Norway spruce are approximately 1.5 times more costly to maintain than beech forests in terms of silviculture measures and up to 4 times more expensive than preserved beech forests in terms of protective measures. These findings speak in favour of the economic benefits of close-to-nature deciduous forests.[17]

4. Discussion

4.1. Technical Findings

Usually, the key input spatial layer of the visibility analysis is a precise DEM, which ensures the reliability of results obtained by conducting a visibility analysis from a certain viewpoint. Reliability also depends on taking into account visual barriers in the field (overgrown vegetation, built structures, etc.). Using georeferenced and classified point cloud data (GKOT), such obstacles

17 Pirnat, J., Hladnik, D. 'Artificial energy inputs into spruce lowland forests in suburban landscapes in Slovenia', *Zbornik gozdarstva in lesarstva* **89** (2009): 67–77.

can be identified over the entire area of Slovenia, and thus a reliable DEM can be built.[18]

Because forests change over time––instantly (due to natural hazards, pest infestations, etc.), during the year (foliage), and over many years––it would be reasonable to determine potentially visible forests as well. These are forests that are not visible due to the current forest structure. To that end, only a precise DEM should be consulted in the visibility analysis.[19]

Additionally, the process of assessing the tree structure of forests could be improved by replacing the analysis of stand map data with more advanced methods of tree species recognition, either using Lidar data or various multi- and hyperspectral records. This would enable us to gather data on the spatial distribution of coniferous trees more precisely, as they are currently only available on the stand level. In this way, we would obtain clear data on the future tree structure, enabling us a controlled assessment of close-to-nature stand structure in the future.[20]

4.2. Research Findings

The answer to our research question – that is, determining the extent of forest that, based on its visibility, forms a definable part of the landscape surrounding the charterhouse comprising a so-called pristine atmosphere – showed that by conducting a visibility analysis in a GIS environment, it is possible to objectively identify forests with emphasized heritage and aesthetic functions, while by estimating the depths of distances along the paths, it is also possible to objectively assess forests with an emphasized recreational function.

In accordance with regulations related to forests with the highest-ranking emphasized heritage function, our future goal should be to increase the share of deciduous trees and reduce the share of coniferous trees, thus considering their aesthetic, heritage, and recreational functions in the process of preserving or even changing forests to increase their close-to-nature structure according to the modern doctrine of multifunctional forest management. Priority should be given to stands with the highest share of spruce and high visibility lying near roads and paths open to visitors (Tables 1, 2).

18 Lee, J. 'Analyses of visibility sites on topographic surfaces', *International Journal of Geographical Information Systems*, **5** (4) (1991): 413–429.

19 Podobnikar, T., Vrečko, A. 'Digital elevation model from the best results of different filtering of a LiDAR point cloud', *Transactions in GIS* **16** (5) (2012): 603–617.

20 Čekada, M.T., Lavrič, M., Fras, M.K. 'Ločevanje iglavcev in listavcev na podlagi neobdelane intenzitete laserskih točk', *Geodetski vestnik* **61** (1) (2017): 23–34.

At the same time, no clearings should be permitted in these forests in the future, as together with the charterhouse, these forests constitute a form of indispensable landscape pattern that according to Forman represents the foundation of future cultural landscapes. In the case of the Žiče Charterhouse, we were able to add a new meaning to this concept. It is impossible to imagine the Žiče Charterhouse without its forested landscape; only together do they retain their authenticity and meaning. This is no nostalgic search for wilderness or a lost paradise; it is merely the implementation of the idea of multifunctional forest management and an attempt to define the concept of 'traditional cultural landscape'.[21]

The reduced share of spruce as a long-term forest management goal is in accordance with the standpoint in favour of the close-to-nature principle and landscape authenticity.

In the past, the monastery used a lot of wood to extract potash (potassium carbonate), for which local beech was particularly suitable.[22] Lithographs and etchings depicting the Žiče monastery confirm that the surroundings of the monastery were covered by deciduous forest until the 19th century, when the share of spruce in the forests gradually began to increase.[23]

These goals do not contradict each other; they are complementary. In addition, natural beech forests are economically more suitable in terms of silviculture investments and protective measures.[24] Moreover, predictions of the effects of climate change speak in favour of a reduced share of spruce in future stand structure as well. Kutnar and Kobler have presented expected changes in forest vegetation over the entire surface of Slovenia in the context of three different scenarios of global climate change up to the year 2100, connecting the current state of forest vegetation types with climate factors, terrain, and land. The authors present three scenarios of vegetation development up to the year 2100, and in all three, the population of thermophilous

21 Cronon, W. 'The Trouble with Wilderness; or, Getting Back to the Wrong Nature', in W. Cronon (ed.), *Uncommon Ground. Rethinking the Human Place in Nature* (New York: W.W Norton & Company, 1996), pp. 69–90.

22 Blaznik, P. et al. *Gospodarska in družbena zgodovina Slovencev. Zgodovina agrarnih panog: 1, Zvezek-Agrarno gospodarstvo. /Economic and Social History of the Slovenes. History of Agrarian Industries: Vol. 1—Agrarian Economy/*. (Ljubljana: Slovenska akademija znanosti in umetnosti, Državna založba Slovenije, 1970).

23 Zadnikar, M. *Srednjeveška arhitektura karetuzijanov* (Ljubljana: SAZU, DZS, 1972).

24 Pirnat, J., Hladnik, D. 'Artificial energy inputs into spruce lowland forests in suburban landscapes in Slovenia', *Zbornik gozdarstva in lesarstva* **89** (2009): 67–77.

deciduous forests will increase significantly, whereas the population of coniferous trees, especially spruce, will decrease.[25]

In addition to the limitations put on current and future potential land use and landscape structure in the powerline area, the powerline route (conductors, support towers, and the clearing) has a negative impact on landscape appearance as well. Consequently, powerline installation results in reduced visual qualities of authentic heritage landscape appearance. The visibility of the powerline depends on its dimensions and spatial conditions. Its impact largely coincides with observation intensity, which is dependent on physical obstacles in the area (geomorphology and height of the vegetation cover as well as the position and number of observers).[26]

According to the visibility analysis of the powerline as an element obstructing the perception of authentic heritage landscape appearance, it would be necessary to bury 184 m of the powerline, with precedence being given to at least 144 m of the line. In contrast to overhead cables, underground cables have fewer negative impacts on the environment, the most obvious difference between them being their visibility. The use of underground cables eliminates the risk of power outages due to weather conditions, but they are more susceptible to mechanical damage (e.g., machine damage) and cannot be repaired as fast as overhead cables. The construction of underground cables in agricultural areas does not limit land use; such cables are generally deep underground.[27]

Although powerline visibility could be diminished by planting additional trees along the road at the charterhouse, this solution is not optimal, as it interferes with the authenticity of the charterhouse's immediate vicinity. Therefore, we favour the burying of the mentioned section of powerline. While we are aware that this would mean an additional expense, it is the only way to establish the greatest degree of authenticity at the Žiče Charterhouse site, one of the most significant cultural heritage monuments in Slovenia.[28]

Additionally, we suggest that visibility analysis or the estimation of

25 Kutnar, L., Kobler, A. 'Prediction of forest vegetation shift due to different climate-change scenarios in Slovenia', *Šumarski list*, **3–4** (2011): 113–126.

26 Cronon, W. 'The Trouble with Wilderness; or, Getting Back to the Wrong Nature', in W. Cronon (ed.), *Uncommon Ground. Rethinking the Human Place in Nature* (New York: W.W Norton & Company, 1996), pp. 69–90.

27 Buser, N. *Daljnovodne preseke v gozdnem prostoru* (Master's Thesis. Ljubljana: Univerza v Ljubljani, Biotehniška fakulteta, 2016), p. 59.

28 Golob, N. *Srednjeveški rokopisi iz Žičke kartuzije* (Knjižnica Narodne galerije. Predstavitve, 2006), pp. 19–21.

decreased visual landscape qualities becomes a regular practice in the spatial placement of (point and line) objects, especially in extraordinary cultural landscapes, in both environment impact assessments and forest management planning.

5. References

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Animals and Forests in Transylvanian Fairy Tales

DORIN-IOAN RUS, Gesellschaft zur Erforschung des 18. Jahrhunderts im südöstlichen Europa c/o Institut für Geschichte, Universität Graz

Abstract: The article discusses the relationship with forests in Transylvania from the perspective of fairy tales on and with wild animals. As sources, I will use Transylvanian Saxon, Romanian and Hungarian fairy tales collected by Joseph Haltrich, Ioan Pop Reteganul, Elek Benedek, Agnes Kovács and László Arany. I will conduct the analysis by considering the following structural elements of fairy tales related to forests: (1) the equality between humans and animals, found more often in Transylvanian fairy tales than in German ones; (2) the motive of liberation in which humans are ranked above animals; (3) linking the motive of liberation to that of gratitude to the force that facilitated liberation; (4) the motive of self-sacrifice to save the person that was magically turned into an animal. In all these motives, animals though they do not play the leading role, which is assigned to the human hero, are nevertheless portrayed as active and mostly beneficial forces.

Keywords: Transylvania, fairy tales, animals, self-sacrifice, liberation

1. State of the art

The first Transylvanian historian to deal with animals and forests in Transylvanian fairy tales was Joseph Haltrich. In 1855, he published in Brașov a study on Transylvanian Saxon animal legends in the Programme of the Saxon Evangelical gymnasium in Sighișoara for the 1854/5 school year. This academically sound work was the result of years of collecting texts, by Haltrich himself as well as by gymnasium students, priests, and other volunteers from Saxon villages. It presents the general characteristics of 33 fairy tales selected from the more than 100 that were collected and transcribed from the Transylvanian Saxon dialect into Standard German.[1]

1 Haltrich, J. 'Zur deutschen Thiersage', in Teutsch, G.D. (ed.), *Programm des evangelischen Gymnasiums in Schässburg und der damit verbundenen Lehranstalten,* (Kronstadt: Johann Gött, 1855), pp. 1–41.

The author of this article has recently explored humans' relationship with the forest as reflected in Transylvanian fairy tales and stories in the study *Der Umgang mit dem Wald in Siebenbürgen – widergespiegelt in den siebenbürgischen Volksmärchen und -sagen.*[2]

In the nineteenth century, the Brothers Grimm pioneered the comparative study of fairy tales and were closely followed by Theodor Benfey. Benfey's research focused on Indian fairy tales…[3] In 1910, Antti Aarne began classifying fairy tales according to their plot elements; this was the starting point of the Aarne-Thompson Index,[4] an essential tool still used by ethnographers today. Aarne and Thompson divide the animal fairy tale type into four sub-types: (1) magic fairy tales; (2) legend-like fairy tales; (3) novel-like fairy tales; and (4) fairy tales of the stupid devil or giant.[5] In 1928, Russian philologist Vladimir Yakovlevich Propp published *The Morphology of the Folktale*,[6] a major contribution to folktale studies in which he applies a structuralist approach to fairy tale morphology. Eleasar Meletinsky also played an instrumental role in the development of this field with his studies on the distinctions between fairy tales and myths.[7]

Contemporary scholars use interdisciplinary approaches to study fairy tales, drawing from the theoretical methods developed in disciplines such as anthropology,[8] oral history,[9] and psychoanalysis.[10] The psychoanalytic

2 Rus, D.-I. 'Der Umgang mit dem Wald in Siebenbürgen – widergespiegelt in den siebenbürgischen Volksmärchen und –sagen', *Forschungen zur Volks-und Landeskunde* **57** (2014): 166–187.

3 Kirfel, W. 'Benfey, Theodor', in *Neue Deutsche Biographie. 2*, (Berlin: Duncker & Humblot, 1955), pp. 46 f.

4 Aarne, A., Thompson, S. *The Types of the Folktale: A Classification and Bibliography.* 2, (Helsinki: Suomalainen Tiedeakatemia, 1973).

5 Aarne, A., Thompson, S. *The Types of the Folktale: A Classification and Bibliography.* 2, (Helsinki: Suomalainen Tiedeakatemia, 1973), 8.

6 *Propp's main works are Morfologiia͡ skazki* [The Morphology of the Folktale], (Leningrad, 1928) and *Istoricheskie korni volshebnoĭ skazki* [Historical Roots of the Fairy Tale], (Leningrad, 1946).

7 Renger, A.-B. *Zwischen Märchen und Mythos. Die Abenteuer des Odysseus und andere Geschichten von Homer bis Walter Benjamin. Eine gattungstheoretische Studie,* (Stuttgart: Springer, 2006), 106–128.

8 Pöge-Alder, K. *Märchenforschung. Theorien, Methoden, Interpretationen,* (Tübingen: Gunter Narr, 2011).

9 Röhrich, L. 'Die deutsche Volkssage. Ein methodischer Abriss', *Studium Generale* (1958): 664–690.

10 Isler, G. 'Franz, Marie-Louise von', in Ranke, K., Bausinger, H. et al. (eds), *Enzyklopädie*

study of fairy tales is based on the theories of Carl Gustav Jung who argues that fairy tales contain archetypal images which are derived from the collective subconscious and which are active in the human psyche.[11] The Jungian interpretation of fairy tales starts from the observation that in them the representation of people's spiritual processes can be easily read. The fairy tale shows the archetype in a relatively pure form and, in an abstract form, it clarifies the laws governing the human soul.[12]

Dore Rebholz's dissertation, published in 1944, also provides methodological inspiration for this article, but it was adapted to the specificity of the Transylvanian area.[13] Her work only serves as a partial model given that the German model does not fully comport with the situation in Transylvania. Firstly, Transylvania is a multi-ethnic and multicultural area, the meeting place of Balkan, Russian and Central European influences. Numerous fairy tales were imported from Germany to Transylvania by the Saxon colonists between the twelfth and thirteenth centuries. Furthermore, Hungarians from the Great Hungarian Plain and Romanians from Wallachia and Moldavia also brought their respective fairy tales to this province. Thus, a significant number of them were the result of cultural crosspollination. Another difference is that, unlike the German area where we have one dominant ethnic group and a mythos of the forest, in the Transylvanian area we have three – Romanians, Saxons and Hungarians (including the Szeklers) – and, according to the place they inhabit, there are three specific animals that can be found in fairy tales: the bear for the Romanian and Szekler communities inhabiting mostly mountainous areas, the wolf for the Saxon community inhabiting hilly areas, and the fox for the Hungarians inhabiting plain areas.

Furthermore, Gertrud Ennulat's article[14] and Bernd Springer's[15] study

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des Märchens. Handwörterbuch zur historischen und vergleichenden Erzählforschung, (Berlin, 1987), pp. 97–100.

11 Jung, C.G. 'Zur Phänomenologie des Geistes im Märchen', in Jung, C.G. *Gesammelte Werke. vol. 9/I,* (Freiburg: Olten, 1976), pp. 384–455.

12 Jung, C.G. 'Zur Phänomenologie des Geistes im Märchen', in Jung, C.G. *Gesammelte Werke. vol. 9/I,* (Freiburg: Olten, 1976), 233.

13 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffassung des Waldes, seine Darstellung und Rolle im deutschen Märchen,* (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944).

14 Ennulat, G. 'Der Wald im Märchen', in *Märchenspiegel. Zeitschrift für internationale Märchenforschung und Märchenkunde. April*, (1995).

15 Springer, B.F.W. *Der Wald in den Märchen der Brüder Grimm. Anmerkungen zur kul-*

of the cultural-historical significance of German forests as reflected in the Grimm Brothers' fairy tales are also highly relevant. These studies comprise a very small selection of works from the vast German literature.

Heinz Rölleke argues that a story is defined, among others, by the fact that it tells of a miracle often identified with magic or sorcery.[16]

Major sources on animal fairy tales include theoretical works by Mizuyo Ashiya on Japanese tales,[17] Isidor Levin on Tajiki tales[18] and Jack Haney on Russian tales[19]. According to these scholars, animal fairy tales are a typical part of folklore and feature anthropomorphised animals as protagonists. Another author, Wilhelm Solms, uses the Grimm Brothers' fairy tales as a starting point for his analysis and identifies the following defining features of animal fairy tales:

- The protagonists and the antagonists are always animals.
- The story is told in a manner meant to grab the listener's attention.
- These tales are variations on the same motif: a small, weak character courageously and intelligently confronts a bigger, stronger one and often triumphs.[20]

The aim of this article is to investigate the relationship between humans and the forest as presented in fairy tales that are about or feature wild animals because, as Dore Rebholz argues,[21] almost all animal tales are also forest tales and vice versa.

The sources I am relying on are collections of Saxon, Romanian, and

turgeschichtlichen Bedeutung des Waldes in Deutschland, (2018). http://blogs.uab.cat/berndspringer/files/2014/07/Der-Wald-in-den-Märchen-der-Brüder-Grimm-und-danach.pdf.

16 Rölleke, H. 'Zauber-Märchen-Märchen-Zauber. Vom Zauber im Volks- und Kunstmärchen', in Heindrichs, U., Heindrichs, A. (eds.), *ZauberMärchen. Forschungsberichte aus der Welt der Märchen,* (München: Diederichs Eugen, 1998), 9.

17 Ashiya, M. *Japanische und Deutsche Tiermärchen, besonders Fuchsmärchen, in ihrem Wesen und nach ihrer volkstumskundlichen Grundlage,* (Cologne: Orthen, 1939), 10.

18 Levin, I. 'Tiermärchen im Tadschikischen', in Foltin, H.F. et al. (eds), *Kontakte und Grenzen. Probleme der Volks-, Kultur- und Sozialforschung. Festschrift für Gerhard Heilfurth zum 60. Geburtstag,* ˇ(Göttingen: Otto Schwartz, 1969), pp. 93–113.

19 Haney, J. (ed.), *The Complete Russian Folktale,* (New York: Routledge, 1999).

20 Solms, W. 'Die Gattung Grimms Tiermärchen', in Esterl, A., Solms, W. (eds.), *Tiere und Tiergestaltige im Märchen,* (Regensburg: European Fairy Tale Society, 1991), 201.

21 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffassung des Waldes, seine Darstellung und Rolle im deutschen Märchen,* (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944), 79.

Hungarian fairy tales from Transylvania, edited by Joseph Haltrich,[22] Ioan Pop Reteganul,[23] Elek Benedek and Illyés Gyula,[24] Agnes Kovács[25] and László Arany[26] respectively. Although many Romanian scholars have examined Transylvanian fairy tales, there is still no comprehensive study of the relationship between humans and forests in them.

It is assumed that there are certain features considered typical of and internationally valid regarding animal tales. The most important are the animal protagonists, as Mizuyo Ashiya argues with regard to Japanese animal fairy tales,[27] Isidore Levin with regard to the Tajiki tales,[28] and Jack Haney with regard to Russian animal tale. The latter claims: 'Animal tales are stories in which human beings are not the main actors. Animals, less commonly birds and fish, are the chief "movers and shakers."'.[29] Wilhelm Solms further adds that the main characters or bearers of the plot – the heroes and many of their antagonists – are animals in each case.[30] According to Ashiya, the tone of Japanese animal tales "is usually light, good-natured, cheerful and simple, in keeping with the character of the inhabitants".[31]

In my study I will use as a starting point Dore Rebholz's analysis of forest-animal fairy tales. She proposes that such tales usually contain one of four motifs:[32]

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22 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856).

23 Pop Reteganul, I. *Povești ardelenești. Basme, legende, snoave, tradiții și povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986).

24 Benedek, E., Illyés, G. *Prinz Klein-Weißnicht. Ungarische Volksmärchen,* (Budapest: Corvina Kiadó, 1979).
Creangă, I. *Povestea porcului.* In: Creangă, Ion. *Povești, amintiri, povestiri,* (București: Minerva, 1980), pp. 47–63.

25 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966).

26 Arany, L. *Ungarische Volksmärchen,* (Budapest: Corvina Kiado, 1984).

27 Ashiya, M. *Japanische und Deutsche Tiermärchen, besonders Fuchsmärchen, in ihrem Wesen und nach ihrer volkstumskundlichen Grundlage,* (Cologne: Orthen, 1939), 10.

28 Levin, I. 'Tiermärchen im Tadschikischen', in Foltin, H.F. et al. (eds), *Kontakte und Grenzen. Probleme der Volks-, Kultur- und Sozialforschung. Festschrift für Gerhard Heilfurth zum 60. Geburtstag,* ˇ(Göttingen: Otto Schwartz, 1969), 108.

29 Haney, J. (ed.), *The Complete Russian Folktale,* (New York: Routledge, 1999).

30 Solms, W. 'Die Gattung Grimms Tiermärchen', in Esterl, A., Solms, W. (eds.), *Tiere und Tiergestaltige im Märchen,* (Regensburg: European Fairy Tale Society, 1991), 201.

31 Ashiya, M. *Japanische und Deutsche Tiermärchen, besonders Fuchsmärchen, in ihrem Wesen und nach ihrer volkstumskundlichen Grundlage,* (Cologne: Orthen, 1939), 9.

32 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffas-*

- The motif of human–animal equality, which is rarely encountered in German fairy tales.
- The motif of liberation (humans are placed above animals).
- The motif of gratitude, which is linked to the liberation motif (gratitude is expressed to the force that facilitated liberation).
- The motif of self-sacrifice (animals save a person who was magically transformed into an animal from humiliation).

Animals play a major role in the tales that feature these motifs because they possess secret transformative powers and miraculous abilities. Even though they do not play the main role, that of the protagonist, they are mostly portrayed as benevolent creatures.

Rebholz's motif structure can only be partially applied to Transylvanian fairy tales because they are affected by cultural and ethnic (German-Hungarian-Romanian) interference—that is, they feature Eastern European influences from the Romanian-Slavic-Balkan area and Central European influences of German-Hungarian origin. On the other hand though, as I have indicated in a previous article (*Der Umgang mit dem Wald in Siebenbürgen – widergespiegelt in den siebenbürgischen Volksmärchen und -sagen)*, the same fairy tales can be found among Transylvanian Saxons, Hungarians, and Romanians. They differ mainly in their language and the number of characters they feature.

A common feature of animals in animal fairy tales is their 'good nature': right from the start they are friendly and kind to the protagonist. In such tales humans and animals also have close relationships because the former do not have a condescending attitude towards the latter, but they do suspect the range of the latter's powers.[33]

As regards the *position of equality between humans and animals*, mention should be made of fairy tales such as the Szekler tale *Der Bär, der Wolf, der Fuchs und der Hase auf dem Jahrmarkt zu Gyergyó*[34] [The Bear, the Wolf, the Fox and the Hare at the Fair of Gyergyó] and its Saxon version published by

sung des Waldes, seine Darstellung und Rolle im deutschen Märchen, (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944), 96–97.

33 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffassung des Waldes, seine Darstellung und Rolle im deutschen Märchen,* (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944), 79.

34 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966), 98–99.

Haltrich titled *Der Bär, der Wolf, der Fuchs und der Hase auf dem Medwischer Margrethi* [The Bear, the Wolf, the Fox, and the Hare at the Saint Margaret Fair in Mediaș] in which a hunter is summoned by a home owner and asked to catch the wild animals that have come into the town. Many Saxon tales feature wolves and foxes, either together or separately, as protagonists. These fairy tales do not have human characters, but only animals assigned human roles and endowed with human attributes. However, in general, only few such fairy tales can be encountered in Transylvania. These are generally morality tales, reflecting human attributes such as goodness, evilness, kindness, cunning, and so forth.

2. Magical transformation

Forest animals can transform into humans or other beings with magical attributes. Thus, the fairy tale *Făt-Frumos zălogit* [Făt-Frumos Taken Hostage][35] includes an episode in which a king's daughter is transformed into a swallow in the forest but reverts to human form as soon as she gets away from a dragon.

On the other hand, some fairy tales recount the humiliation of an animal that has transformed into a human being, for example, the swan in *Die Schwanenfrau* [The Pen].[36] This story takes place in an enchanted castle located in a forest, where a young man enters another world by unlocking a forbidden door.

In some tales, an animal endowed with supernatural powers disinterestedly helps the human protagonist, such as in the Saxon fairy tale *Die Königstochter in der Flammenburg* [The King's Daughter in the Flame Fortress],[37] in which a bull contributes to the girl's escape from a fortress where she is held captive by a twelve-headed dragon. This tale lacks a proper hero; the liberator is the youngest child of a poor family who is gifted a bull by a mysterious old man endowed with magical powers. The bull disinterestedly helps the human protagonist once he has come of age, and extracts its magical powers from the flowers that it grazes on a pasture close to the forest. It also tells

35 Pop Reteganul, I. *Povești ardelenești. Basme, legende, snoave, tradiții și povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 80–88.

36 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 20–25.

37 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 109–112.

the hero to introduce himself to the king with a view to freeing the latter´s daughter from captivity.

Human-to-animal transformation occurs by uttering a magical formula, sometimes in error. This motif appears, for example, in *Cerbul*,[38] in which the protagonist, transformed into a stag, can revert to human form by uttering magical formulae. In some tales, however, people can be turned into animals by a negative mythical character, such as the Forest Mother (*Muma Pădurii* in Romanian), a recurring character in Romanian folklore that was adopted by Saxon folklore.

Characters that have been transformed into animals can revert to their original human selves after they expiate for their transgressions. The torturous nature of this metamorphosis is revealed by the humans' desire for liberation; they will do anything to meet a creature or being, usually from the world beyond, capable of setting them free. For example, in the fairy tale *Povestea Porcului* [The Pig's Tale][39] the emperor's daughter is willing to go through all manner of trial in order to set her husband free and give birth to their child. She is assisted not only by human characters with magical powers, such as Saint Friday (Sfânta Vineri) and Saint Sunday (Sfânta Duminică), but also by birds and horses endowed with similar powers.

More motifs and characters with magical powers are found in the Romanian fairy tale *Crâncu, vânătorul codrului* [Crâncu, the Forest Hunter].[40] The story recounts a fight between Crâncu, the son of a forester, and Master Pogon, a negative character with malefic powers. Crâncu, on a quest to find his wife who has been kidnapped by Pogon, is assisted by his three brothers-in-law: an eagle, a hawk, and a wolf. The protagonist is killed three times, but each time his companions bring him back to life by administering the water of life. He eventually liberates his wife from the forest castle in which she is held captive with assistance from the his companions. Along the way he obtains an enchanted horse after undergoing several initiatory ordeals while serving an old lady in the forest. The story is set in forested mountains where time is measured differently (an earthly calendar year lasts only three days

38 Pop Reteganul, I. *Poveşti ardeleneşti. Basme, legende, snoave, tradiţii şi povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 89–95.

39 Creangă, I. *Povestea porcului.* In: Creangă, Ion. *Poveşti, amintiri, povestiri,* (Bucureşti: Minerva, 1980), 49.

40 Pop Reteganul, I. *Poveşti ardeleneşti. Basme, legende, snoave, tradiţii şi povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 201–212.

in the forest) and where people can transform by using magical formulae. This fairy tale includes not only the liberation motif but also the motifs of transformation and disinterested help. Magically transforming from human into animal form and vice versa, however, does not occur in a realistic setting, but only in distant places, more precisely deep in a forest.

In order to achieve liberation, the human must often undergo one or more complex tests and trials. Humans can only be liberated once their heart and resolve have grown stronger, they have become more mature, and they succeed in defeating malevolent forces. A tense, unarmed fight between the protagonist and the forces of evil usually takes place in the forest. The protagonist usually possesses qualities such as courage, capability, loyalty, and steadfastness. Only good-hearted protagonists are helped by animals in achieving their goal. For example, in the tale *Der goldene Vogel* [The Golden Bird][41] a fox is on the hero's side, assisting him in accomplishing his task.

In tales that mainly take place in human settlements—villages, towns, the courtyards of castles or imperials residences—the decisive moment, namely, the meeting between the protagonist and supernatural creatures from beyond, usually occurs in the forest. In *Povestea Porcului* the emperor's son is transformed into a pig and withdraws into a forest to a place called Mănăstirea-de-Tămâie (The Incense Monastery), which is inaccessible to ordinary people. His wife manages to reach and free him after encountering a series of positive supernatural characters that dwell in the forest and undergoing several trials.

This group of animal fairy tales indicates a certain relationship between humans and animals: they are not equal in value, as humans are placed above animals. When humans are transformed into animals, regardless of the reason, it is always regarded as a misfortune. This feeling generates a yearning for liberation, which can be achieved in several ways.[42]

41 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 31–39.

42 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffassung des Waldes, seine Darstellung und Rolle im deutschen Märchen,* (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944), 91.

3. The animal's (self-)sacrifice.

In some tales, the animal into which the protagonist has transformed by a spell must be killed. For example, the wild cat in *Der Federkönig* [The Feather King][43] asks to be decapitated in the forest so that it can turn back into the beautiful woman it was before being bewitched.

In the Saxon fairy tale *Der seltsame Vogel* [The Strange Bird][44] a poor man follows a beautiful bird in the forest and catches it. Under its wings he notices an inscription that reads 'The one who eats the heart will find three pieces of gold under his pillow each morning; the one who eats the liver will be king in Rome.' The man's two children eat the bird's organs unaware of the significance of their action. Later, after several adventures, the inscription comes true.

4. The motif of gratefulness

Humans that have been transformed into animals by a spell and animals endowed with magical powers are aware that nothing is free; thus, these characters always try to *repay* their helpers. In many cases, animals use their great powers to help human protagonists achieve their goals. Fairy tales such as *Vizor, craiul șerpilor* [Vizor the Serpent King][45] and *Trifon hăbăucul* [Trifon the Fool][46] contain very similar characteristics to the Hungarian tale *Schlangenhold und Tatarenstark* [Schlangenhold and Tatarenstark][47] in which a snake helps the human protagonist achieve his goals. The rewards humans receive for liberating animals include not only assistance in successfully undergoing an initiatory ordeal or in freeing a beloved one, but also 'cultural help' as in the Hungarian tale *Die Geschichte eines Schafhirten* [The Story of

43 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 63–67.

44 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 31–39.

45 Pop Reteganul, I. *Povești ardelenești. Basme, legende, snoave, tradiții și povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 147–163.

46 Pop Reteganul, I. *Povești ardelenești. Basme, legende, snoave, tradiții și povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 59–65.

47 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966), 64.

a Shepherd],[48] where a snake, saved by a shepherd from a fiery death, reveals to the man the secret of learning languages, including those of animals.

The animals in such tales are grateful; they do not forget the good that humans have done to them and try to repay their helpers. The fairy tale *Der goldene Vogel* is about a king constructing a church. All that is missing to complete the building is a golden bird. Therefore, he sends his three sons to search for one. The oldest one goes to a forest, where he lights a fire for heat and nourishment. A cold, hungry fox appears and asks him for help, but he refuses and chases it away. The middle son does the exact same because he also has a heart of stone. Only the youngest son is kind to the fox. As a sign of gratitude, the animal helps the son by giving him directions to the location of the golden bird: 'Keep going ahead through this forest for seven days until you reach a large pasture. There is a castle with maidens that want to be freed.' The fox helps the youngest son in his further adventures as well. For instance, when his older brothers throw him into a well, the fox takes him out. Thus, nothing stands in the youngest son's way to accomplishing his mission, and the fox, having repaid him, disappears back into the forest.

In the Saxon fairy tale *Von den zwölf Brüdern, die zwölf Schwestern zu Frauen suchten* [On the 12 Brothers Looking to Marry 12 Sisters][49] the male protagonist sets out on a journey to look for his 11 brothers that were lost while looking for wives. He comes to a forest where he is guided by a mysterious elderly man whom he faithfully serves for a year. After completing his initiation, he spares the lives of a lion,[50] an eagle, and a fish. All three animals – representing fire, air, and water, respectively – are the kings of their species. As a reward for the kindness the protagonist has shown to them, they help him find his brothers and the 12 sisters whom they eventually marry.

In the Romanian fairy tale *Trifon hăbăucul* the protagonist is sent into the forest for a cartful of timber. Some eagles ask him to allow them to eat his oxen in exchange for helping in accomplishing his mission, as a reward for his kindness.

48 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966), 108–114.

49 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 187–190.

50 Transcription mistake made by the story collector. It is, in fact, about a bear, as seen in similar tales. Haltrich, J. 'Zur deutschen Thiersage', in Teutsch, G.D. (ed.), *Programm des evangelischen Gymnasiums in Schässburg und der damit verbundenen Lehranstalten,* (Kronstadt: Johann Gött, 1855), 5.

In the fairy tale *Der Knabe und die Schlange* [The Young Man and the Snake][51] a poor young man saves a small snake from his malicious playmates and looks after it. As a sign of gratitude, the snake leads him 'far away into a forest' to its father, the Snake King, who rewards him with numerous gifts for his good deed. In this tale's Romanian version, *Povestea lui Parhon* [Parhon's Tale][52] the protagonist saves the life of the Snake King's son. As a reward Parhon receives a bead that, after a string of adventures, helps him become rich and get married. The Hungarian fairy tale *Schlangenbruder* [The Snake Brother][53] tells the story of a poor child who saves the Snake King's son from his playmates who who intend to kill him. As a reward, the child is helped in accomplishing his mission. Unlike in other fairy tales in which the snake is a hero and a helper, in this one the serpent turns into a winged horse. Hence, here we witness not an animal-to-human transformation, but an animal-to-animal one. Another difference is that the snake does not accompany the protagonist, who is instead helped by the magic gifts he receives from the Snake King as a reward for saving his son's life.

In the Hungarian story *Der blinde König* [The Blind King][54] the youngest son of a blind king sets out on a journey to find a cure for his father's ailment. In the middle of a forest, he saves a fox from being killed. As a reward for his good deed, it assists him in accomplishing his mission.

In the Hungarian fairy tale *Prinz Brennessel* [Prince Nettle][55] a fox whose life is saved by a poor miller repays him by helping him to become wealthy and marry an emperor's daughter.

51 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 100–109.

52 Pop Reteganul, I. *Povești ardelenești. Basme, legende, snoave, tradiții și povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 298–307.

53 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966), 268–280.

54 Arany, L. *Ungarische Volksmärchen,* (Budapest: Corvina Kiado, 1984), 5–23.

55 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966), 31–38.

5. The animal as adoptive parent of the hero

We find this motif in the Saxon fairy tale *Goldhaar* [Goldhair][56] in which the protagonist gains his strength by drinking an animal's milk. A man bewitches his wife, transforming her into a cow. Then she, together with her son, runs into the forest where she nurses him and looks after him until he turns 21 and successfully passes a test of strength.

In the Hungarian fairy tale *Gabelhorn*[57] a wicked family starts climbing the social ladder after they bring home a cow endowed with magical powers that they find on the edge of a forest. Later, however, the cow thwarts the female head of the family's plans to kill her stepson and then helps him find a wife.

The Romanian fairy tale *Voinicul Parsion* [Strapping Parsion][58] includes the motif of *non-magical liberation and transformation*. Parsion, the youngest son of a poor old man, guards wheat piles, but one night a bird steals an ear of wheat. He chases the bird into the forest where it injures one of its wings so badly that it falls off. The protagonist then comes to the middle of the forest where he encounters a giant whom he serves for some time. As a reward, the giant reveals to him a way to get married. One night the son notices a flock of doves bathing in an enchanted lake and turning into fairies. He decides to steal the wings of one of them so she remains in human female form. They eventually marry and live in the giant's home in the forest. One day, the giant gives them permission to visit Parsion's parents in the real world. At one point during their visit Parsion becomes inebriated and falls asleep; his wife seizes the opportunity to recover her fairy wings sewn onto his doublet and uses them to fly away to the Unseen and Unheard Citadel. Taken aback, Parsion asks the giant for help, but the giant sends him to his brothers instead. Finally, after no forest animal manages to find the citadel, Parsion re-encounters the bird that he injured, which leads him to the citadel. The protagonist liberates his wife, the fairy, and sets out with her for the real world, thanking everyone that helped him achieve his goal along the way.

The Hungarian tale *A majommá vált szerzetes* [The Monk Who Turned

56 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 55–62.

57 Kovács, A. (ed.), *Ungarische Volksmärchen,* (Köln, Düsseldorf: Diederichs, 1966), 173–184.

58 Pop Reteganul, I. *Povești ardelenești. Basme, legende, snoave, tradiții și povestiri*, [Transylvanian Tales: Fairy Tales, Legends, Anecdotes, Traditions and Stories], (Bucharest: Minerva, 1986), 339–345.

into a Monkey][59] also includes a human-to-animal transformation that occurs without external intervention. A monk turns into a monkey at the edge of a forest where a peasant is working and ends up helping the latter to do his field work.

Another Hungarian fairy tale *Janko und die drei verwunschenen Prinzessinnen* [Janko and the Three Enchanted Princesses][60] is about the miraculous transformation of three swans into princesses. The action takes place on a lake in a forest. The protagonist, Janko, ultimately liberates the princesses and marries the youngest. The Hungarian fairy tale *Die Fee und das Zigeunermädchen* [The Fairy and the Gypsy Girl][61] is also about a person who transforms into an animal in a forest setting. A young king rescues a fairy from an oak tree, who is transformed into a fairy by a Gypsy girl. Finally, after going through several transformations, the fairy manages to liberate herself without help from humans or creatures endowed with magical powers.

6. Encountering fabulous animals

The Saxon tale *Das Zauberroß* [The Enchanted Mare][62] includes the transformation of a fantastic character into a human with the help of an animal endowed with magical powers. All trials that the hero must undergo take place in the forest. A poor young man enters the service of a mysterious old blind man, promising to watch over the blind man's flock of sheep for a year. He is only armed with a sword. The old man agrees but forbids the young man to go into the forest. Nonetheless, he goes into it four times, each time slaying one of the dragons defending it (a three-, seven-, nine-, and twelve-headed dragon, respectively). Upon entering the forest for a fifth time, he encounters the Forest Mother, who shows him the slain dragons and tells him that they were her sons. Before being killed herself, she tells the young man of a place holding a tincture that could cure the old man and gifts him with a wondrous mare that helps him accomplish future missions. The young man then enters the service of a king who makes him perform several tasks. One of them is

59 Benedek, E., Illyés, G. *Prinz Klein-Weißnicht. Ungarische Volksmärchen,* (Budapest: Corvina Kiadó, 1979), 147–148.

60 Arany, L. *Ungarische Volksmärchen,* (Budapest: Corvina Kiado, 1984), 80–88.

61 Arany, L. *Ungarische Volksmärchen,* (Budapest: Corvina Kiado, 1984), 114–130.

62 Haltrich, J. *Deutsche Volksmärchen aus Siebenbürgen,* (Berlin: Springer, 1856), 45–55.

the liberation of a siren, which he successfully carries out with the help of his trusted mare. After the siren turns into a woman, he marries her.

The animals in these stories help humans because, to some extent, they feel that they are under an obligation to do so. These tales reject the idea that humans and animals are equal; in them animals do not possess magical attributes or powers with which they help humans in perilous situations.[63]

Typically, animals in forest tales do not display their species-specific traits when they interact with humans. Dore Rebholz explains this by assuming that such tales are younger than the idea of animals helping disinterestedly. She further argues that these stories could indicate a certain level of cultural maturity given that the idea of people transforming into animals and then back to their original human form after expiating for their transgressions is not often encountered in the folklore of ancient peoples.[64]

7. Conclusions

My first observation is that all fairy tales in which forest animals assist in the (self-)liberation of a character or repay someone for their help have a happy end. These animals are kind and benevolent, have positive human attributes, and help humans.

Forests are places where human-to-animal and animal-to-human transformations take place, where humans are liberated, where encounters with magical creatures happen, and where the gateway to the world beyond is situated. Due to their vastness, they are measured by units of time, not by units of space. Time here has a different dimension than in real life.

Tales of magical liberation include the notion that human souls can migrate to animal bodies and vice versa. This notion can be found among all peoples of the world, and these are in fact the only two transformative directions observed. Another observation is that the animals in these tales

63 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffassung des Waldes, seine Darstellung und Rolle im deutschen Märchen,* (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944), 94.

64 Rebholz, D. *Der Wald im deutschen Märchen. Das Erlebnis als Grundlage für die Auffassung des Waldes, seine Darstellung und Rolle im deutschen Märchen,* (Heidelberg. Inaugural-Dissertation zur Erlangung der Doktorwürde der Philosophischen Fakultät Ruprecht-Karl-Universität in Heidelberg, 1944), 96.

mediate the protagonist's access to the world beyond, which usually occurs in the forest.

Hunting as a royal attribute is another characteristic of these tales. The king or the king's son(s) hunt and fight against the forces of evil dwelling in the forest. However, in some stories, such as *Cerbul*, the king's servants are also permitted to hunt animals designated by the king. In these tales, hunting is more of a ritual than a sustenance-providing act. In some cases, the participation of youngsters in hunting can be perceived as a trial before coming of age. The animal as a prototype of virility and masculinity is present in every tale that includes hunting. The hunter is analogous to the hero, a king or a prince hunting perpetual prey in a boundless forest.

The most frequently encountered animals in these fairy tales are the wolf, the fox, the snake, the mighty horse, and the swan. The bear is found especially in forest tales, while the first two are encountered in other types of tales as well. The stag is less frequently present, but when it is, it is portrayed as a Christ-like animal *par excellence*—a creature of light and a mediator between heaven and earth. The stag is an enchanted young man, a symbol of fertility and resurrection.

Birds are assigned feminine roles. They are usually a king's daughter, a fairy, or a maiden that has been transformed into a swan (or sometimes a different bird) as punishment for transgressions or as the result of a spell cast by evil forces. Male protagonists, after successfully undergoing several trials, liberate these female characters by releasing them from the spell and ultimately marry them.

The horse, especially one endowed with supernatural powers, is the most prominent domestic animal to appear in such fairy tales. This animal is a symbol of liberty; it can be neither obtained nor owned by anyone. Only those with a pure soul can have access to it, usually after having undergone an initiatory trial. In the forest, the horse is not wild; it is owned by human beings with magical powers or by supernatural creatures such as the Forest Mother, Saint Friday, or the old man archetype.

Regardless of content, these tales are based on a structure that performs certain functions connected to archetypal characters (the protagonist, the antagonist, and the mediator). In fairy tales, characters are normally good or evil. Animals are overwhelmingly good. Central to the plot is a human protagonist who must prevail in the fight against the forces of evil—natural and/or supernatural. In many cases, the hero is a weak person—a child or a young man—who is assisted by an animal endowed with supernatural powers in the quest to achieve his goal.

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Human-forest relationship in Finland

TUULIKKI HALLA[1], REETTA KARHUNKORVA[1],
JAANA LAINE[2] AND LEENA PAASKOSKI[3]
University of Eastern Finland[1], University of Helsinki[2],
Lusto – the Finnish Forest Museum[3]

Abstract: Our relationship with the forest can be defined as human-forest relationship (HFR). This relationship is the result of our individual history, family history, cultural background, the society where we live, and the forest surrounding us. HFR combines both historical and modern values and practices, reflects the constantly evolving global, national, communal and individual attitudes towards forests. In this article, we define the concept of HFR and demonstrate how HFR has been, and continues to be, integrated into Finnish society and culture. Finally, we will gather some ongoing societal discussion on changes in HFR. The Finnish National Inventory of Living Heritage, established in 2017, included HFR as one of its elements. It seems that the essence of the HFR is evolving, and Finns are adapting various HFRs in accordance with the fading traditional economic importance of forests as new values are arising.

Keywords: human-forest relationship, human-nature relationship, forest culture, ecosystem services, forest recources

1. Forest in Finnish society

Finnish environment, economy and culture are tightly connected to the forests that cover approximately 86 per cent of total land area.[1] This abundance makes forests the most valuable natural resource of Finland, which as such have played a significant role in the Finnish economy from ancient slash and burn agriculture to the modern bioeconomy.

According to recent surveys, forests are still important for Finns. About 83 per cent of respondents have stated that the forest is somewhat or very important to them, but mainly as spaces for recreational rather than traditional economic purposes. Outdoor activities are the most popular ways to

1 *Luke. Land classes on forestry land, Statistics database,* https://statdb.luke.fi/PXWeb/pxweb/en/LUKE/?rxid=9f54923b-e9c4–486e-a66d-09848c1cdbc6.

spend time in the forest; approximately 70 per cent of the Finns walk, hike or do some other outdoor activities. Citizens gain health benefits from forests, including stress relief. In addition, spirituality and the desire to protect nature are important to Finns. In Finland, Every Man's Right tradition acknowledges that the forest benefits all society and the Finns are entitled to enter and use forested areas even though most forests are privately owned. In this way, the forest belongs to all people and is a part of the Finnish identity. Of those surveyed aged 25–34 years old, 48 per cent have stated that they see nature and national parks as important patriotic symbols.[2]

Approximately 60 per cent of Finns live in one of the ten biggest urban areas, mainly in southern and western Finland. According to projections, this share of urban Finns will rise to 72 per cent by the year 2030. The identity and lifestyle of urbanized Finns influence their values and choices, and the forest's future importance to them or to their finances may differ from those of previous generations.[3]

Since 2018, Finnish media has released several nature and forest related programs and publications.[4] Some of these programs reflect an interesting shift in attitudes where nature and trees are represented as communicative and even emotional creatures. This boom coincides with ambitious national-level plans to increase the extraction of forest resources.[5] Since the forest industry buys approximately 80 per cent of roundwood needed from private forests[6], it is important for the forest industry to understand how Finnish citizens value forests.

Forests play a crucial role in solving many contemporary environmental challenges, including mitigating climate change. Forests provide multiple ecosystem services and substitutes for fossil-based products in circulation

2 *Kantar TNS. Suomalaisten metsäsuhteiden tila. Selvitys. Kestävästi metsäsuhteessa-hanke. MMM, SMY*, (Lusto – Suomen Metsämuseo, 14 March 2018). https://smy.fi/wp-content/uploads/2018/03/Suomalaisten-mets%C3%A4suhteiden-tila-selvitys.pdf; 'IL-kysely: Sotaisa historia väistyy – luonto ja kansallispuistot ovat nuorille tärkeintä isänmaallisuutta', *Iltalehti* (5 December 2018) https://www.iltalehti.fi/kotimaa/a/120cea84–0937–4766-b1e8-dde0d5ace355; Pöntinen, P. Suojelun suosio kasvaa. *Suomen kuvalehti10/2021.*

3 Aro, T. *Suomi kaupungistumisen näkökulmasta vuonna 2030? ARA-seminaari 19.1.2016*, (Helsinki, 2016). https://www.slideshare.net/TimoAro/suomi-kaupungistumisen-nakokulmasta-2030.

4 For example Yle: Suomi on metsäläinen 2019 and Elävät puut 2018.

5 *National Forest Strategy 2025,* Ministry of Agriculture and Forestry. https://mmm.fi/en/forests.

6 *Luke. Forest ownership,* https://www.luke.fi/en/natural-resources/forest/forest-resources-and-forest-planning/forest-ownership/.

economy and form important carbon storages and sinks. One of the major issues in disputing the forest's role in climate change is the quantity and quality of forest cuttings. In May 2018, Finnish environmental non-governmental organizations (ENGOs) launched a citizens' initiative, which aimed to prohibit clearcuttings in state-owned forests. In six months, the initiative gathered the support of 50,000 citizens for parliamentary processing.[7] The survey done in the spring 2021 revealed that only 21 per cent of citizens approved clearcuttings.[8]

Exploitation of forest resources has been one of the main issues in recent political debates. During the latest elections in 2019, the main political party leaders – when campaigning – disagreed whether Finland should increase or decrease forest cuttings.[9] The climate change and environmental issues were the third most important themes in the parliamentary election in April 2019. In election compass surveys YLE (Finland's national public broadcasting company) has included the statement, 'Finland fells too much of its forests' as one of its questions to citizens.[10] In March, Evangelical Lutheran Church of Finland organized a forum in Helsinki to discuss conflicts on forest exploitation.[11] The public consciousness of forest-related issues were among the top-three issues in the political arena.[12]

In this article, in order to increase the awareness of the relationship with forests, we, firstly, define the concept of human-forest relationship and secondly, show how it is connected to the history and present of the Finnish society and culture. We also gather some ongoing societal discussion on changes in our relationship with forests.

This article is based on different, mainly published sources, which are analyzed following the guidelines of qualitative research. Our starting point

7 *Lakialoite avohakkuiden lopettamiseksi valtion mailla. VN/1699/2018,* (2018) https://www.kansalaisaloite.fi/fi/aloite/3184.

8 Pöntinen, P. Suojelun suosio kasvaa. *Suomen kuvalehti10/2021.*

9 'Metsä palasi Suomessa poliittisen keskustelun ytimeen', *Helsingin Sanomat* (26 December 2018). https://www.hs.fi/paakirjoitukset/art-2000005946436.html; 'Mitä Suomen pitäisi tehdä taistelussa ilmastonmuutosta vastaan? HS esitti neljä kysymystä kaikille eduskuntapuolueille, näin ne vastasivat', *Helsingin Sanomat* (9 October 2018). https://www.hs.fi/politiikka/art-2000005857403.html.

10 *Vaalikone 2019*, https://vaalikone.yle.fi/eduskuntavaali2019/1/kysymykset?lang=en.

11 'Kirkko tahtoo liennyttää metsäkiistelyä', *Maaseudun Tulevaisuus. Metsä* **2** (2019).

12 'Tässä ovat suomalaisten tärkeimpinä pitämät vaaliteemat: Kärkeen nousi niin perinteisiä kuin uusiakin – ja yksi, joka loistaa vaaliohjelmissa poissaolollaan', *Helsingin Sanomat* (7 February 2019). https://www.hs.fi/politiikka/art-2000005992241.html.

was a survey published in 2018, which clarified Finnish citizens' relationship with forests.[13] The survey showed the importance of forests, but due to its rather cursory nature, further research is needed. In order to understand the relationship with forest adopted by various forestry and environmental organizations, we utilized a non-published survey on web pages of forest-related organizations provided by the Lusto Finnish Forest Museum. We especially looked for what values organizations declared to promote in their forest-related issues, and what main differences existed.

Visual and narrative sources utilized include over 160 photos and descriptions, which Finnish citizens have taken of themselves in forest. These photos taken from 2017 onwards, known as 'Woodsies' (form of selfies taken in woods) and associated texts reflect citizens' impressions of their own HFR.[14]

2. Human-forest relationship

We define human-forest relationship (HFR) as an individual's or community's living relationship with the forest. Everyone's HFR is unique and pluralistic and evolves over one's lifetime. Individual HFR is formed in early childhood when we adopt beliefs and knowledge from our society, i.e. parents, relatives, teachers, friends. Besides this socialization, we attach our personal emotions and experiences to the forest. Later on, we go on to assimilate professional culture, traditions, knowledge and values to create our identity.

HFR can also be collective and this relationship is based on commonly shared values and experiences as well as ecological, cultural, social and economic aspects of our societies.[15] Forestry organizations such as schools, universities, companies, state administration represent the institutional cultures and traditions of forestry, forest policy and nature conservation, and have the power to create and maintain organizational HFR. Organizations'

13 *Kantar TNS. Suomalaisten metsäsuhteiden tila. Selvitys. Kestävästi metsäsuhteessa-hanke. MMM, SMY*, (Lusto – Suomen Metsämuseo, 14 March 2018). https://smy.fi/wp-content/uploads/2018/03/Suomalaisten-mets%C3%A4suhteiden-tila-selvitys.pdf.

14 *Lusto – Woodsie. Woodsie collection V18001.* The Finnish Forest Museum, Punkaharju, Finland.

15 Karhunkorva, R., Paaskoski, L., Matila, A., Arnkil, N. 'Merkityksellinen metsäkulttuuri', *Tapion raportteja, 10,* (Tapio Oy, 2016). https://tapio.fi/wp-content/uploads/2016/12/merkityksellinen-metsakulttuuri.pdf; Karhunkorva, R., Kärkkäinen, S., Paaskoski, L. 'Metsäsuhteiden kenttä', *Luston julkaisuja, 1*, (Punkaharju: Lusto – Suomen Metsämuseo, 2017). https://issuu.com/luston_julkaisuja/docs/metsasuhteiden_kentta.

HFR is, more often than individual HFRs, affected by conscious choices and selected aims. HFR can be a central part of organizations' mission.

Besides HFR, forest culture and forest history define our attitudes towards forests. Forest culture consists of activities, practices, values, meanings and viewpoints related to forests that individuals share as community members in a social context.[16] Presently, forest culture manifests itself as an HFR. Forest history reveals the description or the periods of the community's forest-related past.[17] These three concepts, HFR, forest culture and forest history, are related and are in the interactive process with each other. Both HFR and forest culture, as a living heritage, are constantly changing.[18]

Several disciplines have scrutinized people's relationship with surrounding nature from various viewpoints. In scientific research, the concept HFR is usually, if at all, mentioned alongside or as a synonym for the human-nature relationship. Due to this, HFR itself is a vaguely defined concept in the existing scientific literature. However, the research on human-nature relationship offers excellent benchmark for the current research of HFR concerning theoretical and methodological issues.

In Finland, there has been a lot of research in different disciplines concerning human-forest relationships but the concept of HFR has not been defined. The research has especially concentrated on children and youth and non-industrial private forest owners' (NIPF) behavior on the timber market. Especially the Finnish Forest Research Institute (Metla)[19] has analyzed the attitudes and behaviors of the Finnish NIPFs from the 1970s onwards. Often the aim of the research is encouraged by the national administration's and forest industry's need to understand how to promote forest owners' silvicultural and roundwood sale activities. However, HFR affects many forest-related stakeholders in versatile ways. One major question is how urbanized citizens define their HFR today and in future.

Finland is a country of 5.5 million individual HFRs and it seems that big social changes are occurring in these relationships. Megatrends and other

16 Paaskoski, L. 2014. *Experienced, recollected and reconstructed. The establishment of Nordic forest museums in the 1940s60s*. Nordisk museologi 1/2014, 22.

17 Fritzbøger, B. 2001. Kulturskoven. *Dansk skovbrug fra oldtid til nutid*. DSR: Frederiksberg, 13.

18 Paaskoski, L. & Karhunkorva, R. 2018. "Metsäkulttuurinen näkökulma." Teoksessa Metsäkulttuurinen näkökulma kansalliseen metsästrategiaan. Airi Matila & Leena Paaskoski & Reetta Karhunkorva & Nora Arnkil & Katja Matveinen. Tapion raportteja nro 25. Tapio Oy: Helsinki. 10-13.

19 From 2015 Natural Resources Institute Finland, Luke.

changes in complex global and local operational environments might have an unexpected impact on values and attitudes towards forests and the exploitation of forests. It is vital to recognize and understand these changes in society and in HFRs. Forest-related debates, decisions and activities take place in societal contexts and in constant interaction between different actors and stakeholders. Growing awareness of HFR will help these actors understand and reconcile the variety of different and even contradicting objectives.

3. Forests are vital to most Finns

Finnish "forest folk" includes a great number of different stakeholders and actors: forest owners like private citizens, forest companies, municipalities and the state, steering and advisory organizations including ministries and forest centres, foundations and unions, environmental non-governmental organizations (ENGOs), educational and vocational organizations, and above all, citizens.

In 2018, Finnish citizens' feelings about the forest were analyzed in a survey (n=1,236). For the first time, this kind of survey focused on the Finnish population as a whole. The report based on Kantar TNS's NeedScope research system measured emotional drivers. It provided information on feelings and behaviors, and what kinds of attitudes, images and functional needs were attributed to the forest.[20]

According to survey, only a mere 2 per cent of Finns stated that the forest evokes more negative than positive feelings. The survey revealed that spirituality and the desire to do things that benefit nature are common in Finnish HFRs. Finns generally see the forest as a safe, secure place, and that being in the forest provides relief from stress. The forest belongs to all people and Finns find the commercial use of forests acceptable if this use is sustainable.

Surveys identified six types of feelings associated with the forest and offered understanding as to what the forest means to people and what it offers. The six types of feelings are as follows: The forest 1) provides a sense of adventure and excitement, 2) gives a sense of control and financial security, 3) provides a sense of orderliness, competence and skill, 4) involves the feeling of peace and sanctity, 5) offers naturalness and intimacy, and 6) provides the sense of joy, passion and togetherness.

20 *Kantar TNS. Suomalaisten metsäsuhteiden tila. Selvitys. Kestävästi metsäsuhteessa-hanke. MMM, SMY*, (Lusto – Suomen Metsämuseo, 14 March 2018). https://smy.fi/wp-content/uploads/2018/03/Suomalaisten-mets%C3%A4suhteiden-tila-selvitys.pdf.

Everyone's relationship with the forest is plural in nature: forest related feelings and attitudes vary according to for example, one's needs, roles, stage of life, time and place. However, other contributing factors, such as age, place of residence, gender or whether the person owns part of the forest or not, did not affect individual's feelings associated with the forest.[21]

The survey analyzed only the HFR of Finnish adults. However, children's and young people's HFR is equal or perhaps more important because relationship with the forest develops in childhood. Children's relationship with nature has changed in recent decades. Research on children's relationship with nature exists in environmental education, environmental psychology, sport science and education.[22]

Nowadays children have less immediate experiences of the forest. They spend much of their time indoors and in the digital world. At the same time, abundance of research shows the positive health and well-being effects of the nature on children, including strengthening children's natural resistance and reducing allergies and asthma.[23] A close relationship with nature also develops motoric skills, imagination, collaboration and social skills. Free, creative and exploratory play in nature is especially important for children's development.[24]

Despite the fact that young people in the Western world are urbanized and somewhat alienated from nature, youth all over Europe have recently paid attention to environmental issues, especially climate change. Swedish activist Greta Thunberg who has taken vocal actions against climate change and thousands of young people marching for climate in Belgium and Finland in early 2019 are two examples.[25] This implies that nature and forests are important for young generations, too.

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21 *Kantar TNS. Suomalaisten metsäsuhteiden tila. Selvitys. Kestävästi metsäsuhteessa-hanke. MMM, SMY*, (Lusto – Suomen Metsämuseo, 14 March 2018). https://smy.fi/wp-content/uploads/2018/03/Suomalaisten-mets%C3%A4suhteiden-tila-selvitys-ESITYS-21.3.2018.pdf.

22 Häyrinen, L., Pynnönen, S. A Review of the Concepts and Measurements for Connection to Nature and Environmentally Responsible Behaviour—a Call for Research on Human-Forest Relationships. Current Forestry Reports, 6, 4, pp. 323–338. (Cham, Springer 2020). https://doi.org/10.1007/s40725–020–00131–62198–6436.

23 Saarinen, K., Jantunen, J. Luonto lähelle ja terveydeksi. Kysely Suomen päiväkodeille 2014, (Lappeenranta: Etelä-Karjalan Allergia ja ympäristöinstituutti, 2015). http://www.allergiaterveys.fi/upload/valtakunnallinen-kysely-2014.pdf.

24 Louv, R. *Last child in the woods: saving our children from nature-deficit disorder,* (London: Atlantic Books, 2010).

25 'Ilmastokapina leviää Euroopassa – Tuhannet belgialaisnuoret lintsaavat torstaisin koulusta: "Me saamme päättää!"', *Helsingin Sanomat* (8 February 2019). https://www.hs.fi/ul-

4. Non-industrial private forest owners

Private citizens, whose average age is 62 years, own around 60 per cent of Finnish forests. Majority of them were born in the 1950s–1960s when domestic and industrial use of forests were very intensive. In the long run the scope of forest values has enlarged to more biocentric attitudes and forests financial importance for urban NIPFs is often lower in comparison with the past generations. However, the latest survey on Finnish NIPFs showed an increase in the economic importance of forests.

From the 1970s onwards, the Finnish Forest Research Institute (Metla, from 2015 Natural Resources Institute Finland Luke) has explored the attitudes and behavior of the Finnish NIPFs. Research, based on surveys, interviews and statistics aims to discover the incentives and motives, which promote and even urge NIPFs on silvicultural and roundwood sale activities.

The latest follow-up study published in 2020 confirmed the long ongoing changes in private forest ownership. Forests no longer were an essential part of an agricultural entity; only 14 per cent of NIPFs were farmers and 62 per cent lived in the same municipality with their forest holdings. Even though some NIPFs did not quite accept forest management practices (e.g. clearcuttings), 48 per cent of NIPFs sold timber at least once during the years 2004–2008. The economic utilization of the forest is still an essential dividing factor among the NIPFs.[26]

5. Forestry professionals

Many communities or groups share and maintain their own HFR. These communities and groups include forestry professionals, nature entrepreneurs, environmental educators, campers, scouts, berry pickers, hunters and

komaat/art-2000005993548.html; 'Tältä Helsingin ilmastomielenosoitus näytti – HS kuvasi nuorten viestit päättäjille', *Helsingin Sanomat* (15 March 2019). https://www.hs.fi/kaupunki/art-2000006035851.html.

26 Takala, T., Hujala, T., Tanskanen, M., Tikkanen, J. 'Forest owners' discourses of forests: Ideological origins of ownership objectives', *Journal of Rural Studies* **51** (2017a): 1–14; Takala, T., Hujala, T., Tanskanen, M., Tikkanen, J. 'The order of forest owners' discourses: Hegemonic and marginalized truths about the forest and forest ownership', *Journal of Rural Studies* **55** (2017b): 33–44; Karppinen, H., Hänninen, H., Horne, P. 'Suomalainen metsänomistaja 2020', *Luonnonvara- ja biotalouden tutkimus 30* (Helsinki: Luke, 2020). https://jukuri.luke.fi/handle/10024/545837.

summer cabin owners. Their HFR may relate to the forest as an environment, resource or as a source of inspiration, experiences or knowledge.

In 2018, the forest sector formed 2 per cent of employed persons in Finland. Forestry employed 21,000 and the forest industries 42,000 people.[27] Although the number of employees in the forest sector has continued to decrease, the need for forestry professionals is estimated to grow when the scenarios for bioeconomy will be implemented.[28]

Forestry and the forest industry have been central to Finnish society and therefore forestry professionals have occupied a strong institutional position. They have played a key role in defining and determining the use of forests. The environmental movement has strongly challenged the position and expertise of forestry professionals since the 1970s. As a result, forest expertise has been pluralized in recent decades.[29]

According to previous research, based on large biographical sources collected in 1999–2002[30], the forestry profession is strongly based on the collective ideas of the national economic importance of forestry and driving the interests of all Finns. For forestry professional, the forest is comprehensive and extends to all aspects of life. Forest is both a habitat and a way of life, but above of all, forest is a source of livelihood and work. The economic value of the forest is the starting point for all values. The forestry professionals' HFR is human-centered. For them, a good and beautiful forest is 'manmade'; humans must intervene in the natural cycle of the forest. The harvesting of forests is natural and acceptable since reforestation always takes place after human activity.[31]

In forestry professionals' HFR, human activities are emphasized because they are considered benefiting all citizens. Such a utilitarian attitude contradicts an attitude emphasizing the intrinsic value of forest nature. Nature

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27 *Luke. Forest sector labour force. Finnish forest statistics,* https://stat.luke.fi/sites/default/files/suomen_metsatilastot_2019_verkko2.pdf.

28 Strandström, M., Poikela, A. 'Metsäalan työvoimatarve – Savotta 2025', *Metsätehon tuloskalvosarja* **15** (2016). http://www.metsateho.fi/metsaalan-tyovoimatarve-savotta-2025/.

29 Suopajärvi, T. *Sukupuoli meni metsään. Luonnon ja sukupuolen polkuja metsäammattilaisuudessa*, (Helsinki: SKS, 2009), 194; Paaskoski, L. *Herrana metsässä. Kansatieteellinen tutkimus metsänhoitajuudesta*, (Helsinki: SKS, 2008).

30 Snellman, H., Kaunisto, K., Paaskoski, L. *Metsäammattilaiset metsätalouden murroksessa – metsäperinteen tallennushanke 1999 – 2002.* (Metsähistorian Seura, Metsämiesten Säätiö, 2002).

31 Suopajärvi, T. *Sukupuoli meni metsään. Luonnon ja sukupuolen polkuja metsäammattilaisuudessa*, (Helsinki: SKS, 2009); Tervo, K. *Metsän hiljaiset. Metsätyön rakennemurroksen kolme sukupolvea,* (Helsinki: SKS, 2008).

conservationists see nature valuable for itself, regardless of its instrumental value. Their HFR is based on different values and it evolves in a different everyday life and social context than that of forestry professionals. The cultures of forestry professionals and conservationists may conflict.[32]

6. Forestry and nature organizations

Forestry and nature organizations with an official mission related to forests also possess forest relationships, which can be seen on values they produce and maintain in their strategies and actions. Forestry organizations' and ENGOs' forest relationships are often based on different values and traditions causing contradictions. Organizations' official forest relationships can be defined on their corporate web pages and in the way they describe their core activities and targets.

In our ongoing research, we divided 30 Finnish forestry organizations and ENGOs according to their web page vocabularies into three categories: Category 1 (utilitarian actors) includes the traditional forest sector, whose attitude toward forests emphasizes economic benefits. However, sustainability and responsibility are important concepts in their vocabulary since they aim to guarantee the optimum sustainable return on forests and natural resources over generations.

Category 2 (humanistic actors) includes different actors in cultural and educational fields such as museums, research institutions, universities, vocational institutions, schools, and tourism organizations. They are primarily interested in the social benefits that forests provide, emphasizing cultural, recreational, scientific and educational attitudes rather than economic ones.

Category 3 (biocentric actors) includes environmental organizations like ENGOs and the Ministry of the Environment. They, more than the actors in the two previous categories, include biocentric values in their attitudes. Forests are valuable as such, regardless of their usefulness to humans.

In categories 1 and 2, the attitude closely resembles stewardship tradition, which is common in many Judeo-Western cultures. According to this tradition, forests and natural resources in general are valued on their usefulness to humankind.[33] From this perspective, it would be interesting to study whether

32 Tervo, K. *Metsän hiljaiset. Metsätyön rakennemurroksen kolme sukupolvea,* (Helsinki: SKS, 2008).

33 Des Jardins, J.R. *Environmental Ethics. An Introduction to Environmental Philosophy,*

the biocentric values connected to forests are partly an attempt to emphasize the ecological importance of forests for humankind.

7. Forest Culture

In Finland, forest has affected society, culture and history in an extremely profound way. Finns have always depended on forests, using forests in multiple ways and have regarded forests as meaningful places. Even many disagreements and conflicts in society have been connected to forests.

Forest culture can be defined as activities, practices, viewpoints, meanings, and values related to forests and shared by individuals and communities in a social context. Forest culture is a process, which takes place along a timeline from the past to the future and at present, forest culture manifests itself as HFR.[34]

The forest culture viewpoint is one way to understand the timeline from the past to the future and to understand divergent values and aims in a constantly changing society. In connection with place (forest environment), time (history, present, future) and social dimension (culture), individuals and communities build their identities. Simultaneously, through connection with the intangible cultural heritage that is associated to forests, humans can benefit from a higher state of wellbeing.

In Finland, HFR is undoubtedly very meaningful intangible cultural heritage. HFR was included in the National Inventory of Living Heritage in 2017.[35] The future goal is for HFR to be included in UNESCO's Convention for the Safeguarding of the Intangible Cultural Heritage. This Convention promotes the protection and awareness of the significance of living intangible cultural heritage and emphasizes transmitting traditions, cultural diversity and people's involvement in cultural heritage. Intangible cultural heritage is present in people's everyday lives, encompassing all forms of human activity.[36]

(Boston: Thomson Wadsworth, 2006).

34 Karhunkorva, R., Paaskoski, L., Matila, A., Arnkil, N. 'Merkityksellinen metsäkulttuuri', *Tapion raportteja, 10,* (Tapio Oy, 2016). https://tapio.fi/wp-content/uploads/2016/12/merkityksellinen-metsakulttuuri.pdf.

35 *Lusto – Relationship with the forest is living heritag*e. https://lusto.fi/en/collections/relationship-with-the-forest/.

36 *Intangible Cultural Heritage. Finnish Heritage Agency.* http://www.aineetonkulttuuriperinto.fi/en/index.

HFR, being present in everyday life, is a good example of living heritage, which empowers individuals, communities and the whole nation. Awareness of various HFRs promotes constructive communication, enables the coordination of multiple forest-related aims and shapes the commonly shared future of Finnish forests.

Lusto, the Finnish Forest Museum, has highlighted the multidimensional forest relationship and forest culture. Based on Lusto's initiative, as a member of The National Forest Council, forest culture aspects and the human-forest relationship approach were included in the Finnish National Forest Strategy.[37]

8. Concrete tools to recognize HFR

Lusto has promoted HFR in various collaborative networks over the past few years and has launched new museum services based on the HFR approach. One example is the HFR workshop *Me in the Forest* that is part of the occupational welfare project Roots and branches. In *Me in the Forest* workshops, participants discuss their personal and professional HFR, aim to raise awareness of forests' significance to individuals, to forest sector and to Finnish culture and society. The outcomes of these workshops are added to Lusto's museum collection.[38]

In Lusto's new museum service, *Human-Forest Relationship Clinic*, customers can discuss their HFRs with Lusto's specialists. This clinic helps customers to learn how HFR might enhance well-being and at the end of the appointment, the customer is given a 'prescription' to strengthen HFR.[39]

The Human-Forest Relationship Method developed in 2017–2018 was a part of the Sustainable Forest Relations project funded by the Finnish Ministry of Agriculture and Forestry.[40] This Method includes workshops and different tasks based on the Human-Forest Relationship Approach, which helps forest-related actors to clarify their identity, personal HFR and to develop

37 *Forest Council,* (Ministry of Agriculture and Forestry, 2019). https://mmm.fi/metsat/strategiat-ja-ohjelmat/kansallinen-metsastrategia/organisaatio; *The Forest Relationship in Finland. Wiki-inventory for the living heritage in Finland*. https://wiki.aineetonkulttuuriperinto.fi/wiki/The_forest_relationship_in_Finland.

38 *Lusto – Me in the forest. The collection of Me in the forest -pilot A17007*. The Finnish Forest Museum, Punkaharju, Finland.

39 *Lusto – Human-forest relationship clinic*. https://lusto.fi/en/services/clinics-and-workshops/.

40 *Lusto – The Forest Relationship Method 2019*. https://issuu.com/luston_julkaisuja/docs/978–952–69018–2-4.

their working skills. Further, this Method promotes the understanding about different values associated with HFR and builds constructive cooperation and decision-making.

In 2017 and 2018, Lusto collected 'Woodsies' – or selfies in the woods. People were asked to take a selfie doing something they love or typically do in the forest and attach a description to the selfie. There are over 160 Woodsies, which provided insight into contemporary Finnish relationships with the forest.[41] According to Woodsies, Finns relax, recharge, feel free, and gain strength and health in the woods. They admire, love, observe and experience the forest through all senses.

9. Conclusions

In this article, we defined the concept of human-forest relationship (HFR). We also showed how HFR is connected with the history and present of the Finnish society and culture, and gathered some ongoing societal discussion on HFR.

HFR is an individual's living relationship with the forest. Everyone's HFR is unique and pluralistic and evolves over one's lifetime. HFR can also be collective and based on commonly shared values and experiences of different societies, organizations or communities connected to forests. HFR, consciously or unconsciously, affects forest-related actions or decisions. HFR is part of wider concepts of human-nature relationship and human-environment relationship. Unlike the other two relationships, Finnish HFR has strong implications of work and economic usage of forests.

Throughout the past fifty years, forestry in Finland has experienced great changes that have stripped forestry off its advantaged national position. The forest sector has lost its position as an engine of economic growth and simultaneously environmental activists have challenged foresters' knowledge and expertise. Finally, climate change and forests' importance in mitigating it, has caught ordinary citizens' attention and raised questions whether we should exploit or not our forests.

What is the forest paradigm of our times? What kind of values does it include? We believe that these paradigms and values exist in HFRs. By studying all different actors, i.e. citizens, NIPFs, forestry professionals and forest

41 *Lusto – Woodsie. Woodsie collection V18001.* The Finnish Forest Museum, Punkaharju, Finland.

organizations, it is possible to understand their HFRs more intricately and furthermore the changes in the Finnish forest paradigm.

Private citizens own 60 per cent of Finnish forests and forests are important for 83 per cent of Finns. Their attitudes towards forests are thus influential in forest-related discussions and decision-making. The major questions are, what kind of HFR do these urbanized citizens have now and will have in future, and how this will affect their forest-related behavior. HFR can be the source of wellbeing for Finns in the future. Understanding about HFRs can help current and future generations solve the conflicts and find solutions in forest-related decision-making.

Forestry professionals are essential actors in the Finnish forest sector. These actors are responsible for managing forests, supplying wood, consulting private forest owners. Because they form a network that has impact on Finnish forests, economy, and society at every organizational level, it is both imperative and valuable to understand their HFR. At the individual and societal level, deeper understanding provides tools for managing and mitigating forest-related conflicts that often persist between forestry professionals and ENGOs.

Forestry and nature organizations emphasize different values and objectives in their core activities. Natural resources in general are valued because of their usefulness to humans although ENGOs present more biocentric values than other actors do. Contradictory objectives usually cause tensions and even conflicts. Global environmental challenges need more collaboration than disputes and in order to create opportunities for collaboration it is vital to understand organizational relationships to the forests.

Forest culture, defined as activities, practices, emotions, viewpoints, meanings, and values related to forests and shared by individuals and communities in a social context, manifests itself as HFR. Forest culture, its place connectedness, timeline and social dimensions enable individuals and communities to build their identities and furthermore cultural heritage. In Finland, HFR is undoubtedly one of the most meaningful living heritage phenomena.

Profounder understanding about HFR helps communities ultimately produce the well-being of both people and forests. Accurate knowledge on individual and shared HFRs is important because these relationships inherently affect the future through persons' and communities' everyday life. This knowledge can be used for the constructive communication and better coordination of the various sustainable aims set for forests. At the international level, this could enlarge cultural perspectives on forests by giving tools to promote HFRs and a more sustainable way of life.

Figure 1: *The forest is my soul's home. Even as a child I would play up in the trees, and when I was a teenager, the forest became a refuge from the world, and it still is for me. I forage a large amount of my food from the forest, and in this picture you can see mushrooms that I picked in a couple of hours. I was mushrooming with my mother, and I felt happy and peaceful inside.*
Photo: Hilla Solja / The Woodsie collection / Lusto – The Finnish Forest Museum.

‹ ***Figure*** *2: I grew up in the country, in the woods. As a child I spent time in the woods, taking heifers to woodland for grazing, picking and eating wild berries, planting trees, hiking and skiing, and trying to find animal tracks and forest spirits. My father gave me and my brother a forest site, which we take care of together – and we hope with our children in the future; we want to respect our father and the environment and to offer our children similar experiences to those we had. I live in a city with my family, and I miss the woods, the humming of trees, the silence and the scent of the forest.*
Photo: Anne Lyytinen / ibid. / ibid.

Figure 3: *My father inherited a forest site, which I then inherited from him. I've always taken good care of the woods. I also worked on a logging site when I was a teenager. Since childhood, I have loved being in the woods, by myself, with my brothers and with my wife. I'm over 80 now but I still go to the forest to pick blueberries and lingonberries. I get our Christmas tree from my forest every year. Martti Torvikoski.*
Photo: Anne Lyytinen / ibid. / ibid.

‹ ***Figure*** *4: The dog has just been let loose to track deer. I'm excited to see what happens. The forest offers new experiences every time I go there. For me, the forest is a place for leisure where I forget my everyday life. It's the most important place to revive my body and mind. I often hike in the woods with my dogs, especially in the autumn, but I go there all year round for the exercise and to relax. We enjoy berries, mushrooms and game at the dining table.*
Photo: Johanna Virtanen / ibid. / ibid.

› ***Figure*** *5: I've lived here all my life, 62 years, sometimes working in the city. For me, the forest is a place where I can breathe and enjoy the silence. I can feel the presence of the Forest Spirit. I get to take close-up photos of birds. I tend my own forest with love, using a clearing saw and a chain saw, sometimes apologising to the trees. I load the timber by hand and bring it out on my MF165 tractor.*
Photo: Jarmo Mäntykangas / ibid / ibid

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Put Yourself in the Picture: Art Interpretation as a Tool for Forging Deeper Connections to the Forest

NINA LUOSTARINEN, MINNA HAUTIO,
University of Lapland, Humak University of Applied Sciences

Abstract: This article is based on an experiment conducted in Finland in 2014 in which people were given the task of building visual reinterpretations, in a natural environment, of artworks they were given. The premise for the project Mätäsmetäs was a curious idea: if we could use forest-themed art to get adults to play in the forest, these places – and the works being interpreted – would acquire an experiential emotional connection that would create a world of meaning and achieve bonding and attachment. With pictures, it is possible not only to connect the photographer and a place, but also to share the experience of the feeling, mood and spirit of the place with the viewer of the picture. In the case studied by us the activities called 'play' could be classified as 'pictorial play', in which mental visualization extends, through the new meanings of the roles or objects, to pictorialization.

Keywords: Forests, forest-themed art, well-being, landscape interpretation, imagination

1. Introduction

This paper is based on an experiment that was conducted in three selected hiking areas in Finland during summer 2014 as part of a project called Mätäsmetäs. The principal motivation for the experiment was to study whether art-based participatory activities can be used to make participants experience nature in a new, emotionally based, experiential way. We set this experiment up out of curiosity of combining the effects of both forests and art on well-being.

During this era of the ludic turn[1,2] the era, where playfulness has and been accepted into many areas of working life and past time activities, we were also curious about adding adult playfulness to this combination.

For this playful experiment, Finnish forest-themed art was gathered and used to create 50 idea cards. The basic concept was simple: choose an idea card with a forest-themed piece of art, play with the idea of it, take a photograph and upload your interpretation on a website for others to see.

Although the materials for the experiment were translated into English, the experiment was based around Finnish art and took place in Finnish forests. Not surprisingly, it attracted predominantly Finnish people (approximately 92 per cent of all participants). Therefore, the results are likely to tell us mainly about the relationships of Finnish people to art and the forest. In total 375 interpretations were uploaded; in this paper we analyse them and listen carefully to the stories they tell.

2. Finnish People and Their Forests

Finland is by far the most forested country in Europe; forests cover 78 per cent of its area and aquatic environments, 10 per cent. Thus, there are about 22 hectares of forest for every Finn. The European average is 1.3 hectares per person.[3] Forests have been an important source of livelihood for Finns for millennia. Even today forest industry products are key exports amounting to about 20 per cent of total annual exports.[4]

Finnish people are never very far from forest, lakes or rivers; forests form an important part of most Finns' physical surroundings and visual landscape. The average distance of a Finn to a forest is 700 metres, but half of them live no further than 200 metres from one. For half of Finns, water can be found within one kilometre of their residence, the average distance being two kilometres.[5]

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1 Frissen, V., De Mul, J., & Raessens, J. (2013). Homo Ludens 2.0: Play, Media and Identity. In Thissen J., Zwijnenberg R., & Zijlmans K. (Eds.), *Contemporary Culture: New Directions in Art and Humanities Research* (pp. 75–92). Amsterdam University Press.

2 Sutton-Smith, Brian (1997) The Ambiguity of Play, Harvard University Press, Cambridge, Massachusetts.

3 Luke. *Euroopan metsäisin maa,* (2013). http://www.metla.fi/suomen-metsat/ (accessed 31 January 2019)

4 Customs. *Exports by Products by Activity (CPA2008) in 2018*. (2019). https://tulli.fi/tilastot/taulukot/muut-tilastot (accessed 31 January 2019).

5 Sievänen, T., Neuvonen, M. 'Luonnon virkistyskäytön kysyntä 2010 ja kysynnän muutos',

In Finland everyone is allowed to walk, ski or cycle freely in all forests, both private and public, based on everyman's right. This freedom to roam also makes it possible for everyone to pick wild berries, mushrooms and most plants and practice angling and ice fishing without a license or fees. Also, camping is allowed at a reasonable distance from homes and yards. In return for such rights, everybody is expected to treat nature sustainably and with respect.[6]

An extensive survey found that Finnish people engage in outdoor activities three times a week on average, 31 per cent of them daily. Walking and hiking are by far the most common activities, practiced by 80 per cent of the population. Due to the abundance of forested environments in close vicinity to most people and everyman's right the harvesting of nature's resources is frequent – more than half of the population picks berries and 40 per cent also pick mushrooms. Hunting, fishing and collecting wild herbs are also practiced, albeit to a lesser extent. Landowners harvest their forests for firewood on a regular basis.[7]

According to another survey, three out of four Finns perceive forests as safe and protective environments where they feel relaxed and calm. The respondents also said that forest environments enable them to 'be their true selves' and to feel free, at one with nature, active, accepted, small, sensitive and creative.[8] The benefits of being exposed to forest elements are widely acknowledged: in a large survey carried out in four Finnish national parks visitors were asked to value the perceived health and well-being benefits of these parks in terms of money. The respondents estimated a single visit to a park to be worth €208 on average.[9]

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in Sievänen, T., Neuvonen, M. (eds.), *Luonnon virkistyskäyttö 2010. Metlan työraportteja*, 212 (2011), 76.

6 Ministry of the Environment. *Everyman's Rights: Legislation and Practice*, (2016), http://www.ym.fi/download/noname/%7B595923BE-007D-4405-B69C-1748A02055EF%7D/57650 (accessed 31 January 2019).

7 Sievänen, T., Neuvonen, M. 'Luonnon virkistyskäytön kysyntä 2010 ja kysynnän muutos', in Sievänen, T., Neuvonen, M. (eds.), *Luonnon virkistyskäyttö 2010. Metlan työraportteja*, **212** (2011), http://www.metla.fi/julkaisut/workingpapers/2011/mwp212.htm (accessed 31 January 2019), 37–43, Silvennoinen, H., Sievänen, T. ,Ulkoilu luonnossa yksityisten omistamilla alueilla', in Sievänen, T., Neuvonen, M. (eds.), *Luonnon virkistyskäyttö 2010.* Metlan työraportteja **212** (2011), http://www.metla.fi/julkaisut/workingpapers/2011/mwp212.htm (accessed 31 January 2019), 116.

8 Reunala, A. 'Turvallisuuden tunne metsän henkisenä arvona', *Kalevalaseuran vuosikirja* **73** (1994), 173.

9 Vähäsarja, V. *Luontoympäristön terveys- ja hyvinvointivaikutusten taloudellinen arvot-*

Finnish people therefore have quite a unique relationship to their forests – to the extent that the concept of the 'Finnish forest relationship' has even been inscribed on the Finnish National List of Intangible Cultural Heritage based on the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage.[10] Although each individual's relationship to the forest is different and the concept itself is complex and vague, it can be argued that most Finns feel at home in forests and even have a sense of immaterial ownership to them.

3. Forest and Well-being

Exposure to nature has many overall positive effects on well-being. Whereas physical well-being (e.g., relaxation) can be measured clinically, mental well-being can be assessed by studying perceived feelings of pleasure and restoration.

In a study carried out in Japan it was found that participants in an experiment showed clear physiological indicators of relaxation (as measured by heart rate, blood pressure and nervous activity) after viewing a forest for just 15 minutes. Another test group was presented an urban view; the members of this groups displayed greater stress-related indicators. The 'forest group' also had better scores in subjective ratings, reporting less negative and more vigorous moods than the 'urban group'.[11] Similar physiological and psychological tests have been conducted in Germany and yielded similar results.[12] Another Japanese study supports these findings by indicating that feelings of hostility and depression diminish greatly even after the shortest visit to the

taminen, (Vantaa: Metsähallitus, 2014), https://julkaisut.metsa.fi/assets/pdf/lp/Asarja/a210.pdf (accsessed 6 March 2019).

10 National Board of Antiquities. *Museoviraston esitys elävän perinnön kansalliseen luetteloon hyväksyttävistä kohteista opetus- ja kulttuuriministeriölle.* (2017),

11 Tsunetsugu, Y., Lee, J., Park, B.-J., Tyrväinen, L., Kawaga, T., Miyazaki, Y. 'Physiological and Psychological Effects of Viewing Urban Forest Landscapes Assessed by Multiple Measurements', *Landscape and Urban Planning* **113** (2013): 90–93.

12 Meyer, K., Hey, S., Bürger-Arndt, R. 'Psychological and Physical Effects of Walking through a German Mixed Stand Forest', *International Conference on Landscape and Human Health: Forests, Parks and Green Care May 17–19, 2017, Diplomatic Academy of Vienna, Austria*, (2017), http://www.landscapeandhealth.at/images/Conference-LHH-May-17–19-Vienna_small.pdf (accessed 8 March 2019).

forest. In fact, length of forest exposure does not seem to play any significant role, nor does the type of forest.[13]

According to a large survey, Finnish people regard activities carried out in nature as more pleasurable than other leisure activities. Nature-related activities are also considered more refreshing than leisure activities carried out in a built-up urban environment. The presence of other people versus being alone did not seem to play any significant role in the experience.[14] In order to experience the positive benefits of the natural environment, one does not need to spend time in pristine forests. Perceived restorativeness is also higher after visiting urban parks or managed urban woodlands as opposed to built-up environments.[15]

Furthermore, visiting favourite natural settings may serve as a resource for regulating negative feelings and coping with perceived stress. Research findings indicate that people with health complaints report more emotional benefits from visiting their favourite places than those who had less problems. The positive effect was based on being able to be present in natural environments and relaxing in them.[16]

Forests provide people with ample opportunities for self-regulated exercises for improving physical and mental well-being.[17] With their capacity to reduce stress, forests could also be used more extensively to prevent and decrease the risk of stress-related diseases.[18] Therefore, they are also an excellent healthcare resource.[19]

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13 Morita, E., Fukuda, S., Nagano, J., Hamajima, N., Yamamoto, H., Iwai, Y. et al. 'Psychological Effects of Forest Environments on Healthy Adults: Shinrin-yoku (Forest Air Bathing, Walking) as a Possible Method of Stress Reduction', *Public Health* **121** (2007), 60

14 Korpela, K., Paronen, O. 'Ulkoilun hyvinvointivaikutukset', in Sievänen, T., Neuvonen, M. (eds.), *Luonnon virkistyskäyttö 2010. Metlan työraportteja 212,* (2011), http://www.metla.fi/julkaisut/workingpapers/2011/mwp212.htm (accessed 31 January 2019), 84, 87.

15 Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., Kagawa, T. 'The Influence of urban green environments on stress relief measures: A field experiment', *Journal of Environmental Psychology* **38** (2014): 1–9.

16 Korpela, K., Paronen, O. 'Ulkoilun hyvinvointivaikutukset', in Sievänen, T., Neuvonen, M. (eds.), *Luonnon virkistyskäyttö 2010. Metlan työraportteja 212,* (2011): 80–89, http://www.metla.fi/julkaisut/workingpapers/2011/mwp212.htm (accessed 31 January 2019).

17 Tyrväinen, L. 'Metsän virkistyskäytön terveys- ja hyvinvointihyödyt', in Salo, K, (ed.) *Metsä. Monikäyttö ja ekosysteemipalvelut,* (Helsinki: Luonnonvarakeskus, 2015), 275.

18 Morita, E., Fukuda, S., Nagano, J., Hamajima, N., Yamamoto, H., Iwai, Y. et al. 'Psychological Effects of Forest Environments on Healthy Adults: Shinrin-yoku (Forest Air Bathing, Walking) as a Possible Method of Stress Reduction', *Public Health* **121** (2007): 54–63.

19 Morita, E., Fukuda, S., Nagano, J., Hamajima, N., Yamamoto, H., Iwai, Y. et al. 'Psycho-

4. Art and Well-being

Like forests, art has been proven to be beneficial for perceived well-being. Numerous studies show that participating in art-based activities contributes to well-being at the individual, community and societal levels. Similar findings have been made in different countries and amongst different target groups.[20]

Participating in – or quite simply just attending – art-related activities and events has a positive impact on the body's physiology as well. Neuroscientific research has shown that engaging with the arts has a cognitive effect on humans. Some findings also suggest that art-related stimuli could help boost the immune system in times of stress. The benefits of art for both health and overall quality of life are not just linked to physiological effects; art can stimulate creative thinking. In doing so, it also enables people to gain insight into and new perspectives on how they feel and how they position themselves within society.[21]

5. Forests and Art

Forests have inspired artists throughout the ages. In Finland forest inspiration has been prominent especially in literature but also in visual arts. Paintings of forests grew in importance in the National Romantic era. This period was also characterised by the political struggle to form a sovereign Finnish state. Therefore, motifs in forest-themed paintings (such as specific types of trees) were imbued with political connotations.[22] Tuula Karjalainen[23] refers to some of these motifs as 'stock images' (*kantakuvat*) that have played a role

logical Effects of Forest Environments on Healthy Adults: Shinrin-yoku (Forest Air Bathing, Walking) as a Possible Method of Stress Reduction', *Public Health* **121** (2007): 54–63.

20 Mental Health Foundation. *An Evidence Review of the Impact of Participatory Arts on Older People,* (2011). https://baringfoundation.org.uk/wp-content/uploads/2011/04/EvidenceReview.pdf (accessed 9 March 2019).

21 Gordon-Nesbitt, Rebecca 2015. *Exploring the Longitudinal Relationship between Arts Engagement and Health.* (Manchester: Arts for Health, Manchester Metropolitan University, 2015), http://artsforhealth.org/research/artsengagementandhealth/ArtsEngagementandHealth.pdf (accessed 9 March 2019).

22 Reitala, A. 'Metsä suomalaisessa kuvataiteessa', *Silva Fennica* **21** (4) (1987), 441

23 Karjalainen, T. *Kantakuvat. Yhteinen muistimme*. (Helsinki: Maahenki, 2009).

in shaping the Finnish understanding of both the Finns' relationship with the forest and their national identity.

Whereas in earlier works the relationship between man and forest was depicted as mainly straightforward and uncomplicated, contemporary art portrays a more complex and controversial relationship. Artists today do not shy away from less idealised themes and problems and intentionally leave many questions open for the viewer to reflect upon and contemplate.[24]

Reflection, holistic experiencing and imagination are closely connected to creativity. They bring forth memories and ideas from within a person's mind and combine them with external stimuli. Probably all Finnish people remember from their childhoods how the forms, shadows and shapes of the forest seemed to be full of imaginary creatures – whangdoodles, elves and wights – especially when strolling amongst the trees at twilight. Just a small bit of stimulation is enough to effortlessly evoke these feelings and locate the origins from where iconic pieces of forest-themed art evolve.

6. Play + Landscapes = Play(e)scapes

Play as an activity consists of two levels. The first level is the real, physical location of play, which can include playthings. The second level consists of the meaningful content of the activity, without which play does not occur. The other essential element of play, its immaterial spiritual structure, enables play to be something more than just a mere function.[25]

In using an art-based method we wanted to enable other ways of seeing, doing and thinking, all of which are methods typical of art. Through artistic activity we sought to delicately steer participants towards being able to investigate, stretching their boundaries, and daring to enter unfamiliar zones.[26] We also aimed to encourage participants to form a new kind of relationship with the environment, as the process of interpreting recycling art also requires, at

24 Bonsdorff, P.v. 'Huomioita ihmisen ja ympäristön suhteesta', in Heinänen, S., Bonsdorff, P.v., Kaukio, V. (eds.), *Tunne maisema. Jyväskylän taidemuseon julkaisuja 1* (2011), 125–131.

25 Juel Larsen, L. 'Play and Space: Towards a Formal Definition of Play', *International Journal of Play* **4:2,** (2015), 183

26 Ylirisku, H. 'Metsään menemistä, poluilta pois astumista', in Suominen, A. (ed.), *Taidekasvatus ympäristöhuolen aikakaudella – avauksia, suuntia, mahdollisuuksia*, (Helsinki: Aalto ARTS Books, 2016), 157.

its best, a sensitive reading of nature, sensory immersion in the environment, and observation of the effects of one's own activities.[27]

The method employed in the Mätäsmetäs project is informed by Sutton-Smith's modern rhetorics of play. [28] During the project, art education (play as progress) took place. The project channelled participants' imagination and self-expression (play as imaginary) and had meaning for the individual (play as the self). We might also conclude that, based on most of the pictures produced during the process, acting silly and wanting to have fun played a central role (play as frivolous).

When we combine playing and landscapes, we might end up creating even more than playful landscapes or playscapes. When we let our imagination be involved in experiencing the landscape, play can enable us to see the narrational – even surreal – layer of place. In giving participants an excuse to play we are also allowing them to escape from the roles and routines that normally limit their behaviour, self-expression and capability of seeing the magical realism around them.

7. Forest + Art + Play = Well-being^3, a.k.a. the Mätäsmetäs Project

We were driven to conduct this experiment by the desire to find out what happens when we combine the known well-being drivers of forest and art and mix in a spoonful of playfulness. Could we end up with "well-being cubed"?

The Mätäsmetäs project was officially developed to increase the use of selected hiking areas. The landowner, the Finnish forestry administration, considered these sites to be interesting and inviting but underused considering their potential. We were also curious whether this kind of experience could be used to attract new regular visitors to these sites, who would spread the word about them by sharing the photographs they took. Thus, can reinterpreting forest-themed art appear as a playful cartography of these places, as a result of which a map of the place is drawn with emotions in the mind?

For this playful experiment, Finnish forest-themed works of art were

27 Ylirisku, H. 'Metsään menemistä, poluilta pois astumista', in Suominen, A. (ed.), *Taidekasvatus ympäristöhuolen aikakaudella – avauksia, suuntia, mahdollisuuksia*, (Helsinki: Aalto ARTS Books, 2016), 157.

28 Sutton-Smith, B. 'Play and Ambiguity', in Salen, K., Zimmermann, E. (eds.), *The Game Design Reader: A Rules of Play Anthology,* (Cambridge, Mass.: MIT Press, 1997), 304.

gathered, and 50 idea cards based on them were created. The cards were divided amongst the three nature centres on the hiking routes. They were also available on the project website for the entire duration of the experiment in summer 2014. The basic idea of the game was simple: choose an idea card depicting a forest-themed artwork (or a detail from it) that appeals to you or excites you; play with the work's motif, scale and media; and take a picture of your interpretation and upload it to the project website. The experiment was presented as a competition to make it more attractive to potential participants.

The participants were challenged to create playful reinterpretations of existing works. By encouraging playfulness, we sought to emphasise the strengths of play: play already takes place in real landscapes, in which by their nature various realities exist, and thus such landscapes have the ability to raise new perspectives and interpretations that differ from normality.[29] The forest is a familiar play site to most Finns, but artworks as meaningful content of play[30] are generally abnormal in that environment.

The quest for interpretation was not of a direct mimicry. It was rather one of conceptualizing another artist's thinking and converting the interpreter into a produced picture.[31] The photographs taken also tell stories. In these visual stories, though, there is no clearly visible plot. This does not mean, however, that these stories could not also be told through pictorial expression. Narratisation can visualize things that are formless and hidden.[32]

8. What Did the Photographs Reveal?

Of all 375 photographs, 76.5 per cent depicted active agency in some form. The ones that did not were mainly landscapes depicting land where human impacts were totally absent or where there were only vestiges of human

29 Mainemelis, C., Ronson, S. *Ideas Are Born in Fields of Play. Towards a Theory of Play and Creativity in Organizational Settings. Research in Organizational Behavior. Volume 27*, (2006), pp. 81—131. https://doi.org/10.1016/S0191–3085(06)27003–5.

30 Juel Larsen, L. 'Play and Space: Towards a Formal Definition of Play', *International Journal of Play* **4:2,** (2015): 175–189, 183.

31 Räsänen, M. *Visuaalisen kulttuurin monilukukirja,* (Helsinki: Aalto-yliopiston taiteiden ja suunnittelun korkeakoulu, 2015), 230–240.

32 Sava, I., Katainen, A. 'Taide ja tarinallisuus itsen ja toisen kohtaamisen tilana', in Sava, I., Vesanen-Laukkanen, V. (eds.), *Taiteeksi Tarinoitu oma elämä,* (Jyväskylä: PS-Kustannus, 2004), 27.

activity from the distant past. Any kind of activity carried out by living creatures or the indication of such recent activity (such as use of playthings to create a scene) was considered active agency. The agents in these pictures were either animals (9 per cent) or people (91 per cent). Pictures showing human activities consisted of those in which people themselves were in the picture (52.5 per cent) and those that only contained playthings (47.5 per cent).

Of all the pictures depicting people, only two were 'selfies'. This was a surprisingly low number considering the overall popularity of taking selfies and the fact that the 'forest selfie' featured prominently in promotional materials for the competition. It is likely that the incentives for taking part in the competition and engaging in playfulness primarily attracted groups of at least two people.

In the following chapter we will examine four entries in the competition more closely – all with human activity in them – and analyse their contents from the perspective of how these images interpret the original artwork, what other meanings have been added to them and what kind of play was needed to produce them.

9. Four Interpretations of an Interpretation

We chose to examine more closely interpretations of Akseli Gallén-Kallela's 1899 painting *Kullervo Cursing*. Gallén-Kallela was part of the Finnish National Romantic movement. His most famous paintings, including *Kullervo Cursing*, depict scenes from the *Kalevala*, the Finnish national epic. This painting and the story of Kullervo are widely used in general education and are therefore familiar to most Finns.

Kullervo is a classic tragic character, an ill-fated orphan slave whose life is plagued by misfortune and unhappiness. This painting pictures him at a time when he was herding cattle in a forest. When he tried to cut his bread, he found out that his master's wife had baked a stone it. The stone broke his knife, the only thing he had inherited from his late father. As a result of this, he curses the wife and seeks revenge by summoning the beasts of the forest to slay her. He is a troubled young man with a fierce nature that often leads him into tragic circumstances – at one point he even ends up having an incestuous encounter with her sister by mistake. Finally, after losing everything he holds dear he finally takes his own life by throwing himself on his sword. The story of Kullervo has inspired many musicians, painters and writers. One

of them was J. R. R. Tolkien, who used Kullervo as inspiration for the tragic hero Túrin Turambar in his novel *The Silmarillion*.[33]

The young man in the painting is clearly infuriated, as implied by his facial expression and tense, extended body. His feelings of defiance and his wish to take revenge culminate in his raised fist.[34] The pristine forest around him enhances the spontaneous and primitive nature of his act. Even though his actions suggest fierce intention and purpose, his rage, however, does not have a clear and imminent target; it seems to be targeted more towards the unjust world order than anything else. The only things suggesting action and motion in the picture are his clenched fist and the assumed shout arising from his open mouth. Nature stands pronouncedly still and further underlines the helplessness of this man.

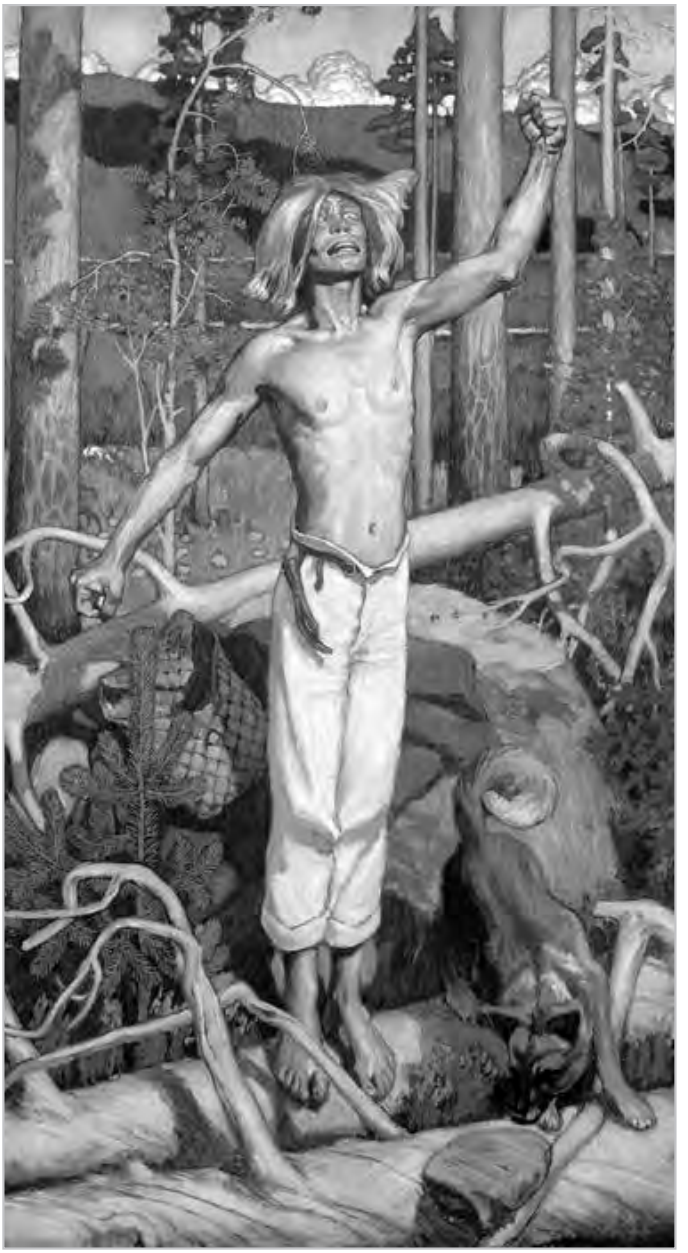

Figure 1: *Kullervo Cursing, a painting by Akseli Gallén-Kallela (1899).* Photo: Finnish National Gallery / Pirje Mykkänen

33 Tolkien, J.R.R., Flieger, V. '"The Story of Kullervo" and Essays on Kalevala', *Tolkien Studies: An Annual Scholarly Review. Volume 7.* (West Virginia University Press, 2010), 211.

34 Hoeven, A.v.d… 'The Making of Kullervo', in Hasselblatt, C., Hoeven, A.v.d. (eds.), *Finno-Ugric Folklore, Myth and Cultural Identity: Proceedings of the Fifth International Symposium on Finno-Ugric Languages in Groningen, June 7–9, 2011. Studia Fenno-Ugrica Groningana 7* (Maastrich: Shaker, 2012), 81.

Not even the dog is paying attention to him; Kullervo stands alone, and there is no one else there to witness his action and support his purpose.[35]

Apart from the obvious context of a young man cursing the evil deed of his master's wife, the painting has also been given other interpretations. At the time it was painted Finland was still a grand duchy of Russia, but the idea of gaining independence was growing in popularity. Therefore, it has been seen as a metaphor of a small nation (Finland) demonstrating its feelings under a regime installed by a larger nation (Russia). Regardless of the time and place it was created, it tells a universal story that viewers can easily associate with feelings of injustice and humiliation.

9.1. First Interpretation

The first interpretation of this painting depicts a person standing on a small mound, possibly a cliff, with a clenched fist raised in front of his face. He is a young blond man with a lean figure, who has taken off his shirt, probably in order to imitate the original painting as closely as possible. The photograph is taken in a forest, but the trees have been blurred. Therefore, it is difficult to say how much the surrounding forest resembles that of the original painting. A few vertical lines, most likely formed by pine trees, bear some resemblance to the strong vertical lines in the original painting.

The lines of the blurred trees radiate from the man's torso and accentuate the invisible sound waves and echo-like effect of the shouting of the curse. They draw the viewer's attention to the man and his act. This, and the low angle from which the photo has been taken, imbue the subject with greater power.

The man's posture, however, seems to be less tense and extended than that of the subject in the original painting; thus, his overall expression comes across less fierce and determined. The man's face is not clearly shown, so it is difficult to say what kind of expression he has on it.

Nonetheless, this picture is clearly a manifestation of physical power and might, and the key focus is on the act of cursing itself as well as on the man's expression of frustrated rage. Here, too, the person is pictured being in total solitude in the wilderness, standing alone for his actions and thoughts.

In terms of play, this scene depicts roleplay, as the man has taken upon the role of another figure. This is manifested in the near-identical posture and other shared key elements such as clothing and physical resemblance. In this

35 Sarasti, E. 1979. 'Myth and Music: A Semiotic Approach to the Aesthetics of Myth in Music', *Approaches to Semiotics* **51** (1979), 264.

Figure 2: First interpretation

play scene the only plaything is the player itself, but the physical location is also an integral part of the act of play. Without it, the context and the overall message of the act would be less powerful. The play needs the player's ability to get into the role and the forest environment to support the context in order to become more than just an act of simply raising a fist.

9.2. Second Interpretation

This interpretation draws inspiration from the posture of Kullervo with his extended arm, but its context only becomes complete when the text 'What! Isn't there any mobile reception here?' is added to the whole. This minimalistic yet captivating picture has, by giving just a few subtle hints, succeeded in illustrating a moment of disbelief and frustration that the viewer can easily relate to.

The woman is pictured from a very high angle, which enhances both her helplessness and her act of looking for help from the sky above. Like Kullervo, she too is met with unjust circumstances, expresses her frustration and anger, and is quite alone in the forest with no one there to even take a photograph of her.

The expression on her face could also be interpreted as showing some degree of anxiety caused by her having fallen off the grid. The the lack of grid is a metaphor for civilization and the lack of it is a metaphor for wilderness – leaving her balancing between the two. Her expression clearly shows that she is keen to find her way back to civilisation with the help of the invisible lifeline of a mobile phone signal. For her the forest does not represent a romanticised hideaway or sanctuary.

Figure 3: Second interpretation

In this act of play she is using her mobile phone as a plaything in two ways: as a concrete plaything in her effort to find a signal and as a plaything documenting the act itself. The strong message present in the picture relies not only on the interplay between image with text but also

on the associative interplay between image and viewer. In fact, the message comes across so clearly that the key object – the mobile phone – can be framed outside the picture and yet remain very present.

This interpretation is more conceptual than the first one. It too is identifiable with the original painting based on some details in the woman's posture and the way it uses the intangible element of Kullervo's frustrated anger. The frustration is, however, recontextualised, and the woman's posture is determined by her efforts to take a selfie, which also contribute to the mobile phone context.

9.3. Third Interpretation

This interpretation is site specific. This photograph was taken on top of Pallas fell in Lapland, where the Olympic torch was lit (and conjoined with the actual flame lit in Greece) for the 1952 Summer Olympics in Helsinki. The story of this historic event has been carved onto a stone marker. In this

Figure 4: Third interpretation

interpretation, a woman pretending to hold an imaginary torch stands next to the monument in a classical pose.

This interpretation only borrows the detail of the raised arm from the original painting of Kullervo. The act of cursing has been discarded altogether, evoking a totally different mood and setting in the viewer. The only thing in common between cursing and holding a torch is the pronounced solemnity of the act.

Like the second interpretation, clever interplay between the viewer and the photograph takes place; it relies heavily on the viewer's ability to identify the concept of the Olympics and to 'see' the imaginary object in her hand. The iconic pose evokes many associations: the viewer not only sees the torch but also pictures the Olympic games in his or her mind's eye. Therefore, this picture is not just a picture but an open window to a collectively shared culture and history.

Seen from the perspective of play, this picture is a great example of the power of imagination: the key plaything here – the torch – is not even real, but its presence is generally accepted and most viewers probably visualise it in the same way. The location (which probably served as inspiration for this act of play) lends essential credibility to the situation. This simple playful act, in which physical location and the immaterial act of play work together, invites the viewer to join in a shared moment of make-believe.

9.4. Fourth Interpretation

In this interpretation you can see a man cursing at a broken-down car's engine. At first sight it only seems to be a playful update of the original painting, but upon closer examination other levels appear.

This picture brings us to the fringe of modern civilisation and the primeval landscape. The background with its lake and birch trees is that of a classical painting. The car, however, puts the picture in a modern context. The gravel on the ground is the border between these two worlds; although it is natural material, it has clearly been laid on the ground by people to hinder the growth of vegetation (though it seems to be finding its way through) and to make place for cars.

The man's pose resembles that of Kullervo, and the frustrated anger present in both pictures is easy to identify. In this photograph, however, it has a clear target: the man is holding a tool in his hand with the intention of hitting the engine with it. It is highly unlikely that this action will mend the engine, which further underlines the man's frustrated and uncontrollable act.

Like his anger, his message also has a clear target; he is making eye contact with the viewer, thus almost forcing the viewer to be a part of the whole.

In this act of play both the content of play and the playthings are clearly visible and identifiable. They are exactly what they look like: a man fighting with his car with a tool. The context of a broken-down car is familiar to all car owners and so is the futility of his angry action, and thus the depicted situation is easy to identify with.

This photo seems to tell a story of how forests are mostly accessible through car ownership, which is not a very eco-friendly idea that may weigh on our consciousnesses and negate the positive effects of forest well-being. It also tells us that should your car break down on the way to the wilderness, you will be left all alone in the woods. A line here can be drawn to the second interpretation, in which we can also experience the helplessness in the face of Mother Nature's power when technology fails us.

Figure 5: Forth interpretation

10. Conclusions

The aim of this experiment was to open playing with forest-themed art to everyone. We sought to enshrine it as an everyman's right – like strolling in the woods. We also wanted to enable forest visitors to unlock the narrative layers of places and thus reveal a dimension of the forest related to its effects on well-being.

During this process, iconic works of art were 'let loose' in the middle of a Finnish forest. Based on both quantitative and qualitative analyses of the photographs people took, we determined that experiment participants really did play in the forest. For most Finnish people forests are a natural place to be, and they have visited them frequently since early childhood. The ease with which the forest was transformed into a playscape is evident in many pictures – you can walk off official paths, climb on rocks, and play with sticks and pinecones you find on the ground. Permission to walk in the forest easily transforms into permission to play.

The imaginary layer of a place that exists during play creates an emotional attachment to that place. Place-based play facilitates adult playscapes, and the physical location where play occurs is no longer the same as it was before. The dimension of a place that play unfolds leaves a trace in the player's experiential world: what has been seen cannot be unseen. As a result of this, the place is permanently experienced in a post-play way: seeing the place evokes emotions and memories of the play experience.

We also conducted a survey amongst the participants. Some respondents described the experience as follows: 'I observed more than just what I saw' and 'It was as if I found a new side to myself, I guess.' It seems that these experiences are connected with more than the visible activity itself; they are connected to the internal world, with meanings related to play, art and place. These matters are hard to verbalise, as they are subjective experiences, and therefore we believe that through the photographs we can understand the effect even more profoundly. From the visual data it seems clear that this kind of art-based playfulness can indeed deepen the connection to forests and even create new forms of inner forest(e)scapes.

Based on this experiment it seems that it is possible to encourage adult play by using art-based exercises. We were also impressed with how participants produced astonishingly multidimensional and deeply meaningful interpretations when they were given, through play, a good reason to do so. They did not settle for making copies of the original works but effortlessly transferred them to other places and situations. They studied the works and

picked them apart by choosing to use the visual, narrative and/or conceptual stimuli they provided. They adapted their own interpretations to the surrounding environment, sometimes letting the place inspire them to choose the artwork. And most important of all, they seem to have had fun while doing it.

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Historical wood craft techniques and documentary film: A way to safeguard knowledge

SEBASTIAN NEMESTOTHY,[1]* MICHAEL GRABNER,[1]
ROSA VON SUESS,[2] GEORG KUNTNER,[2]
KLAUS SEELOS,[3] FELIX BLASINGER,[2]
JOHANNES WINKLER,[2] CLEMENS BAUMANN,[2]
CORINNA STIEFELBAUER[2]
[1] University of Natural Resources and Life Sciences, Vienna
Institute of Wood Technology and Renewable Materials
[2] FH St. Pölten, Institute of Creative\Media/Technologies
[3]Austrian Open-Air Museum Stübing

Abstract: Wood-processing has changed considerably over the past centuries, developing from farm or manual processing to ultramodern industrial production. Knowledge about wood selection, storage, and processing was traditionally passed on, mainly orally, from generation to generation. Only in exceptional cases were written records kept. Publications that do exist often lack the details necessary for fully understanding specific processes. To safeguard wood-processing techniques that have survived till modern times or which have been rediscovered, a pioneering project was set up to fully document six woodworking techniques on film. The concept for each technique was developed jointly according to a strongly participatory approach of pupils, craftspeople and scientists. The main focus was creating end-to-end technical documentaries which are produced with the aid of up-to-date media technologies.

Keywords: Wood utilisation, woodworking, craftsmanship, oral history, digital heritage, documentary film

1. Introduction

Wood is still one of the most important raw materials today. However, wood processing has changed considerably; agricultural and manual processing have given way to ultramodern industrial production.[1] As early as 1917, folklorist Josef Blau described the vanishing of woodcraft: 'The old economy and way of working, the skills, knowledge, experience and conditions long inherited and with them much of the necessary language and cultural heritage are moving ever higher up the forests and mountains.'[2] Nowadays in Austria the number of indigenous tree species used in the wood-processing industry has dwindled to 10 to 20. Some wood species with disadvantageous properties are treated to improve their qualities (e.g., steaming, thermal treatment, etc.).

Wood is a material that can be used sustainably. Therefore, we can assume that in the future it will play an even greater role than at present, as resource scarcity increases and CO_2 emissions must be reduced. The application of historical knowledge may, in some circumstances, help increase sustainable forest use.

In earlier times wood was used to construct or make different structures and items, such as farmhouses, castles, palaces, churches, furniture, tools, weapons, kitchen utensils, and fences. In many cases, the people who built things out of wood were not specially trained. Knowledge about what types of wood to use, how to store and process it, and so forth was traditionally passed on from generation to generation. Only in exceptional cases do written records exist. It was not until the fourteenth century that special wood-related crafts developed.[3] But even then the oral transmission of knowledge prevailed. Available historical documents often do not describe wood processing with the necessary detail to be able to understand the processes or to understand why a certain type of wood was used for a particular purpose.[4] Thus, in order to understand historical wood-processing techniques and the

1 Wegener, G. 'Holz – Multitalent zwischen Natur und Technik', in Fansa, M., Vorlauf. D. (eds), *Holz-Kultur. Von der Urzeit bis in die Zukunft. Schriftenreihe des Landesmuseums für Natur und Mensch, Heft 47,* (Mainz am Rhein: Zabern, 2007).

2 Blau, J. *Böhmerwälder Hausindustrie und Volkskunst. Band 1: Wald- und Holzarbeit*, (Prag: Calve, 1917).

3 Radkau, J. *Holz – wie ein Naturstoff Geschichte schreibt,* (München: Oekom Verlag, 2007).

4 Grabner, M., Klein, A., Nemestothy, S., Winner, G. 'Historische Holzverwendung – ewig gestrig, oder Wissen für die Zukunft?', in Grabner, M., Kohlross, H. (eds), *Wald, Holz und Menschen. Festschrift anlässlich des 90. Geburtstags von Hiltraud Ast,* (Gutenstein: Verein der Freunde Gutensteins, 2013).

knowledge behind them, we must, in addition to studying historical literature, also analyse artefacts.

Certain handicraft techniques have been preserved in or rediscovered by Austrian museums (especially in the Austrian Open-Air Museum Stübing). Several grants projects (FWF TRP 21-B16, Sparkling Science SPA 04/188, Volkskultur Niederösterreich) have focused on sampling and analysing the collections of some museums in Austria. These projects contributed to the acquisition and rediscovery of 'material knowledge'. Klein has produced an excellent overview of the wood species previously used in Austria.[5] Why was ash or Cornelian cherry used for tool handles? These woods are strong and tough and can dampen vibrations. However, we also encounter tool handles made of wood types that are not well suited for this purpose, for example, alder. The reasons for alder's use here are explained by knowledge that has been passed down through oral tradition; it is said that 'it lies better in the hand' and 'you don't get blisters from it'. Modern methods cannot be used to determine such critical information. We must therefore rely on traditional knowledge that may be thousands of years old and try to understand and reconstruct the reasons for specific techniques and utilisations.

Klein and Grabner[6] have studied buildings using dendrochronological methods to date rural houses and to determine when modifications were made. They have also examined timber to better understand forest use (e.g., signs of pollarding in the tree-ring-growth patterns).

An extensive analysis of wooden artefacts in museum collections (furniture, appliances, tools, vats, barrels, etc.), in which dendrochronology was also used, has revealed much information about processing techniques. It was found that both in furniture and vats the outermost part of the wood (with the best wood quality) was processed as little as possible. In the case of one painted box, seven years lie between the dating of the outermost annual ring and the date painted on it. The difference of seven years is the result of two to three years of seasoning and the loss of tree rings due to planing (i.e., a few millimetres).[7] This is one of the few examples where knowledge,

5 Klein, A. et.al. 'Cetral European Wood Species: characterization using old knowledge', *European Journal of Wood Science* **62** (2016): 194–202.

6 Klein, A., Grabner, M. 'Analysis of construction timber in rural Austria – wooden log walls', *International Journal of Architecturual Heritage* **9** (5) (2015): 553–563.

7 Klein, A. et.al. 'Dating furniture and coopered vessels without waney edge – Reconstructing historical wood working in Austria with the help of dendrochronology', *Dendrochronologia* **32** (2014): 90–96.

specifically craft knowledge of wood seasoning and woodworking, could be reconstructed based on a material analysis.

Museums perform an important role in preserving ancient knowledge, at least in the form of material goods. The International Council of Museums (ICOM) supports such activities.[8] Preserving cultural assets is very important; this applies not only to 'high culture' but also to everyday culture, as it is presented, for example, in the Austrian Open-Air Museum in Stübing. If such objects were not preserved and described (also in the sense of oral history), it would be almost impossible to comprehend the historical use of wood and to relearn earlier techniques for processing it. It is not enough, however, to preserve just material cultural history; knowledge, skills, and experience must be safeguarded and passed on as cultural assets as well.[9]

In this paper, we present an approach for preserving and passing on knowledge, skills, and experiences related to specific woodcraft techniques through detailed documentary films. A still-ongoing pilot project was launched in 2017. These films focus on the knowledge and technical processes required to produce wooden goods out of raw material. A modern approach is taken to producing these documentaries, and state-the-art film and media techniques are used to make them more attractive to young people. The films should arouse interest in woodcraft and guide and assist those interested in producing wooden goods. School students are involved in planning and testing the documentaries, and they contribute their personal experiences and ideas together with the academic team consisting of wood scientists, film and media-creation researchers, museum and ethnology experts, and craftspeople. During the development and design process, usability testing played an important role in the ongoing evaluation. The interdisciplinary team developed a form of presentation that appeals to young people and can also be used on mobile devices. In addition to discussing modern documentary formats that will inspire people to take up woodcraft, we also examined the possibilities of presenting these films at museums in a way that will not disturb the atmosphere and mood. Monitors and mobile applications are two possible ways to show the documentaries in the Austrian Open Air Museum Stübing.

8 *ICOM Code of Ethics for Museums,* (2004). http://icom-oesterreich.at/page/icom-oesterreich (accessed 1 April 2018).

9 *UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage,* (2009). https://www.unesco.at/kultur/immaterielles-kulturerbe/die-unesco-konvention/ (accessed 1 April 2018).

2. The subject of documentation: historical wood use

Opportunities for acquiring knowledge about the handicraft techniques of the past have become growingly rare. The Austrian Open-Air Museum Stübing still uses several old techniques in exhibitions and is therefore a precious source of knowledge. The museum has preserved and even rediscovered such techniques, for example, in order to produce, or at least professionally restore, a historically accurate waterwheel. The museum has also developed a network of still active craftspeople, in addition to its experienced workers. In a few years, skilled craftspeople will no longer exist, and their knowledge will be lost.

Although many items were produced by trained craftsmen such as carpenters and joiners, wooden objects were also made by farmers and rural inhabitants who sought an additional source of income. Their activities have been barely documented. Farmers and woodcutters made important home, farming, and work equipment on the side. In spaces known as *Machelkammer* they carried out various repairs and proved their skills as carpenters, wainwrights, woodturners, and instrument makers. They made ladders, rakes, shovels, forks, baskets, vessels, clips, spoons and bowls, troughs, and much more. When they had made enough for their own needs, they produced goods to be exchanged or sold by peddlers or at markets. Cottage industries developed as a supplement to agriculture. Goods that were no longer produced for immediate use were handed over to a trader or merchant. The result was an entrepreneurial culture that provided greater dependence for these craftsmen/farmers. Increasing industrialisation eventually displaced the peasant cottage industry.[10]

Historical literature dealing with craftsmanship has been referenced in earlier works.[11] However, it is impossible to build pieces, let alone to re-

10 Liesenfeld, G. *Viechtauer Ware. Studien zum Strukturwandel einer Hausindustrie in Oberösterreich,* (Wien: Verlag der österreichischen Akademie der Wissenschaften, 1987).

11 Amman, J., Lemmer M. (Hg.). *Das Ständebuch. 133 Holzschnitte mit Versen von Hans Sachs und Hartmann Schopper,* (Leipzig: Insel-Verlag, 1568); Monceau, H.d. 'Von Fällung der Wälder und gehöriger Anwendung des gefällten Holzes. Wie mit dem Schlagholz, halb und ganz ausgewachsenem Oberholz, umzugehen, und alles benannte Holz richtig zu schätzen und anzuschlagen ist. Nebst einer Beschreibung der Handwerker, die ihre Arbeit in den Wäldern verfertigen, als ein zur vollständigen Abhandlung von dem Forstwesen gehöriger Theil', in *Zweiter Theil oder 4. Band zur Naturgeschichte der Bäume*, (Nürnberg: Adam Wolfgang Winterschmidt, 1767); Stübling, R. *Das gesamte Drechslergewerbe. Handbuch für Drechsler, umfassend Werkzeuge, Hilfseinrichtungen, Arbeitsmethoden und Materialkunde für sämtliche Zweige dieses Gewerbes nach den Fortschritten der Neuzeit,* (Weimar: Bernhard

produce the work steps in detail, solely with the help of written sources. An overview of available video sources has been created.

The Waldbauernmusuem in Gutenstein (Lower Austria) did pioneering work in filming 'forest farmers' practicing their trades.[12] Some crafts were documented in very good quality, for example, rake-making. However, such films focus more on the craftsmen and not the technical production process. Similar films were also produced for the series 'Der Letzte seines Standes' (The last of their trade) by Bavarian Broadcasting. They depict several crafts, including wainwrighting. These made-for-television films also do not document in detail all the steps necessary to reproduce the techniques involved and thus do not meet the standards of our project. It should be noted that such folk-life-focused film collections have been studied and analysed to determine which crafts they depict and in what quality.[13]

2.1. Selection of topics for documentation

The handicraft techniques demonstrated in the Austrian Open-Air Museum Stübing or practised by craftsmen associated with the museum network were recorded. We drew up a list of crafts that had priority; we selected them based how endangered they were and the availability of qualified craftspeople. Feasibility within the limited project timeframe was also an important consideration.

We also identified some interesting techniques that were not documented because no craftspeople capable of performing them were found. Documentary films about the following production processes were created: 'the

Friedrich Voigt, 1896); Krauth, T., Meyer F.S. *Das Schreinerbuch I. Die gesamte Bauschreinerei.* (Leipzig: Verlag von E. A. Seemann, 1899); Graef, M. *Moderne Bautischlerei für Tischler und Zimmerleute enthaltend alle beim inneren Ausbau vorkommenden Arbeiten des Bautischlers,* (Leipzig: Verlag von Bernh. Friedr. Voigt, 1905); Jankuhn, H. *Das Handwerk in vor- und frühgeschichtlicher Zeit. Bericht über die Kolloquien der Kommission für die Altertumskunde Mittel- und Nordeuropas*, (Göttingen: Vandenhoeck & Ruprecht, 1983); Haid, H. *Vom alten Handwerk. Edition*, (Tau: Bad Sauerbrunn. Lizenzausgabe für Rosenheimer Verlagshaus, Rosenheim, 1991); Palla, R. *Verschwundene Arbeit,* (Wien: Christian Brandstätter Verlag, 2010); Hasitschka, J. 'Vom verschwundenen Alltag. Arbeitswelt im Wandel von zwei Generationen', in *Schriftenreihe Schloss Trautenfels, Universalmuseum Joanneum Band 9*, (Trautenfels: Verein Schloss Trautenfels, 2010).

12 Pawelak-Ast, J. 'Bibliografie von Hiltraud Ast', in Grabner, M., Kohlross, H. (eds), *Wald, Holz und Menschen. Festschrift anlässlich des 90. Geburtstags von Hiltraud Ast,* (Gutenstein: Verein der Freunde Gutensteins, 2013).

13 Maissen, A., Maissen, A.P. *Handwerkerfilme aus der Surselva (1942–1944),* (Basel: Schweizerische Gesellschaft für Volkskunde. Abteilung Film, Reihe: Altes Handwerk, 2004).

production of a wooden nail', 'the manufacture of a fence ring', 'the hewing of logs with a broad axe', and 'the production of a birch besom', in addition to the process of 'building a hazel basket' and the carving of a 'house blessing'. The duration of the production process was an important criterion for selecting techniques to be documented. Due to the limited number of shooting days in the project, long-lasting processes could not be recorded. Processes such as charcoal burning or the construction of a water wheel, which take several weeks to complete, were therefore not feasible craft techniques. During the selection of techniques to be filmed, additional consideration had to be given to external conditions: if the production of a wooden object is dependent on the timely harvest of raw material, this had to be considered in overall project planning.

2.2. Existing documentaries on woodcraft techniques

A survey of existing films depicting traditional handicraft techniques was conducted to generate an overview of existing material. More than 240 relevant films were identified, but not every film could be reviewed due to problems with access and storage medium. Many are stored on 16 mm film in archives and are thus difficult to obtain. Although systematically digitising this material would be of great importance, such an endeavour would require far more resources than those available in the present project. Some of these films do not focus on the techniques involved and instead concentrate, for example, on documenting folk life. We discovered that many of these films do not suit the objectives of our project, largely due to the target audiences they were made for (ethnologists, television audiences, the do-it-yourself community, etc.). In particular, the frequent focus on craftspeople and their lives puts the technical process of manufacturing a piece in the background, or in the case of television series such processes are demonstrated, but insufficiently. These films do not make handcraft techniques completely comprehensible to viewers, which is the goal of our project. An additional problem is the varying quality of online content about the fundamentals of wood science and the knowledge and sources presented in these homemade videos.

We developed the audio-visual form of our videos by researching relevant literature and films. Students were motivated to collect documentaries from television and the Internet and to analyse them with regard to criteria such as target group, technical implementation, and content conveyed. The same applied to photographic and purely textual documentation. Based on these results, the students, with advice from scholars, evaluated which

documentation techniques are best suited for presenting the steps involved in wood processing.

3. Process of media creation, defining a film concept

It was necessary to define the genre of our films in order to classify the envisaged video production and to find a common research basis with the pupils in the project, a basic assignment to a genre makes sense. The definition of a term comprises two scientific forms: Documentary film and educational film. The films planned and produced as part of this project can certainly be classified as documentary films because they present non-fiction, historical content.[14] Therefore, these films should depict craftsmanship techniques as realistically as possible. But these videos are also educational films and therefore should follow a logical structure to convey information to viewers. To make the films more understandable and attractive to our target audience of young people, we had to add certain elements that are frequently found in feature films. Today, though, videos in which actors play out historical scenes are also defined as documentary films. People's viewing habits have changed to the extent that re-enacting such scenes is recognised as representing reality. Re-enactments create a link between pure documentation and realistically staged tension. If we take the technical and educational aspects of these films into account, we can classify them as 'educational documentary films'.[15]

This definition needed to be further broken down in order to provide an initial framework for our video productions. According to a report on the 2011 Archaeology and Film symposium held in Kiel, 30 years ago science films meant to educate were extremely dry in style. Later, the scientific content and the researchers were brought into the spotlight of such productions.[16] In line with this development, we established that our video clips should also include experts from the woodworking trade as actors and voice-over artists. Thus, we did away with using a neutral 'omniscient' narrator. In the meantime, the catchword *infotainment* also plays an important role in science films because viewers want to be not only informed but also

14 Schadt, T. *Das Gefühl des Augenblicks: Zur Dramaturgie des Dokumentarfilms (3. überarbeitete Auflage)*, (Konstanz: UVK, 2012).

15 Müller, J.K. *Große Bilder mit kleinen Kameras,* (Konstanz: UVK, 2011).

16 Bolewski, N. *Die Quote, der Wissenschaftsfilm, neue Ansätze.* http://www.multimedia-view.com/node/218 (accessed 24 January 2014).

entertained. This often results in very compact presentations. This aspect, alongside the exact reproduction of the craft activities, played a decisive role in the development of our film concept. While traditional scholarly films produced for television must adhere to strict running times, the video clips we intended to produce would be free of time constraints. The content must take priority over duration, since the purpose of our project is to fully document the processes used in wood crafts.

The JIM study on media use by young people between the ages of 12 and 19 in Germany clearly shows that the Internet and mobile phone use are very important for young people. Whereas in 2011 people used a computer to access the Internet 99 per cent of the time, by 2013 this figure had dropped to 87 per cent. In contrast, there is an increasing trend in terms of mobile Internet access. Since 2011, Internet usage on smartphones and mobile devices has risen by 58 per cent to 87 per cent.[17] These figures confirm the necessity of a web presence for presenting handicraft techniques. Smartphones are young people's constant companions, and therefore these devices should be used to support the presentation of the documentaries at the museum. Modern mobile devices provide access to built-in hardware such as cameras, accelerometers, and GPS receivers. This results in new ways for users to provide information in relation to the context in which they are. The spread of smartphones has enabled low-threshold access to technologies such as 360° video and virtual reality. With the help of these technologies, content can be simulated at close range, as the camera's focus is always the same as the users' point of view.[18]

Since this project focuses on student-centred research at the intersection of wood research, folklife, and media technology, students should have the opportunity to get to know current scholarly methods through a highly participatory approach and apply them in practice on specific tasks. The project was divided into four stages that focused on research, concept development, video shooting, and evaluation that were implemented over the course of four

17 Feierabend, S., Karg, U., Rathgeb, T. *JIM-STUDIE 2013 – Jugend, Information, (Multi-) Media. Medienpädagogischer Forschungsverbund Südwest* (LFK, LMK, 2013). http://mpfs.de/fileadmin/JIM-pdf13/JIMStudie2013.pdf.

18 Groundspeak, I. *Geocaching – The Official Global GPS Cache Hunt Site,* (2013). http://www.geocaching.com/ (accessed 23 January 2014); Hornecker, E., Swindells, S., Dunlop, M. 'A mobile guide for serendipitous exploration of cities', in *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services,* (New York, USA: ACM, 2011), pp. 557–562; Konzack, C. *GPS-Navigation für ein mobiles Informationssystem: Von der Idee bis zur Umsetzung,* (VDM Verlag Dr. Müller, 2008).

semesters from September 2017 to October 2019. During each phase of the project, workshops were held at participating schools and with project partners. Additionally, 'project days' were organised. These events ensured the professional and technical training necessary for implementing the project as well as continuous support from media technology experts.

On the basis of literature research and research in film archives, handicraft activities to record were selected in consultation with the Austrian Open Air Museum Stübing and associated craftspeople. Since an important goal of the project is to document handicraft techniques as completely as possible, these techniques and the related work processes must be described meticulously. Among other things, hand positions for holding tools, the angles tools are held, the direction the tools are worked with, and tool speed were recorded in a catalogue that lists the critical points of manual work. The decision to make audio-visual recordings was made based on the findings of the research phase.

Various video and photo cameras, sound recording devices, lighting equipment, and animation software were available during the concept-development phase to produce short video samples to test the presentation form and technical implementation. In addition to experimenting with equipment and presentation methods (video, animation, photo, etc.), students also tested different perspectives, camera positions, and lighting concepts. The catalogue of relevant handicraft techniques and work steps, as well as the formal implementation of methods and media technology tools appropriate for the target group, helped to identify the critical points and media technology and didactically correct options for the production of the desired videos. On this basis a new production concept emerged in terms of content, dramaturgy, and media technology. The concept for each video was discussed and coordinated with craftspeople and scholars specialized in wood research, folklore, and media technology. From the research phase, the key points were already known, which were now discussed with the experts regarding the implementation of the concepts. Special attention was paid to critical contents in order to define an optimal documentation method. During the conception phase, a detailed script and storyboard were created for each video, which were then used to plan and execute the production step by step and as vividly as possible.

The video production is strongly based on the scenes described in the script, which in turn is closely linked to the working methods of each craftsperson. To fully and correctly illustrate the complex handcraft sequences, media technologies had to be selected and used sensibly. The activities depicted

Figure 1: *Conventional 'Nifty' concept with three different camera angles being recorded simultaneously.*

Figure 2: *360° camera concept with one camera capturing the whole scene at once.*

in the videos are recorded from a technical and creative point of view using current media technology methods in order to build a bridge between traditional artisanry and modern recording methods and presentation possibilities. Traditional activities are thus linked to the present by contemporary technology and documented for the future.

Craftspeople's work should be presented as realistically and in as much detail as possible. Two main concepts were developed: A setup utilising conventional cameras recording from three different positions (Figure 1) and a 360° video setup (Figure 2). Close-up camera positions, for example, overhead positions to film top-down shots of craftspeople at work, help viewers more exactly comprehend the work steps involved. Furthermore, the objective of using 360° and VR videos is to produce an immersive, close-proximity representation of craftspeople at work and provide the feeling of 'standing right beside the craftsperson'.

In the post-production phase, animations and graphics are employed to help increase the comprehensibility of complicated processes. Scientific content such as information about wood species, condition of the wood, time of felling, pre-treatment, and the like are integrated into the video through graphics or voice-overs. The videos should be understandable without any additional material. In addition to the focus on the exact documentation of wooden handicraft techniques, attention is also paid to achieving a modern, appealing appearance and to distributing the films. The final products are intended to encourage young people and other interested parties to imitate the work steps and to arouse interest in crafts, especially woodworking. For this reason, the videos should reach a large number of people. Easy access to the content is ensured by publishing the videos on well-established online video platforms such as Youtube.

4. Results of the interdisciplinary film-production process

Videos were produced in two formats: the Buzzfeed 'Nifty' or multicam format using conventional camera technology (Figure 1) for smaller pieces and more intricate craft techniques for producing items such as the 'wooden nail', 'birch besom', 'hazel basket', and 'house blessing'. The 360° video format was reserved for outdoor work, such as the 'fence ring' and 'hewing of roundwood' (Figure 2). The 360° films can be viewed with virtual reality glasses or on a computer or television monitor with a 360° player or on mobile

devices by using the 360° function on Youtube. All videos will be published on the project homepage[19] and linked to the project's own Youtube channel, 'Holzverwendung'.[20]

After comparing typical Nifty videos with the findings of our research on historical wood utilisation, the central elements of the video format we would use emerged. We also studied the key aspects of classic how-to videos, tutorials, and explanatory videos. A combination between educational micro movie and tutorial seemed suitable for the videos that were to be implemented in this project.

The videos are structured as follows:

1. Emotional pull/agreement: to gain the viewer's attention, a voice-over introduces the topic and presents the final product.
2. Priming/context: background information (e.g., optimal harvesting time for the raw material) is provided together with a description of necessary tools and materials.
3. Content/story: the steps involving in making the object are shown; this constitutes the instructive and explanatory section of the recording.
4. Reflection/description: the finished piece is shown, and sometimes key points involved in the production are re-highlighted. Furthermore, possible variations on the piece (in terms of size, etc.) are mentioned.
5. Emotional push/conclusion: the next steps in using the now-finished product are presented. The video concludes with a voice-over and end-frame graphic.

Several characteristic elements of Nifty videos were integrated into our videos. During the depiction of the working process, the craftsman uses his hands to refer to key points, materials, and processes; his movements underline the information provided by the voice-over. The audio track is dominated by the voice-over; the craftspeople rarely speak with the exception of the 360° videos where they introduce themselves and describe the techniques they are demonstrating. Required materials and tools are presented to the camera during the work steps before they are artificially arranged or placed. In post-production, texts and graphic elements are added to help describe the tools and materials. In the Nifty format, this additional layer is often used as a stylistic device. The point-of-view shots employed here allow the viewer to slip into the role of the protagonist. The number of close-ups is

19 See http://www.handwerk.holzverwendung.at/.

20 See https://www.youtube.com/c/Holzverwendung.

Figure 3: Logo animation at the opening of the video on the production of wooden nails.

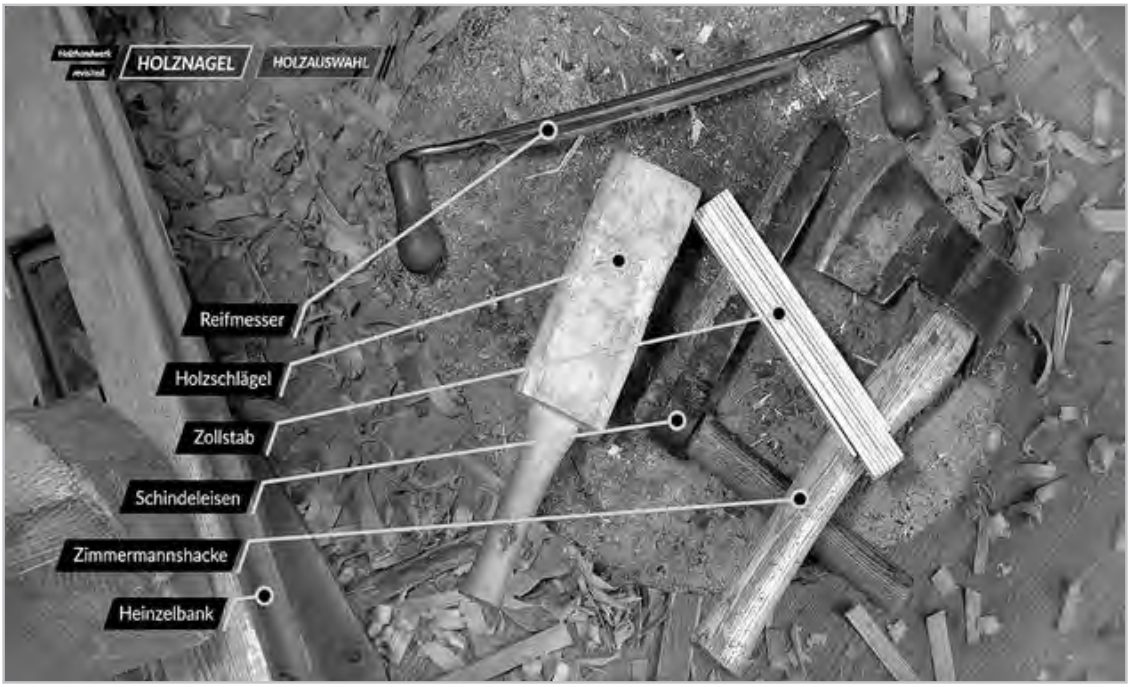

Figure 4: Graphical elements highlighting the tools needed for producing a wooden nail.

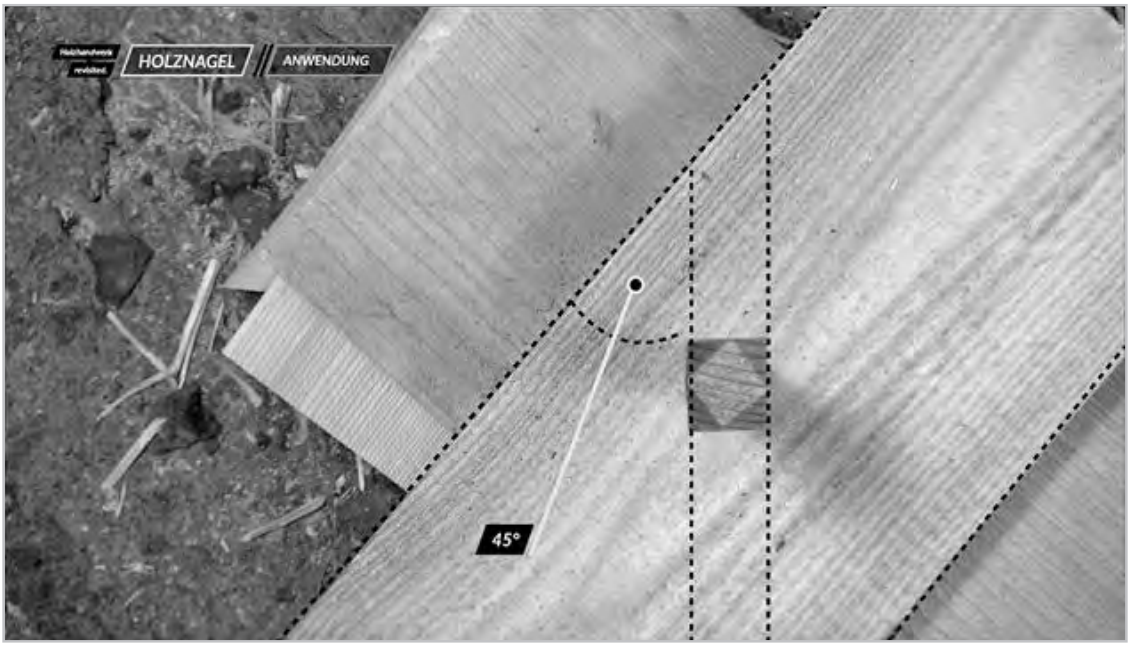

Figure 5: Additional information on the correct use of a wooden nail is provided by an angle depiction.

comparatively above average, and the videos are often shot from a bird's eye view from above. The protagonist is only seldom in frame, usually only out of pure necessity. The technical process being demonstrated plays the main role. In the 360° format the audience watches the process from a third-person perspective as a bystander. Through virtual reality technology viewers can control their viewing angles and follow the craftspeople at work.

Both concepts contain graphical elements supporting the content shown in the frame. The central task was to meet the content requirements of the formats in terms of graphic design. Therefore, the independence of the graphics was reduced in order to remain as close as possible to the appearance of new online video formats. Titles feature mainly text and have a logo-like appearance (Figure 3). Additional information is provided by large-format infographics and text insertions (Figure 4). Motion graphics in the form of lines and circles provide dimensions, angles, and areas that are crucial for producing the items (Figure 5). A style guide was developed to define the basic structure of the graphical elements: colours, fonts, and the logo. Strong colours play a design role and thus correspond to the format. The colour system is basically made up of four main colours, which can be found in the graphic elements of the video and the project homepage.

5. Outlook and Evaluation of the Finished Documentary Films

The end products, six craft films in two formats––the "Nifty" or multicam format (filmed using conventional methods and several camera angles) and a 360° format–– have been published on the project website and on Youtube. Furthermore, the videos have been presented at several public events with a subjectively positive feedback by visitors: Children of elementary school-age upwards were curious on trying out the shown techniques, whereas older generations frequently felt reminded of their own childhood when these craft techniques were still actively practised by parents or grandparents.

Videos in both formats have been evaluated in their final state with usability tests by possible future users––young people. This will allow us to further improve the target-group-specific, content-related presentation of historical woodcraft techniques in possible future follow-up projects. For the evaluation of the finished documentaries a different group of students from a technical school (HTL Mödling, Holztechnik) has tested the videos. They have received a basic education in carpentry and thus have some knowledge of woodworking and tool handling. However, they had no experience with traditional handcraft techniques until then. In total 21 students between 17 and 19 years of age conducted the survey. The students watched selected videos from the present project and simultaneously recreated the depicted pieces in a workshop. They also compared both video formats, conventional and 360°, with each other.

For the review of the videos, the students were given several hours to carefully watch the tutorials and try to recreate the wooden nail and to compare both versions (Nifty and 360°) of the fence ring documentary. Although some students (n=7) considered themselves beforehand as "not skillful" in handcrafts, 17 stated they would now be able or at least rather able (n=4) to produce wooden nails after having watched the film. None of the students considered themselves unable to do so. Therefore, 19 pupils also agreed that the video helped or rather helped (n=2) them to process a wooden nail. The students thereby generally confirmed the production method of the video clips and the presentation via the web platform and its mobile application as being appealing, informative and suitable as a tutorial for reproducing historical wood working techniques. With the help of a detailed questionnaire difficult parts in the production process were identified and solutions for a more comprehensible depiction of some working steps were suggested (slow motion pictures, examples for typical mistakes).

In addition, 360° content was compared with the classic multicam version and evaluated accordingly: After all students watched both versions, twelve said they preferred the multicam version, while six students preferred the 360° video (some did not answer the question). As the 360° video was presented with the aid of a virtual reality headset (Oculus go), the pupils were asked whether they found it easier to follow the action shown through that device. All in all, twelve people found the headset to be beneficiary (n=8) or rather beneficiary (n=4) for following the production of the fence ring, while eight found it to be rather not beneficiary (n=5) or not beneficiary (n=3), and one student did not answer the question. When asked which version they would watch, if they had to reproduce a fence ring at home, 15 students chose the multicam version and four chose the 360° video, while two did not answer the question. Interestingly, all four students who owned a virtual reality headset said they would nonetheless choose the multicam version at home. Overall, the survey brought valuable information for the project team and generally confirmed the production concept for both the multicam and 360° versions, whereas the students preferred the multicam video over the 360° (n=12 to n=6; three didn't define their preference).[21]

For possible future follow up videos, the focus will be set on the multicam production style with the integration of additional scenes like slow motion for exact tool handling guidance, or trial and error scenes with examples of faulty work pieces. In terms of safeguarding historical craft techniques, the authors aim to continue to publish similar videos via online video platforms like Youtube to allow public, free and easy access. Additionally, hardcopies of the produced videos are stored in the archives of the University of Natural Resources and Life Sciences Vienna and the Austrian Open-Air Museum Stübing to guarantee the storage of the videos independent of the future continuation of services like Youtube.

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Forest management activity in prehistoric Hallstatt, Austria

MICHAEL GRABNER[1], ELISABETH WÄCHTER[1],
KONRAD MAYER[1], ANDREA WEBER[1],
HANS RESCHREITER[2], KERSTIN KOWARIK[2]
[1]University of Natural Resources and Life Sciences BOKU Vienna
[2]Natural History Museum Vienna. Department of Prehistory

Abstract: Due to the perfect conservation of all organic materials within the prehistoric salt mines of Hallstatt, Austria, large amounts wooden finds, which are rare at other archaeological sites, have been excavated here. A substantial number of wooden items were analysed applying wood species identification and tree ring analyses. This paper presents the results of these analyses and discusses Bronze Age wood use, forest utilization and management. Our findings allow for important insights into prehistoric forest management. Thus, we were able to: i) demonstrate that the stem of fir tree was used in its entirety, ii) to reconstruct the stem utilization scheme for fir, iii) identify seasonal activity patterns as the harvesting of trees during the dormant season, iv) exclude large scale clear cutting. In conclusion, it is clearly evident that the Bronze Age Hallstatt mining community possessed sophisticated foresting and wood working skills.

Keywords: Fir, wood utilization, wood identification, dating, archaeology, forest history

1. Introduction

The Hallstatt High Valley (Austria) represents one of Europe's oldest cultural and industrial landscapes and forms the centre of the UNESCO World Heritage region Hallstatt-Dachstein/Salzkammergut. For millennia this Alpine valley was the demographic and economic centre of a wide region with intricate links to regional and transregional communities[1]. In this landscape the

1 Kowarik, K., Reschreiter, H., Klammer, J., Grabner, M., Winner, G. 'Umfeld und Versorgung des Hallstätter Salzbergbaus von der Mittelbronzezeit in die Ältere Eisenzeit', in Stöllner, T., Oeggl, K. (eds.), *Bergauf Bergab, 10.000 Jahre Bergbau in den Ostalpen*, (Bochum,

oldest secure evidence for large-scale underground salt mining dates back to the Middle Bronze Age. The extraordinary preservation conditions in the salt-mines allow for unique insights into prehistoric technology, raw material management, working processes and human-environment relations[2]. Due to salt preservation a vast number of organic objects left behind by the prehistoric miners was preserved in perfect condition, e.g. tools and implements made of animal skin and fur, ropes made of grass and lime bast fibres, textiles, and numerous wooden artefacts[3]. Excavated wooden artefacts include mine timber, constructions, lighting chips, tool handles, bowls and cups, and on the surface log basins for curing meat. The inventory of softwood artefacts includes mine timber, lighting chips and wooden containers. Most of these objects are in such good conditions that tool marks, and even the imprints of human teeth are well visible[4].

For the last 27 years, the archaeological excavation activity inside the mines was focused on the Bronze Age mining galleries and more specifically the area of the modern day "Christian von Tusch-Werk, Alter Grubenoffen"[5].

1.1. The site

The Hallstatt High Valley or "Salzbergtal" is located 300 m above lake Hallstatt and the medieval mining town on the lake shore (532 m a.s.l., 13°E 39' 0", 47°N 34' 60"). The area is situated in the northern rim of the Alps – the

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2 Kern, A., Kowarik, K., Rausch, A., Reschreiter, H. *Salz-Reich. 7000 Jahre Hallstatt. Veröffentlichungen der Prähistorischen Abteilung (VPA) 2. Verlag des Naturhistorischen Museums*, (Wien, 2008); Kowarik, K., Reschreiter, H. 'Interdisziplinäre Forschungen in und um das Salzbergwerk von Hallstatt', *Fines Transire 23* (2014), pp. 161–172.

3 Reschreiter, H., v. Miller, D., Gengler, C., Kalabis, S., Zangerl, N., Fürhacker, R., Grabner, M. 'Aus dem Salz ins Depot – Organische Funde aus den prähistorischen Salzbergwerken von Hallstatt', *Österreichische Zeitschrift für Kunst- und Denkmalpflege. Heft 3/4*, (Wien, 2014), pp. 354–367.

4 Barth, F.E. 'Prähistorische Grubenfunde im Stadtmuseum Wels', *Jahrbuch des Musealvereines Wels Bd. 27, 1987/88*, (Wels, 1989), pp. 39–44.

5 Barth, F.E. 'Hölzerne Konstruktionsteile aus dem spätbronzezeitlichen Salzbergwerk in Hallstatt, VB Gmunden, Oberösterreich', in Stöllner, T., Körlin, G., Steffens, G., Cierny, J. (eds.), *Man and Mining – Mensch und Bergbau. Der Anschnitt, Beiheft 16,* (Bochum, 2003), pp. 51–53; Kern, A., Kowarik, K., Rausch, A., Reschreiter, H. *Salz-Reich. 7000 Jahre Hallstatt. Veröffentlichungen der Prähistorischen Abteilung (VPA) 2. Verlag des Naturhistorischen Museums*, (Wien, 2008).

Northern Limestone Alps. A pronounced limestone plateau characteristic and high tendency to karst formation dominate the region. The area is characterized by low mean temperatures and high precipitation with montane spruce-fir-beech forests as the current potential natural vegetation[6]. In the Subboreal period, *Abies alba* had reached its maximum Holocene range in the Eastern Alps. This was particularly true for montane forests but also for today's subalpine spruce forest regions. Based on a forest zonation presented by Mayer[7], an Abieti-Fagetum, most likely with a dominance of fir, and an Abietetum above around 1200 m altitude can be expected as the dominating forest association in the Salzbergtal. Generally, *Abies alba* forests occur in oceanic to sub continental climates. For the Bavarian Alps, Ewald 1997 indicates a minimum of 160 days as vegetation period (number of days > 5°C) for Silver fir. Average January temperature envelopes are in the range between −4.3°C to −2.1 °C[8] and −5°C[9] to −2.5°C[10]. At warmer temperatures, *Abies alba* is outcompeted by European beech (*Fagus Sylvatica* L.*)* and is only found at specific sites like on waterlogged soils. Through pollen analysis it was possible to reconstruct the forest composition over time down to local scales. The palynological analysis clearly shows anthropogenically changes in the variation of different tree species. The proportion of Norway spruce (*Picea abies* L. Karst.) increased since the beginning of human cultivation of forest environments, while Silver fir and European beech decreased to one third of their natural potential[11].

6 Mayer, H. *Wälder des Ostalpenraums. Standort, Aufbau und waldbauliche Bedeutung der wichtigsten Waldgesellschaften in den Ostalpen samt Vorland,* (Stuttgart: Gustav Fischer Verlag, 1974); Böhm, R. 'Lufttemperaturschwankungen in Österreich seit 1975', in *Österreichische Beiträge zur Meterologie und Geophysik. Heft 5. Zentralanstalt für Meterologie und Geodynamik,* (Wien, 1992); Auer, I. 'Niederschlagsschwankungen in Österreich', in *Österreichische Beiträge zur Meterologie und Geophysik. Heft 7. Zentralanstalt für Meterologie und Geodynamik*, (Wien, 1993); Kilian, W., Müller, F., Starlinger, F. *Die forstlichen Wuchsgebiete Österreichs. Eine Naturraumgliederung nach waldökologischen Gesichtspunkten. Forstliche Bundesversuchsanstalt Wien, FBVA Berichte 82*, (1994).

7 Mayer, H. *Wälder des Ostalpenraums. Standort, Aufbau und waldbauliche Bedeutung der wichtigsten Waldgesellschaften in den Ostalpen samt Vorland,* (Stuttgart: Gustav Fischer Verlag, 1974).

8 Ewald, J. *Die Bergmischwälder der Bayerischen Alpen-Soziologie, Standortsbindung und Verbreitung.* (Ph.D. diss., Universität Berlin, 1997).

9 Schütt, P., Schuck, H.J., Aas, G. and Lang, U.M. *Enzyklopädie der Holzgewächse. Handbuch und Atlas der Dendrologie,* (Landsberg/Lech: ECOMED, 1994).

10 Ellenberg, H. *Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht. 5. Auflage.* (Stuttgart: Eugen Ulmer, 1996).

11 Mayer, H. *Wälder des Ostalpenraums. Standort, Aufbau und waldbauliche Bedeutung der wichtigsten Waldgesellschaften in den Ostalpen samt Vorland,* (Stuttgart: Gustav Fischer Ver-

The "Salzbergtal" offers only a delimited surface and is difficult to access as it is closely confined by steep mountains to the North, South and West and by a steep slope in the east descending towards lake Hallstatt[12]. This specific topographic situation delimits the area, where logs can be transported with relative ease to 900 to 1400 m a.s.l.[13]. Considering the challenging entrance route to the High Valley the import of timber seems unlikely, at least in a modern perspective. But the evidence for regular large-scale transport activities of raw materials (e.g. salt) and objects (e.g. tools, textiles, bronze objects) needs also to be taken into account[14].

The Bronze Age site "Christian von Tusch-Werk, Alter Grubenoffen" is situated at the level of the modern mining gallery "Kaiserin Christina Stollen" (930 m a.s.l.) and 100 m below surface.

In this paper we focus on Silver fir (*Abies alba* Mill.) and present the results of wood identification, diameter reconstruction and growth analysis carried out on Bronze Age mine timber, lighting chips and wooden containers excavated in the Hallstatt salt mountain. Based on the extraordinarily large sample size (for prehistoric wooden artefacts) we discuss Bronze Age wood use, forest utilization and management.

2. Mine timber

In the Bronze Age salt mines mine timber was mainly built into the shafts, as platforms and stairs[15]. Large amounts of wood logs were used for these

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12 Barth, F.E., Lobisser, W. 'Das EU-Projekt Archaeolive und das archäologische Erbe Hallstatt', in *Veröffentlichungen aus dem Naturhistorischen Museum in Wien, Neue Folge 29,* (Wien, 2002).

13 Grabner, M., Reschreiter, H., Barth, F.E., Klein, A., Geihofer, D., Wimmer, R. 'Die Dendrochronologie in Hallstatt – Ein Statusbericht', *Archäologie Österreichs* **17** (1) (2006): 40–49; Grabner, M., Klein, A., Geihofer, D., Reschreiter, H., Barth, F.E., Wimmer, R. 'Bronze Age dating of timber from the salt-mine at Hallstatt, Austria', *Dendrochronologia* **24** (2007): 61–68.

14 Kowarik, K., Reschreiter, H., Wurzer, G. P. X. 'Modelling Prehistoric Mining: A Case study on the Prehistoric Salt Mines of Hallstatt', in Danielisova, A., Fernandez-Götz, M. (eds.), *Persistent Economic Ways of Living. Archaeolingua 35*, (2015), pp. 51–68.

15 Reschreiter, H, Barth, F.E. 'Neufund einer bronzezeitlichen Holzstiege im Salzbergwerk Hallstatt', *Archäologie Österreichs*, **16** (1) (2005): 27–32.

constructions. As the Bronze Age mining galleries and shafts were filled by a catastrophic mud slide most of these structures were destroyed, the logs shattered and swept deeper into the mine (see figure 1). However, excavations have revealed a complete wooden staircase that represents, according to current knowledge, the world's oldest wooden staircase[16].

The term mine timber does not define the shape or wood species. Mining timber is all wood used for mining. Bartels describes for the late medieval times and the early modern times, that straight stems were needed especially in the shaft construction. The main wood species was Norway spruce (*Picea abies*). For mine timber only certain diameter classes were used, aiming for an optimal balance between weight and strength. Lincke reports 6.4 to 20 cm diameter as the usual size. Mechanical strength, natural durability and the ability to warn before breaking are described as most important properties of mine timber. The crackling of the wood under the load of the mountain pressure is called "warning before breaking". Since the miners perceive this crackling and rattling, they can flee before the structure breaks. This quality is not present in all wood species to the same extent. With the same degree of dryness, the spruce warns best; followed by larch, pine, beech, hornbeam, birch, oak and robinia. Today the following species are traded as raw material for mine timber: spruce, fir (*Abies alba*), pine (*Pinus sylvestris*), larch (*Larix decidua*), Douglas fir (*Pseudotsuga Menziesii*) and oak (*Quercus spp.*). The diameters are between 8 cm plait and 20 cm center diameter. The number of knots does not play a major role[17].

Until 2012, a total of 899 mining timbers from the Bronze Age "Christian von Tusch-Werk – Alter Grubenoffen" were analysed – cores taken with a conventional dry-wood-borer or by cutting a small disk. Dry disks and mounted cores were sanded until individual tracheids became visible. Wood species were identified by microscopic analysis and the tree-rings were measured to the nearest 0.01 mm using the LINTAB measuring device (www.rinntech.de). All ring-width series of living trees were cross-dated and

16 Reschreiter, H, Barth, F.E. 'Neufund einer bronzezeitlichen Holzstiege im Salzbergwerk Hallstatt', *Archäologie Österreichs*, **16** (1) (2005): 27–32.

17 Lincke, M. *Das Grubenholz von der Erziehung bis zum Verbrauch: Ein Handbuch für Forstwirte, Waldbesitzer Bergbeamte und Holzhändler,* (Berlin: Parey, 1921); Bartels, C. 'Grubenholz – Holz und seine Verwendung im Bergwerksbetrieb des Spätmittelalters und der Frühen Neuzeit', in Ingenhaeff, W., Bair, J. (eds.), *Bergbau und Holz,* (Innsbruck: Berenkamp, 2006); Anonymus. *Österreichische Holzhandelsusancen 2006,* (Wien: Kooperationsplattform Forst-Holz-Papier (FHP), 2006).

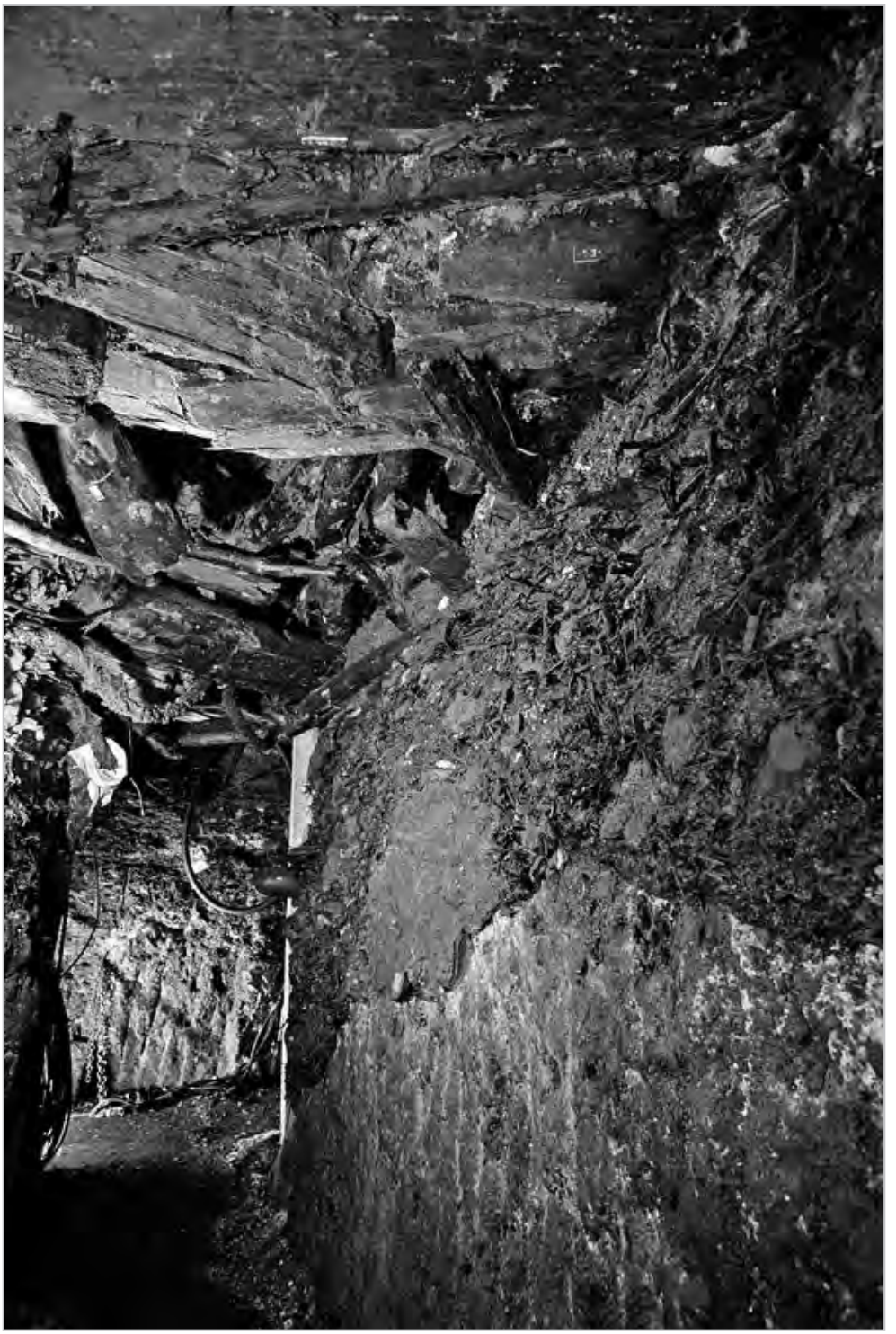

Figure 1: *Mine timber at the upper part of the modern tunnel (within the Bronze Age layer of wastes).*

checked for dating and measurement errors using COFECHA, and by visual synchronization[18].

The most common wood species was Silver fir (*Abies alba*) 40%; followed by Norway spruce (*Picea abies*) with 39%. So, the largest part consists of these two types of wood in approximately equal proportions, followed by: European beech (*Fagus sylvatica*) 15%, maple (*Acer spp.*) 3%, ash (*Fraxinus excelsior*) 2% and European larch (*Larix decidua*) 1%.

The high suitability of spruce and fir wood as construction timber[19], was well known in the Bronze Age. Considering the climatic conditions at that time higher proportions of beech were expected[20]. Beech wood is of higher wood density and has no ability to warn prior to cracking, in contrast to fir and spruce[21]. In the mines beech wood was used for tool handles (e.g. picks). The left-over was used as fire wood because of its high calorific value. Moreover, larch was rather common in the forest ecotype. It seems that there was no particular use for larch in the salt mines. In general, the good durability of larch, made its wood particularly favoured for housing. We have no evidence for Bronze Age or Early Iron Age housing constructions in Hallstatt. But the remains of two wooden log basins, dated to the Bronze Age and used to cure meat were determined as larch wood[22].

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18 Wagenführ, R. *Anatomie des Holzes,* (Leipzig: VEB Fachverlag, 1989); Stokes, M.A., Smiley, T.L. *An introduction to tree ring dating,* (Tucson: The University of Arizona Press, 1996); Swetnam, T.W., Thompson, M.A., Kenedy-Sutherland, E.K. *Using dendrochronology to measure radial growth of defoliated trees. USDA Forest Service Handbook 639,* (Washington D.C., 1985); Holmes, R.L. 'Computer assisted quality control in tree-ring dating and measurements', *Tree Ring Bull* **43** (1983): 69–75.

19 Lincke, M. *Das Grubenholz von der Erziehung bis zum Verbrauch: Ein Handbuch für Forstwirte, Waldbesitzer Bergbeamte und Holzhändler,* (Berlin: Parey, 1921); Bosshard, H.H. *Holzkunde. Band 1: Mikroskopie und Makroskopie des Holzes,* (Basel und Stuttgart: Birkhäuser Verlag, 1974); Sell, J. *Eigenschaften und Kenngrößen von Holzarten,* (Zürich: Bauchfachverlag AG, 1989).

20 Mayer, H. *Wälder des Ostalpenraums. Standort, Aufbau und waldbauliche Bedeutung der wichtigsten Waldgesellschaften in den Ostalpen samt Vorland,* (Stuttgart: Gustav Fischer Verlag, 1974).

21 Lincke, M. *Das Grubenholz von der Erziehung bis zum Verbrauch: Ein Handbuch für Forstwirte, Waldbesitzer Bergbeamte und Holzhändler,* (Berlin: Parey, 1921).

22 Mayer, H. *Wälder des Ostalpenraums. Standort, Aufbau und waldbauliche Bedeutung der wichtigsten Waldgesellschaften in den Ostalpen samt Vorland,* (Stuttgart: Gustav Fischer Verlag, 1974); Barth, F.E., Lobisser, W. 'Das EU-Projekt Archaeolive und das archäologische Erbe Hallstatt', in *Veröffentlichungen aus dem Naturhistorischen Museum in Wien, Neue Folge 29,* (Wien, 2002); Grabner, M., Reschreiter, H., Barth, F.E., Klein, A., Geihofer, D., Wimmer, R. 'Die Dendrochronologie in Hallstatt – Ein Statusbericht', *Archäologie Österreichs* **17** (1) (2006): 40–49; Pucher, E., Barth, F.E., Seemann, R., Brandstätter, F. (eds.), 'Bronzezeitliche

The diameters of the mining timber were determined by averaging two measurements done in perpendicular directions. Usually just short parts of the logs used for mining timber were excavated. Because of the tapering of the logs, the determination of diameter is not very significant, but the length of the fully excavated logs did not exceed 8 m[23].

The wood species distribution of mine timber with small diameters (under 10 cm, 331 pieces), shows approximately the same proportions as the overall result: 44% fir, 42% spruce, 11% beech, 2% maple, 1% larch. For larger diameters (20 to 35 cm, 55 pieces) the ratio changes in favour of spruce: 62% spruce, 36% fir, 2% beech. This is due to the intensive use of the fir for the production of lighting chips (see below). Fir logs were smaller in diameter and showed slightly wider tree-rings than the mean values of all species, which could be attributed to the use of younger trees (in terms of cambial age)[24]. A lot of the mine timbers show big knots and a high number of knots. That is also a hint of juvenility, e.g. the utilization of young trees or of the crown. As a result, only logs of small diameter were available as mine timber. The thicker stem parts were used for the production of the lighting chips (see below).

Dendrochronological dating will not be discussed here. Rather, ring width data acquired in the course of dendrochronological processing will be presented here. First of all, an attempt was made to determine the felling time. If the so-called waney edge ("Waldkante" see figure. 2) is present on the timbers, the dendrochronological dating actually corresponds to the year of the felling. The waney edge is the outermost tree ring below the bark. However, the time of felling is not only interesting for dating, but also for the understanding of forest management and woodworking[25].

To evaluate the time of felling (at intra-annual resolution), 572 mine timbers were analysed from the "Christian von Tusch-Werk, Alter Grubenoffen". First, it was determined macroscopically whether bark was present on the surfaces of the stems, or whether they were worked surfaces or waney edges.

Fleischverarbeitung im Salzbergtal bei Hallstatt', *Mitteilungen der Prähistorischen Kommission 80*, (Wien, 2013).

23 Reschreiter, H, Barth, F.E. 'Neufund einer bronzezeitlichen Holzstiege im Salzbergwerk Hallstatt', *Archäologie Österreichs*, **16** (1) (2005): 27–32.

24 Bräker, O.U. 'Der Alterstrend bei Jahrringdichten und Jahrringbreiten von Nadelhölzern und sein Ausgleich', *Mitteilungen der Forstlichen Bundesversuchsanstalt* **42** (1981): 75–102; Grabner, M., Wimmer, R. 'Variation of different tree-ring parameters in samples from each terminal shoot of a Norway spruce tree', *Dendrochronologia* **23** (2006): 111–120.

25 Grabner, M., Nicolussi, K. 'Dendrochronologie – spezielle Anforderungen der Archäologie', *Vortrag am Dritten Archäometrie Kongress in Salzburg, Mai 13–14 2011*, (2011).

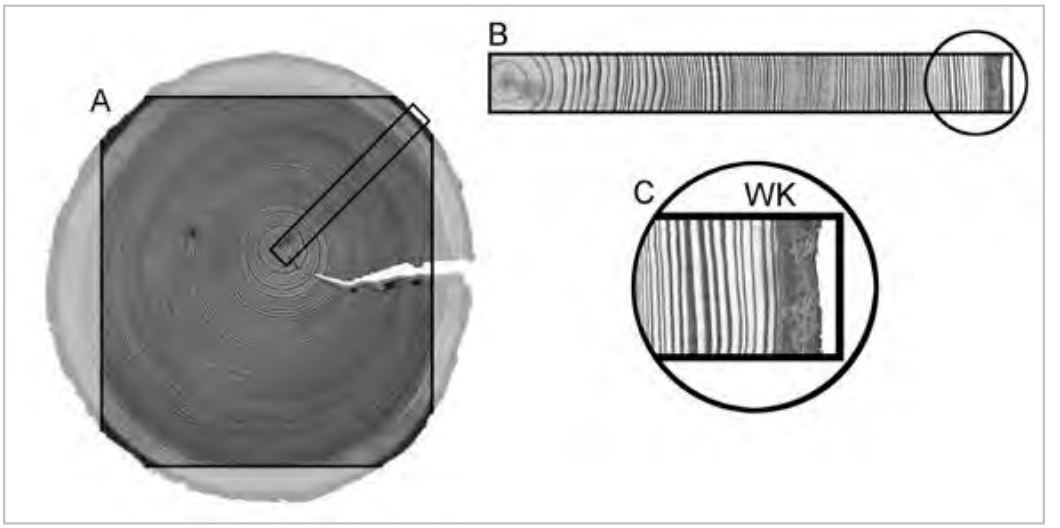

Figure 2: The explanation of the waney edge. A: the whole stem with bark on it flattened to a beam; B: showing a core with waney edge and bark on it; C: showing the detail of the waney edge (ending with latewood) and bark on it.

Bark was detected in 63% of the cases. Waney edge could be detected at 35%. Only 2% were not clearly determinable. This means that mine timbers consist primarily of round logs. In about two-thirds of the cases, the bark was still present. Above all, the bark is firmly attached to the wooden body outside of the growing season – thus indicating the felling of the trees during winter when the cambium is not active[26].

On the basis of the cores for the dendrochronological analyses the outermost ring was examined in detail with the help of a reflected light microscope. In the case of a waney edge, the cells formed last are concentric with the tree ring boundaries. If the felling occurred in winter, the tree ring of conifers ends with a latewood-band. If the outer end of the drill core ends obliquely to the tree ring boundaries, this is an indication that the wood was processed and thus no waney edge is present[27].

The investigations showed that 88% of the trees used for mine timber were felled during winter (within the dormancy – September to April of the

26 Grabner, M., Reschreiter, H., Klein, A. 'Das Grubenholz der bronzezeitlichen Fundstelle Christian-von-Tusch-Werk – Alter Grubenoffen', *Mitteilungen der Anthropologischen Gesellschaft in Wien* **139** (2009): 101–104.

27 Grabner, M., Nicolussi, K. 'Dendrochronologie – spezielle Anforderungen der Archäologie', *Vortrag am Dritten Archäometrie Kongress in Salzburg, Mai 13–14 2011*, (2011).

following year) and only at 2% during summer time. For 10% of the 572 cores, no clear assignment was possible (mostly due to drill core fractures).

3. Lighting chips

One of the preconditions for working below ground is enough light. For this purpose the prehistoric miners used lighting chips in vast amounts[28]. Historical and ethnographic data show that usually these chips were made of resinous wood species like Scotts pine (*Pinus sylvestris* L.). For the use inside living areas, lighting chips were often stored under bad conditions that led them to rot, thus increasing the relative amount of resin. Different types of treatments were described to increase the burn-ability, for example adding nitrate[29].

Burnt down lighting chips of fir or spruce wood, with either a square or rectangular are found in large numbers at all archaeological sites in the Hallstatt salt mines (see figure 3). These 80 to 100 cm long chips were split off the logs – mainly in radial direction[30].

In total we analysed 300 Bronze Age and 80 Iron Age lighting chips. Again, tree species and ring-width were determined following the same procedure as for the mine timber. The outermost diameters of the logs, from which the chips were split off, were determined by comparison of the curvature of the tree-rings with concentric circles in 5 cm distance drawn on paper.

Almost all (93%) lighting chips found at the Christian von Tusch-Werk, Alter Grubenoffen were split from fir-logs. For the Iron Age 100% fir was determined. This underlines the above-mentioned high importance of fir wood, which was specifically selected for the manufacture of lighting chips. As mentioned above lighting chips are usually made of resinous wood, like Scots pine or Black pine and called torch wood. Fir wood has no resin ducts,

28 Kowarik, K., Reschreiter, H., Wurzer, G. P. X. 'Modelling Prehistoric Mining: A Case study on the Prehistoric Salt Mines of Hallstatt', in Danielisova, A., Fernandez-Götz, M. (eds.), *Persistent Economic Ways of Living. Archaeolingua 35*, (2015), pp. 51–68.

29 Ast, H. 'Kienspan und Unschlitt, Beleuchtung im ländlichen Alltag', in *Kulturbeilage zum Amtsblatt der Bezirkshauptmannschaft Wiener Neustadt*, (Wiener Neustadt, 2001), pp. 1–4; Fiala, K. *Mundartkundliches und Sachliches in der Bauernarbeit im Großarltal (Salzburg). Ph.D. diss.,* (Universität Wien, 1965).

30 Klein, A. *Bronzezeitliche Holznutzung in Hallstatt,* (Masterthesis, Universität für Bodenkultur, Wien, 2006); Morton, F. 'Grubenbeleuchtung in der Urzeit', *Berg- und Hüttenmännisches Jahrbuch 75*, (1927), pp. 114–116.

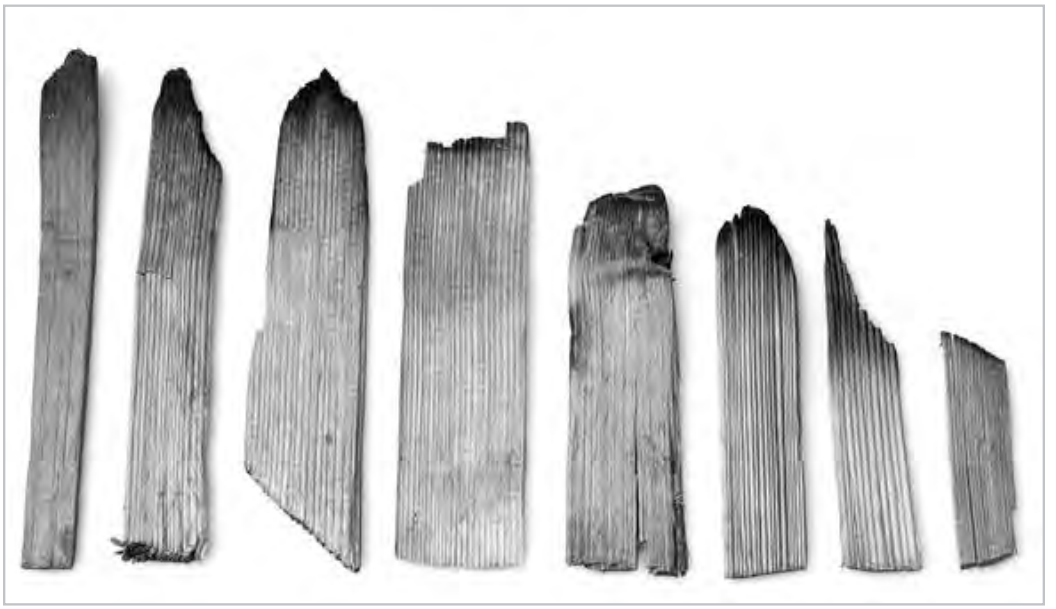

Figure 3: Eight examples of used lighting chips from the Iron Age, which could be found in uncountable numbers at the prehistoric salt-mine Hallstatt, Austria.

except traumatic ones. It is still unclear why fir wood was used to produce lighting chips. Presently the reasons can only be guessed at, such as better cleavage-ability or the low amount of smoke formation during burning[31].

Fir wood is easy to split. This is also true for spruce wood which is reported to show comparable properties in terms of splitting. Schwankl presented results of splitting in radial direction: Norway spruce 2.09 kg/cm²; Fir 2.11 kg/cm² (in comparison Beech: 5.11 kg/cm²). Foresters and carpenters state that spiral grain of fir is less pronounced than in spruce. In literature dealing with spiral grain, spruce and fir are usually not separated[32].

The findings of two bundles of unused lighting chips evidence their original length (one meter) and give important insights into raw material

31 Ast, H. 'Kienspan und Unschlitt, Beleuchtung im ländlichen Alltag', in *Kulturbeilage zum Amtsblatt der Bezirkshauptmannschaft Wiener Neustadt*, (Wiener Neustadt, 2001), pp. 1–4.

32 Wagenführ, R. *Anatomie des Holzes,* (Leipzig: VEB Fachverlag, 1989); Sell, J. *Eigenschaften und Kenngrößen von Holzarten,* (Zürich: Bauchfachverlag AG, 1989); Schwankl, A. *Untersuchungen beim Spalten des Holzes*, (Ph.D. diss., Technische Hochschule in Dresden, C. Rich. Gärtnersche Buchdruckerei, 1939); Krempl, H. 'Untersuchungen über den Drehwuchs bei Fichte (Picea abies Karst.)', *Mitteilungen der Forstlichen Bundesversuchsanstalt Wien: 29, Österreichsicher Agrarverlag*, (1970); Harris, J.M. *Spiral grain and wave phenomena in wood formation. Springer Series in Wood Science*. (Berlin: Springer Verlag, 1989).

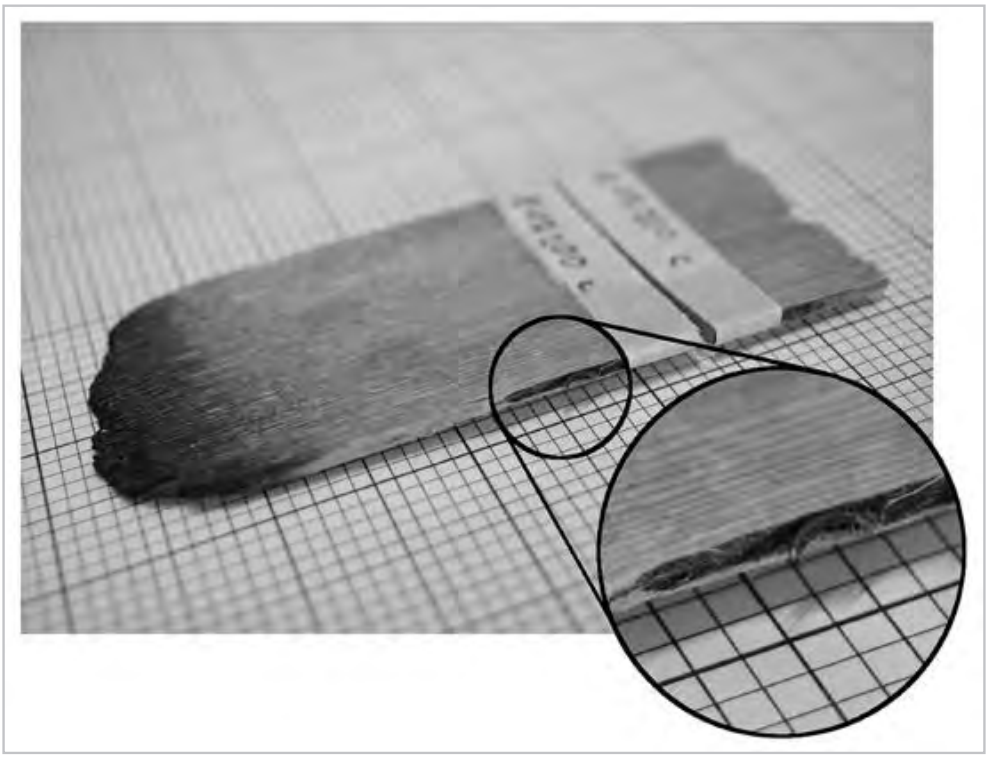

Figure 4: A lighting chip with remnants of bark-bast-fibers on the outermost tree ring.

production. The unused lighting chips were almost free of knots. In addition, amongst the burnt down chips pieces with knots are exceedingly rare. To produce these chips knot-free internodial wood from fast growing trees, or the outermost part of the bud log, usually free of branches, has to be used. As it seems almost impossible at these forest conditions to grow internodial wood of one meter in length the only possibility to meet the enormous demand on lighting chips is to use the branch-free lower part of the stem. The tree rings of the outermost rings of the bud log are usually smaller than the juvenile rings[33]. The mean ring width of fir chips was 1.72 mm (± 0.70 mm). The ring-widths of the mining timber (2.12 mm for fir) were higher than the ones of the lighting chips. Therefore, there is no evidence for juvenility or fast growth conditions in lighting chips. The higher mean diameter (29.4 cm) of the fir-logs, of which the lighting chips were split off, counteracts the hypothesis of using juvenile trees. A lot of lighting chips showed dark coloured

33 Grabner, M., Wimmer, R. 'Variation of different tree-ring parameters in samples from each terminal shoot of a Norway spruce tree', *Dendrochronologia* **23** (2006): 111–120.

bast remains at the small, tangential surface; which could be attributed to the former presence of bark (waney edge; see figure 4).

The question arose whether in radial direction only one chip (completely outside with waney edge) or several (then the inner chips do not show a waney edge) could be produced.

The lighting chips from the Bronze Age and the Iron Age differ from each other in some details: During the Bronze Age, the chips were somewhat differently shaped but tend to be narrower in the radial direction (of the wood). The trunk diameter of the trees from which they were split, was less than in the Iron Age. Thus, 50% of the investigated Bronze Age chips (300 pieces) showed a waney edge, whereas the Iron Age chips had only 31% a waney edge.

Since the trees used in the Iron Age had larger diameters, more chips could be made in radial direction (of the wood); leading to a lower amount of chips with waney edge.

4. Wooden containers for transportation: Bins and buckets

Bronze Age miners used transportation bins, so called "Schwingen" in combination with scraper tools to collect the mined salt and fill it into carry sacks for transport in the mine. These bins were made out of halved tree segments[34] (see figure 5).

49 containers from different sites in the Hallstatt salt mines were analysed (Klein 2006). Stem diameter, ring width and wall thickness of the bins were measured.

For the transportation bins (altogether 37 pieces), fir dominates with 58%. Summarizing the amount of fir, spruce and the group spruce/fir, which could not be separated exactly, the softwoods altogether make up 72%. Other species are maple with 22%, lime tree (*Tilia* spp.) and beech with 3% each.

67% of the buckets (12 in total) could be clearly attributed to fir. For 25%, no clear distinction could be made between spruce and fir. Only 8% are lime wood.

The transportation bins were largely manufactured from overgrown stumps (Klein 2006) and therefore show a not-aligned tree ring structure.

34 Barth, F.E. 'Bronzezeitliche Salzgewinnung in Hallstatt', in Hänsel, B. (ed.), *Sonderdruck aus Mensch und Umwelt in der Bronzezeit Europas,* (Kiel: Oetker-Voges Verlag, 1998), pp. 123–127.

Figure 5: Remnant of a transportation bin ("Schwinge") and the broom-like "Kratze".

This structure is caused by natural root crafting or anastomoses, when the roots of trees are connected[35]. Root crafting most likely appears on roots with rather big diameters, thin roots have a far too elastic tissue to build anastomoses. A long-lasting contact between the roots and sufficiently high pressure are assumed for grafting. Through friction of two roots touching each other the bark is shorn off and the cells get connected. Most grafting appears close to the rootstock because there are many roots lying close to each other and the growth rate is highest[36]. Usually, two or more neighbouring

35 Schweingruber, F.H. *Prähistorisches Holz: Die Bedeutung von Holzfunden aus Mitteleuropa für die Lösung archäologischer und vegetationskundlicher Probleme, Academica Helvetica 106,* (Bern: Haupt., 1976); Schweingruber, F.H. 'Ein 6000jähriges Handwerk im Emmental', *Schweizerische Zeitschrift für Forstwesen* **134** (11) (1983): 915–920; Schweingruber, F.H., Schoch, W.H. *Holz, Jahrringe und Weltgeschehen. Schweizerische Arbeitsgemeinschaft für das Holz*, (Zürich: LIGNUM, 1992); Schweingruber, F.H. *Tree Ring and Environment Dendroecology*, (Bern: Verlag Paul Haupt, 1996); Schweingruber, F.H. *Dendroökologische Holzanatomie, Anatomische Grundlage der Dendrochronologie*, (Bern: Verlag Paul Haupt, 2001).

36 Flury, P. *Über Wurzelverwachsungen, Schweizerische Zeitschrift für Forstwesen* **70** (1919): 37–41; Kutschera, L., Lichtenegger, E. *Wurzelatlas mitteleuropäischer Waldbäume und Sträucher*, (Graz: Leopold Stocker Verlag, 2002); Yli-Vakkuri, P. 'Untersuchung über organischen

trees of the same species tend to build anastomoses, but this phenomenon might happen as well between different tree species. Bormann and Graham[37] stated that root grafting occurs in younger stands as well as in old ones and under a wide range of site conditions. Nevertheless, they concluded that the degree of grafting is a matter of age, density and the density of conspecifics of the stand. Grafting between roots is a widespread phenomenon of many tree species. Especially old trees in forests are often members of an interrelated system with a broad root network[38].

Not only water but also minerals and nutrients are conducted from one tree to the others trough root grafting. If one tree in the tree network is cut down the living trees still provide assimilates, so the cambium of the dead tree stays alive and is still able to produce wood tissue. The trees start overgrowing the stump or wound, the newly produced wood is without orientation, due to the missing crown of the dead tree. If the overgrowing phase lasts long enough, the overgrown wood structure meets in the middle of the stem and builds a cupola. Otherwise, the inner part of the stem rots, so that the overgrown tissue is growing irregularly. Small stems overgrow within 20 years, big ones need more than 80 years. The tree species which is most likely to overgrow after felling is Silver fir, mainly if it is growing on nutrient poor sites. Cells of overgrown wood tissue are unordinary flat; the latewood is less built and the tracheids grow without orientation in typical clew zones[39].

The analysis of the Hallstatt pieces shows, that after felling it took approximately twelve to twenty years before enough new curly-grain-wood was formed. The trunks could then be harvested and the wood from the inside of the former tree trunk was removed (if it had not already rotted). No further shaping of the bin was necessary as the natural form was used. Due to this

Wurzelverbindungen zwischen Bäumen in Kieferbeständen. German summary', *Acta. Forest. Fenn.* **60** (1953): 1–117; Schweingruber, F.H. *Dendroökologische Holzanatomie, Anatomische Grundlage der Dendrochronologie*, (Bern: Verlag Paul Haupt, 2001).

37 Bormann, F.H. 'Root grafting and non-competitive relationships between trees', in Kozlowski, T.T. (ed), *Tree growth,* (New York: Roland Press Company, 1962); Graham, B.F., Bormann, F.H. 'Natural Root Grafts', *Botanical Review* **32** (3) (1966): 255–292.

38 Bormann, F.H. 'Root grafting and non-competitive relationships between trees', in Kozlowski, T.T. (ed), *Tree growth,* (New York: Roland Press Company, 1962); Schweingruber, F.H. *Tree Ring and Environment Dendroecology*, (Bern: Verlag Paul Haupt, 1996).

39 Yli-Vakkuri, P. 'Untersuchung über organischen Wurzelverbindungen zwischen Bäumen in Kieferbeständen. German summary', *Acta. Forest. Fenn.* **60** (1953): 1–117; Wichmann, H.E. 'Wurzelverwachsungen und Stocküberwallungen bei Abietineen', *Centralblatt für das gesamte Forstwesen* **51** (1925): 250–258; Schweingruber, F.H. 'Ein 6000jähriges Handwerk im Emmental', *Schweizerische Zeitschrift für Forstwesen* **134** (11) (1983): 915–920.

special wood structure, these vessels are particularly resistant to wear and especially to breakage, but at the same time very light.

The analysis of diameters shows a mean value of 40 cm for the transportation bins and of 20 cm for the buckets. For the transportation bins a distinct difference in wall thickness can be observed for pieces made of curly tissue and pieces made of regular wood (35 mm). Our findings suggest that to achieve sufficient toughness a wall thickness of 15 mm was necessary for bins made of curly wood and of 35 mm for bins made of regular wood

73% of the bins (37 pieces) and 92% of the buckets (12 pieces) were manufactured with curly-grain fibrous overgrowth tissue. These findings allow for important insights into prehistoric forest management. The described process of overgrowing only occurs when neighbouring trees live nearby and supply the felled tree via root connections. Therefore, the Bronze Age bins and buckets indicate, that clear cuts on a large scale did not occur[40].

5. Reconstruction of forest utilization

Based on the analysis of mine timber, lighting chips and transportation bins and buckets, we reconstructed Bronze Age raw material management processes. We were able to demonstrate that the fir tree was used in its entirety. On the one hand this is confirmed by the increasing diameters from the mine timbers to the lighting chips to the transportation bins and buckets.

To reconstruct the utilization of the individual tree stems the ring width and the stem diameter of mine timber, lighting chips and transportation bins – all made of fir wood – were compared.

The diameter of all measured stems (or parts of stems) was low. Mining timber had a mean diameter of 9.0 cm (ranging from 2.7 to 34.0 cm); the mean diameter of the stems, where the lighting chips were split of, was 29.4 cm (ranging from 10 to 80 cm) and the mean diameter of the overgrown fir-stumps was 39.2 cm (ranging from 15 to 80 cm). The utilization of trees was limited by the weight of the stems. Therefore, usually just medium sized trees were used. The use of small and medium sized logs can be observed at many archaeological sites from the Neolithic period to the Medieval period[41].

40 Klein, A. *Bronzezeitliche Holznutzung in Hallstatt,* (Masterthesis, Universität für Bodenkultur, Wien, 2006).

41 Schweingruber, F.H. *Prähistorisches Holz: Die Bedeutung von Holzfunden aus Mitteleuropa für die Lösung archäologischer und vegetationskundlicher Probleme, Academica Helvetica 106,* (Bern: Haupt., 1976); Schweingruber, F.H., Schoch, W.H. *Holz, Jahrringe und Weltgeschehen.*

The fir samples show the following mean ring widths: mine timber 2.12 mm; lighting chips 1.72 mm, and regularly grown wood of the bins made of overgrown stumps 0.67 mm. The age related trend, i.e. the decrease of ring width with increasing age, is a well-known phenomenon in dendrochronology[42]. These differences in increments can be a result of (1) differences in site conditions of the trees used for different purposes with consistently better growth of trees used for mining timber or (2) utilization of younger trees for mining timber or (3) utilization of juvenile portions of trees for mining timber and mature portions for lighting chips.

At the mine, just short sections of the logs can be analysed. Therefore, a detailed evaluation of branchiness is not possible. However, at the visible parts of the logs, a high density of branches can be observed. The low ring-width of the overgrown stumps can be related to the higher age of the trees.

Stem diameter and ring width show different trends: with increasing stem diameter the ring width decreases. Considering this, as well as the fact that felling was tedious with the available tools, the third explanation (utilization of juvenile portions of trees for mining timber and mature portions for lighting chips) is most likely. Therefore, we conclude that the stem of the fir tree was used in its entirety and suggest the following model:

1. The top of the tree (the crown), with diameters from 5 to 20 cm was used as mining timber.
2. The branchless, outermost wood of the bud-log with diameters of 15 to 30 cm was used to split off lighting chips.
3. The stumps of the fir trees, which started to overgrow with diameters ranging from 25 to 35 cm was used to produce transportation bins.

As discussed further above the local source area of tree stems around the prehistoric salt mines of Hallstatt is limited and the import of round wood as well as high amounts of lighting chips is, at present, considered rather

Schweizerische Arbeitsgemeinschaft für das Holz, (Zürich: LIGNUM, 1992); Eberschweiler, B. 'Bronzezeitliches Schwemmgut vom „Chollerpark" in Steinhausen (Kanton Zug)', *Veröffentlichung der Schweizerischen Gesellschaft für Ur- und Frühgeschichte. Antiqua 37,* (2004); Lobisser, W. *Die eisenzeitlich Bauhölzer der Gewerbesiedlung im Ramsautal am Dürrnberg bei Hallein. Dürrnberg – Forschungen Band 4,* (Rahden/Westf.: Verlag Marie Leidorf GmbH, 2005).

42 Bräker, O.U. 'Der Alterstrend bei Jahrringdichten und Jahrringbreiten von Nadelhölzern und sein Ausgleich', *Mitteilungen der Forstlichen Bundesversuchsanstalt* **42** (1981): 75–102; Grabner, M., Wimmer, R. 'Variation of different tree-ring parameters in samples from each terminal shoot of a Norway spruce tree', *Dendrochronologia* **23** (2006): 111–120.

unlikely. About half of all examined wooden artefacts belong to the species *Abies alba*. Due to the general demands of a forest to grow fir trees as well as due to the necessities given by the fact, that overgrown stumps were used, hypotheses on Bronze Age forest utilization and raw material at the Hallstatt mining site can be stated. Natural root grafting can be found especially in dense forests, and it occurs more often in older stands (30 – 60 years)[43]. Fir is cited as the species with the highest amount of natural root grafting (Wichmann 1925). The mean number of tree rings of the mining timber was 38 (with a maximum of 152).

Therefore, the model of single stem utilisation of fir trees is suggested. In addition, it must be considered that bud logs with low numbers of branches at the outermost parts of the stem require a dense stand.

6. Conclusions

The results presented here demonstrate that the Bronze Age Hallstatt mining community possessed sophisticated foresting and wood working skills. Those skills were partially lost, but some outlasted the millennia and can still be observed today in the region. We were able to identify seasonal activities as the harvesting of trees during the dormant season – after the latewood was completely formed (September to following April). The whole fir trees (from the top to the stumps) were utilized for various products like mine timber, lighting chips, transportation bins and buckets.

To build natural root graftings, which were utilized as bins and buckets, a closed canopy forest is necessary. A dense forest also sustains to reduce the number of branches at the bud log. Dense forest with single stem utilization can be concluded for the Bronze Age at Hallstatt – beside open areas for agricultural plants which can be reconstructed from palynological analyses (not published, not shown here).

43 Yli-Vakkuri, P. 'Untersuchung über organischen Wurzelverbindungen zwischen Bäumen in Kieferbeständen. German summary', *Acta. Forest. Fenn.* **60** (1953): 1–117; Bormann, F.H., Graham, B.F. 'The occurrence of natural root grafting in Eastern White-Pine, Pinus strobus L. and its ecological implications', *Ecology* **40** (4) (1959): 677–691; Kutschera, L., Lichtenegger, E. *Wurzelatlas mitteleuropäischer Waldbäume und Sträucher*, (Graz: Leopold Stocker Verlag, 2002).

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Dendro-provenancing: New Insights for Wooden Cultural Heritage

SANDRA KARANITSCH-ACKERL,[1*]
ELISABETH WÄCHTER,[1] KONRAD MAYER,[1]
SEBASTIAN NEMESTOTHY,[1] FLORIAN LINKESEDER,[1]
HANNA A. LIEBICH,[2] MICHAEL GRABNER[1]
[1] University of Natural Resources and Life Sciences BOKU Vienna,
Institute of Wood Technology and Renewable Materials
[2] Federal Monuments Authority Austria, Department of Architecture
and Structural Engineering

Abstract: Timber is an important part of material cultural heritage. Dendro-provenancing gives insights into the statistically most probable origin of wood and therefore into timber-trade networks from medieval times onwards. Like dendrochronology, it is based on pattern similarity of tree-ring sequences. This first Austrian dendro-provenancing study of the roofs in the city centre of Vienna involved the analysis of 1,421 dendrochronologically dated samples – 228 of them belonging to the Hofburg, the imperial palace in Vienna. Based on the presence of wood from different tree species and of rafting wedges in many of the roof structures indicating water transport, the whole catchment of the Danube River upstream of Vienna must be considered the region of timber origin. Based on dendrochronological dates and building surveys of historic roof constructions, an approach to estimate the amount of timber, the number of trees, and forest area needed for building the roof trusses of Vienna's old town is presented.

Keywords: Vienna, Danube, urban history, dendrochronology, historical footprint of timber trade, timber demand, historical wood utilisation

1. Introduction

In 1276 the historical city centre of Vienna—today's first district—consisted of around 1,000 buildings. In 2001, 1,723 buildings were counted.[1] In recent decades, more than 130 of these buildings have been dendrochronologically investigated. In most cases, wooden elements from roof trusses were sampled. From the 1,889 dated samples (the oldest one comes from 1139), 1,107 are Norway spruce (*Picea abies* L. Karst.) and 707 are silver fir (*Abies alba* Mill.), both together accounting for more than 96 % of all dated elements.

Silver fir and Norway spruce are abundant in the Alpine parts of Austria and neighbouring countries, such as Germany and Switzerland, but neither grow in the vicinity of Vienna, so they must have been transported to the city. Before railways and motorised traffic became common, timber-trade routes followed natural and man-made waterways.[2] Logs were tied together to form rafts and floated downstream.[3] Timber-rafting was reported as early as 1207 in the Danube region, when Archbishop Eberhard II of Salzburg gave rafting permission to the monks in Raitenhaslach.[4] Vestiges of this mode of transport are sometimes still visible in the construction elements of the investigated roof trusses. Rafting wedges, also referred to as floating marks (Fig. 1), which were used to fix the withies connecting logs, were often left in the timber when it was further processed. In some cases, the catchment of origin can be identified based on wedge types or combinations of wedges and withies.[5] Unfortunately, this does not hold true for Austrian river systems, as rafts were often joined or reassembled into greater units as soon as the riverbed was deep and wide enough.[6] Consequently, the entire Danube

1 http://www.statistik.at.

2 Ebner, C. *Flößerei und Schiffahrt auf Binnengewässern. Mit besonderer Berücksichtigung der Holztransporte in Österreich, Deutschland und Westrussland*, (Wien: A. Hölder, 1912).

3 Neweklowsky, E. *Die Schiffahrt und Flößerei im Raume der oberen Donau. 1. Band*, (Linz: Oberösterreichischer Landesverlag, 1952).

4 Neweklowsky, E. *Die Schiffahrt und Flößerei im Raume der oberen Donau. 1. Band*, (Linz: Oberösterreichischer Landesverlag, 1952).

5 Eißing, T., Dittmar, C. 'Timber transport and dendro-provenancing in Thuringia and Bavaria', in Fraiture, P. (ed.), *Tree Rings, Art, Archaeology, Proceedings of an international Conference*, (Royal Institute for Cultural Heritage Brussels, 2011), pp. 137–149.

6 Linkeseder, F. *Analyse von Flößerkeilen zur Herkunftsbestimmung von Holz im Donauraum*. Master thesis, University of Life Sciences and Natural Resources (Vienna: BOKU, 2018).

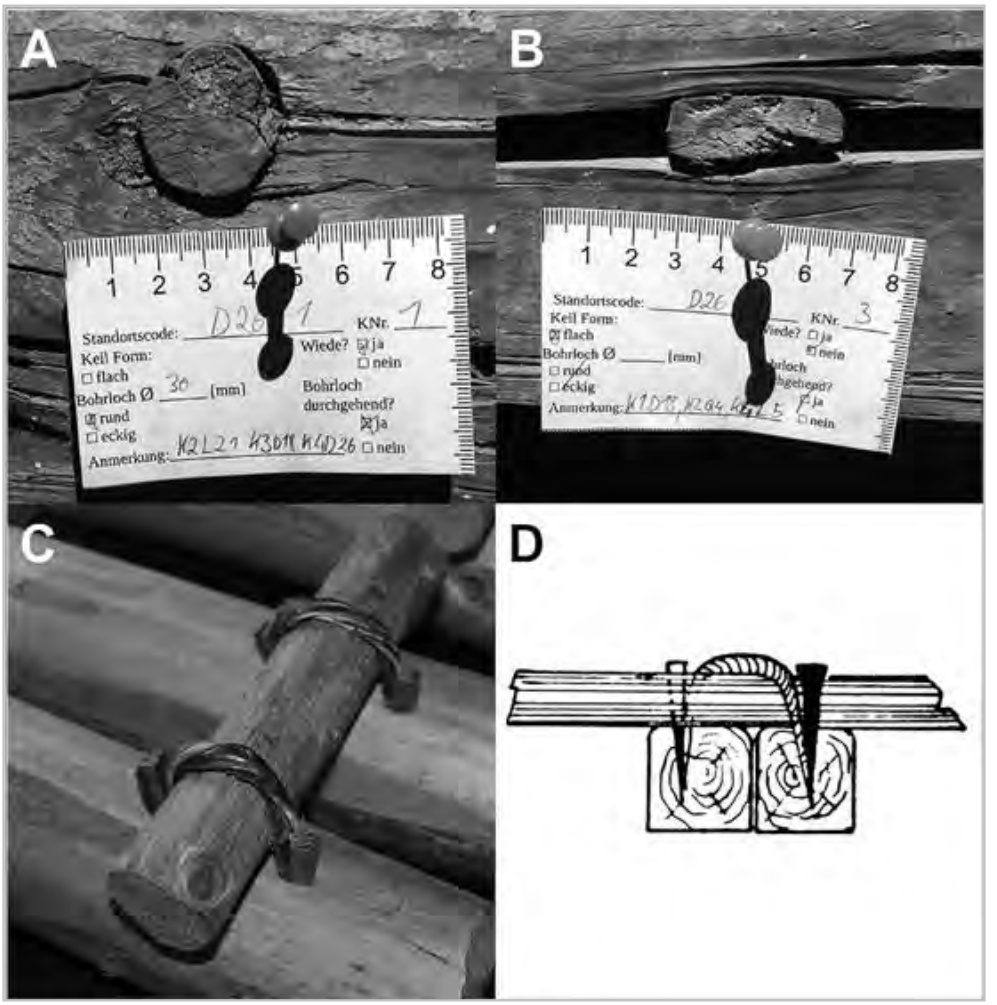

Figure 1: Rafting wedges (A, B) in situ in a roof truss of the Stoß im Himmel building, Vienna (A: pre-bored round wedge with withy; B: flat wedge). Panel C depicts a reproduction of a raft at the Großreifling forest museum (photo by F. Linkeseder). Panel D portrays another way rafts can be tied together.[7]

catchment (Fig. 2) must be considered the region of origin for Viennese construction wood.

In this study we attempt to determine where the timber for the roof trusses in the city of Vienna (within the borders of today's first district) came from, that is, where the trees used to build Viennese roofs grew, by means

7 Neweklowsky, E. *Die Schiffahrt und Flößerei im Raume der oberen Donau. 1. Band*, (Linz: Oberösterreichischer Landesverlag, 1952).

of dendro-provenancing (stratified by tree species and historical building periods) and to test the reliability of these results for the data subset from the Hofburg, the imperial palace in Vienna. We also test the hypothesis that timber was not sold assorted by origin for building projects and provide a rough estimate of how many trees, or rather how much forest area, were needed to erect the roofs of Vienna's old town.

2. Materials and Methods

2.1. Dendrochronology and Tree-ring Dating

According to Speer, 'dendrochronology examines events through time that are recorded in the tree-ring structure or can be dated by tree rings.'[8] It is based on the observation that trees growing under similar environmental conditions produce similar tree-ring patterns, that is, the variations in their annual increments are comparable and can be 'cross-dated'. Cross-dating refers to the 'massively replicated pattern matching of tree-ring properties',[9] which is possible not only for living trees but also for timber used in roof trusses: when the lifespan of trees still standing in the forest and construction timber overlaps for at least 30 to 50 years, they can be cross-dated. Timber can then be cross-dated with even older wood, and thus a master chronology consisting of many samples that extends back in time can be produced. This approach enables dating tree rings to the calendar year of growth 'with a very high degree of confidence'.[10] For the scientific analysis of buildings of historic importance, the calendar date of a construction element's outermost ring is usually of greatest interest because it provides information on the earliest possible erection date of the structure.

2.2. Data

This investigation is based on dendrochronologically dated samples from the city centre of Vienna, which have been compiled by the BOKU Dendro Lab[11]

8 Speer, J.H. *Fundamentals of tree-ring research,* (Tucson: The University of Arizona Press, 2010).

9 Hughes M.K. 'Dendrochronology in climatology – the state of the art', *Dendrochronologia* **20** (1–2) (2002): 95–116.

10 Hughes M.K. 'Dendrochronology in climatology – the state of the art', *Dendrochronologia* **20** (1–2) (2002): 95–116.

11 http://www.dendro.at.

over the last decades. The dataset of 1,889 spruce and fir samples mentioned in the introduction from more than 130 sites has been restricted to series of at least 50 years in length and with an outermost ring dating of no later than 1900. Additionally, only samples from buildings with at least five dated series were used. This resulted in a subset of 1,421 samples (spruce: 906, fir: 515) from 91 buildings to be analysed.

2.3. Hofburg

The roof 'landscape' of the Hofburg palace complex contains 228 of these samples and thus represents 16 per cent of the complete analysed dataset. Therefore, a separate examination is justified. Another reason for special emphasis on the Hofburg is its historical importance for Austria. It was the residence of the Habsburg monarchs for more than six centuries, and its construction history is therefore comparably well investigated. In the sixteenth century there was even a special officer (*Bauschreiber*) in charge of all building activities at the Hofburg.[12] The oldest part of the complex was erected in the Late Middle Ages and includes the partly preserved Gothic *Hofburgkapelle* chapel.[13] Over time, the complex grew until it reached its current area of 24 hectares, including the open spaces of yards and gardens.

The Hofburg's building history is also reflected in its roofs. Over the last 15 years, more than 500 samples from its various roofs have been dendrochronologically analysed, and more than 400 have been dated to years from 1347 to 1922. Numerous rafting wedges (Fig. 1) were found in the Hofburg's roof trusses indicating water transport.

2.4. Chronologies

To determine the origins of these samples, 16 different master chronologies covering the region of interest (i.e., the Danube catchment upstream of Vienna) were considered (Tab. 1). Figure 2 displays the geographic location associated with each chronology. The master chronologies Alp (Austrian Alps) and Avn (Northern Alpine Forelands) represent two separate but vast areas. Anr is a regional chronology (hatched in Fig. 2) representing the Northern

12 Jeitler, M. 'Die Geschichte der Bauverwaltung an der Hofburg', in Karner, H. (ed.), *Die Wiener Hofburg 1521–1705. Baugeschichte, Funktion und Etablierung als Kaiserresidenz. = Veröffentlichungen zur Bau- und Funktionsgeschichte der Wiener Hofburg Vol. 2*, (Vienna: Austrian Academy of Sciences Press, 2014).

13 Eigl, K., Kodera, P. *Die Hofburg in Wien*, (Wien: Forum Verlag, 1977).

Limestone Alps, where Avn and Alp overlap. Other regional chronologies are Wal (Waldviertel), which is almost entirely contained in the Avn chronology, and OsS (the area south-east of Vienna), which overlaps with the Alpine chronology to a small extent. Two local chronologies—SbH and Kal (dark shading in Fig. 2)—complete the picture. Kal represents the Kalkalpen National Park and consists of living trees as well as historical structures for log-drifting.[14] SbH incorporates samples from the cities of Salzburg and Hallein and is therefore representative of a much larger area—the catchment of the Salzach River. Additionally, two chronologies from regions in neighbouring countries (southern Germany and the Czech Republic) are used.

Table 1: *Master chronologies for dendro-provenancing of timber from roof trusses in the city centre of Vienna.*

Label	Species	**Region** see also Fig. 2	**Time span** [years AD]		Replication	
			From	To	Trees	Sites
AlpAA	*Abies alba*	Austrian Alps	857	2012	543	102
AlpPA	*Picea abies*	Austrian Alps	-958	2012	1697	256
AnrAA	*Abies alba*	Limestone Alps	1234	2009	350	71
AnrPA	*Picea abies*	Limestone Alps	1167	2009	531	78
AvnAA	*Abies alba*	Northern Alpine Forelands	832	2011	602	138
AvnPA	*Picea abies*	Northern Alpine Forelands	1251	2011	1233	164
KalAA	*Abies alba*	Kalkalpen National Park	1429	1997	183	35
KalPA	*Picea abies*	Kalkalpen National Park	1421	1996	261	40
OsSAA	*Abies alba*	northern Burgenland, Thermenlinie	1456	1996	303	42
OsSPA	*Picea abies*	northern Burgenland, Thermenlinie	1549	1926	98	20
SbHAA	*Abies alba*	Salzburg and Hallein	1299	1915	201	49
SbHPA	*Picea abies*	Salzburg and Hallein	1322	1875	414	59
S-DeutAA	*Abies alba*	Southern Germany[15]	820	1985	–	–
TschecAA	*Abies alba*	Czech Republic[16]	1131	1998	–	–
WalAA	*Abies alba*	Waldviertel	1214	2016	673	85
WalPA	*Picea abies*	Waldviertel	1319	2016	888	80

14 Grabner, M., Wimmer, R., Weichenberger, J. 'Reconstructing the history of log-drifting in the Reichraminger Hintergebirge, Austria', *Dendrochronologia* **21** (3) (2004): 131–37.

15 Becker, B., Giertz-Siebenlist, V. 'Eine über 1100jährige mitteleuropäische Tannenchronologie', *Flora* **159** (1970): 310–346.

16 Compiled by Josef and Tomáš Kyncl, http://www.kyncl-dendro.com.

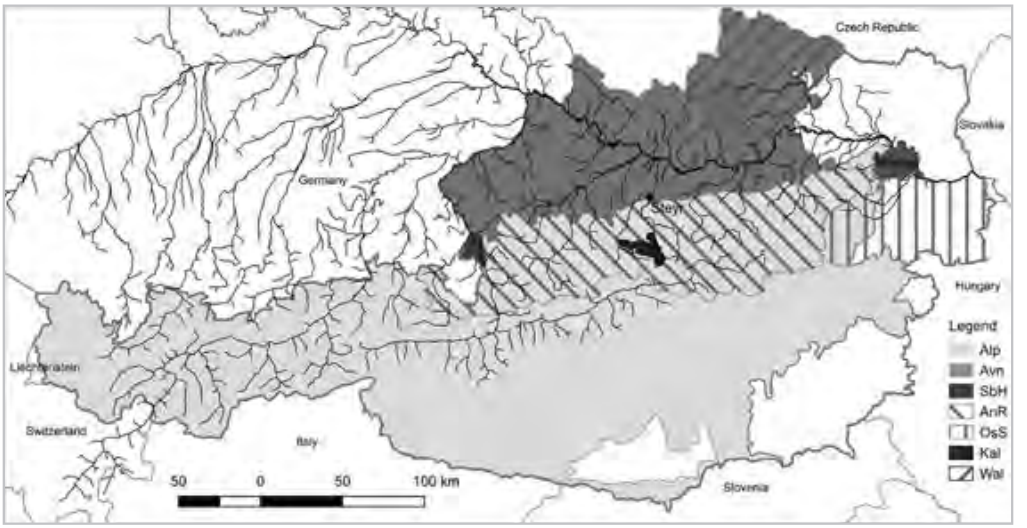

Figure 2: A map of Austria depicting the location of Vienna, the Danube River and its network of tributaries upstream of Vienna, and areas represented by the master chronologies described in Table 1.

Table 2: Site overlaps of Austrian master chronologies. Numbers in rows correspond to the percentage (%) to which a chronology contains the same sites as the chronologies listed in the column heading. Empty boxes indicate overlaps of 0 per cent.

	# sites*	AlpAA	AlpPA	AvnAA	AvnPA	SbHAA	SbHPA	AnrAA	AnrPA	OsSAA	OsSPA	KalAA	KalPA	WalAA	WalPA
AlpAA	102	100						52		2.9		29			
AlpPA	256		100		1				22		1		11		
AvnAA	138			100				12						11	
AvnPA	164		1		100				7						6
SbHAA	49					100									
SbHPA	59						100								
AnrAA	71	75		23				100				41			
AnrPA	78		73		15				100				33		
OsSAA	42	7								100					
OsSPA	20		10								100				
KalAA	35	86						83				100			
KalPA	40		70						65				100		
WalAA	85			18										100	
WalPA	80		1		13										100

*# sites number of sites covered by the chronology

The spatial overlaps of the Austrian chronologies can also be accounted for by the percentage of shared sites (see Table 2). The SbH chronology is the only one completely independent of all other chronologies.

2.5. Dendro-provenancing

Dendro-provenancing has been defined as a 'sub-discipline within dendrochronology with the aim of determining where the wood found in constructions or artefacts originally came from (i.e. where the trees grew)'.[17] It first became popular with the dating of a Viking ship from Roskilde, Denmark, using an Irish oak chronology to 1042,[18] which was later applied to dating panel paintings and musical instruments.[19] The 'basic principle of dendro-provenancing is that the master chronology providing the best match will be, to a certain extent, an indicator for the provenance of the timber (the higher the statistical values providing the match, the more likely that the wood being researched originates from the area represented by the chronology)'[20].

The dated samples from Vienna were cross-dated with the master chronologies listed in Table 1 using TSAP–Win™ 4.64. Results fulfilling the following criteria were considered to be significant: a minimum overlap between the sample and the chronology of 50 years, a *gleichläufigkeit*[21] of at least 60 per cent, and *t*-values of 4.0 and higher. The chronology with the highest Cross-Date Index (CDI) value[22] indicated the likely region of

17 Dominguez-Delmas, M., Benders, J.F., Kortekaas, G.L.G.A. 'Timber supply in Groningen (northeast Netherlands) during the early modern period (16th–17th centuries)', in Fraiture, P. (ed.), *Tree Rings, Art, Archaeology, Proceedings of an international Conference,* (Royal Institute for Cultural Heritage Brussels, 2011), pp. 151–165.

18 Daly, A. *Timber, Trade and Tree-Rings: A dendrochronological analysis of structural oak timber in North Europe, AD 1000 to AD 1650*, (PhD thesis, University of Southern Denmark, 2007).

19 Bridge, M. 'Locating the origins of wood resources: a review of dendroprovenancing', *Journal of Archaeological Science* **39** (2012): 2828–2834.

20 Dominguez-Delmas, M., Benders, J.F., Kortekaas, G.L.G.A. 'Timber supply in Groningen (northeast Netherlands) during the early modern period (16th–17th centuries)', in Fraiture, P. (ed.), *Tree Rings, Art, Archaeology, Proceedings of an international Conference,* (Royal Institute for Cultural Heritage Brussels, 2011), pp. 151–165.

21 Kaennel, M., Schweingruber F.H. *Multilingual Glossary of Dendrochronology. Terms and Definitions in English, German, French, Spanish, Italian, Portugues, and Russian*, (Berne: Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf / Paul Haupt Publishers, 1995).

22 Rinn, F. *TSAP-Win™ Time Series Analysis and Presentation for Dendrochronology and*

origin of the sample. We tested the provenancing results of the Hofburg subset to determine whether cross-dates between samples contradict the initial provenancing based on existing chronologies, that is, if samples from different regions of origin show a cross-match with a higher CDI than with their regional chronology. When interpreting the results, one has to bear in mind that the Austrian chronologies are not strictly separated in terms of geography or data. Table 2 lists the percentage of sites that are part of more than one chronology.

The results are evaluated stratified by two tree species (spruce and fir) and five construction periods (see Table 3), and separately for the Hofburg subset. Additionally, provenancing results for each building are analysed in order to test the hypothesis that timber sold on the Viennese market was not classified by origin.

2.6. An Estimation of the Number of Trees in Viennese Roof Trusses

The roof trusses in Vienna's city centre are very well documented as a result of decades of work by architectural historians, which was recently condensed into the 'roof cadastre',[23] an inventory of the first district's roof structures that gives their age, construction type, and frequency or rareness; many of them are also dendrochronologically dated. The inventory includes 677 structures within the borders of the ancient city walls (the old town) built in five historical periods before 1918 (Table 3).

For a rough estimate on how many trees were 'imported' to Vienna from the forests along the Danube and its tributaries to build the inner city's roofs, we first chose 11 representative examples covering the time span from the Gothic period to the *Gründerzeit* (Table 3). The length (running metres [lfm]) of all wooden roof-construction elements of one primary rafter truss plus its corresponding (paired) common rafters and longitudinal elements were added and then divided by the area they cover. The resulting figures were then extrapolated to calculate the amount of wood used to build the roofs located in the approximately 106-hectare built-up area within the boundaries of the ancient city walls. Today, in Vienna's centre, comprising the

Related Applications. Version 4.64 for Microsoft Windows. User Reference, (Heidelberg: Rinntech, 2011).

23 Liebich, H.A. 'Dächer als Quelle zur Bauforschung. Die Datierung von Wiener Dachwerken', *Österreichische Zeitschrift für Kunst und Denkmalpflege* **VXXII** (1/2) (2018): 79–87.

Table 3: *Buildings classified by period of origin in Vienna's old town. Data source: Vienna roof cadastre.*[24]

Phase	**Time span** [years AD]		Preserved objects	Examples	Dendro date*	Type
	From	To				
Gothic	1246	1529	10	Malterserkirche	1312	sacral
				Hofburgkapelle	1421	sacral
				Michaelerkirche	1525	sacral
Renaissance	1529	1648	25	Franziskanerkirche	1548	sacral
				Dominikanerkirche	1629	sacral
Baroque	1648	1780	144	Schottenkirche	1985	sacral
				Tuchlauben	1712	secular
				Seilerstätte	1762	secular
Classicism	1780	1848	138	Seitenstettengasse	1826	secular
				Michaelerplatz	1845	secular
Gründerzeit	1848	1918	360	Schubertring	1860	secular

* dendro date: dendrochronologically determined date, i.e., the last year the tree was standing in the forest; timber was normally used for construction one to four years after this date.[25]

287-hectare first district, 142 hectares (almost 50 per cent) are built upon.[26] This is an underestimation of the percentage of the building area in the old town, where the building density is much higher today, which can be clearly seen in any map of Vienna. Nevertheless, this figure can also be taken as a minimum estimate for former times, as old maps and paintings suggest that the old town has been densely populated since the Middle Ages.[27] To estimate the number of trees used to construct roofs, we used the length of a *Schachadillenfloß*, defined in the Codex Austriacus 1689 'as a raft originating in Steyr and transporting 15 logs of silver fir spanning a length of 8.5 to

24 Grabner, M., Buchinger, G., Jeitler, M. 'Stories about building history told by wooden elements – case studies form Eastern Austria', *International Journal of Architectural Heritage* **12** (2) (2018): 178–194.

25 Liebich, H.A. 'Dächer als Quelle zur Bauforschung. Die Datierung von Wiener Dachwerken', *Österreichische Zeitschrift für Kunst und Denkmalpflege* **VXXII** (1/2) (2018): 79–87.

26 https://www.wien.gv.at/statistik/pdf/bezirke-im-fokus-1.pdf, p. 9.

27 Ca. 1470 view of the city in the background of 'Flucht nach Aegypten' at *Schottenaltar*, Vienna; 1493, view of the city by Wolgemut and Pleydenwurff; city maps: Wolmuet, 1547; Hirschvogel, 1557; Suttinger, 1684; Steinhausen, 1710.

9 *Klafter* [=16.12 to 17.07 metres]'[28] to determine the usable log length of a harvestable tree. Although we are aware of limits and drawbacks of using this approach, which we discuss below, it still helps us make an educated guess about how much timber was used in Vienna.

3. Results and discussion

3.1. Provenancing

Of the 1,421 samples (spruce: 906, fir: 515) from 91 buildings, 779, or 54.8 per cent, could be assigned to a region of origin by the provenancing method described above (Table 4). The ratio of provenanced spruce trees is 44.2 per cent (400 trees) compared to 73.6 per cent for fir (379 trees). Although it may seem that fir delivers better provenancing results than spruce, for fir, on average four (with a span from 1 to 14) significant provenancing results were produced by the provenancing procedure described above, while for spruce, only three significant results (1 to 13) were obtained on average. This means that the results for fir are on average less unambiguous than the results for spruce, that is, spruce trees can be assigned to a single region of origin with a higher degree of confidence.

Figure 3A displays the provenancing results for the complete dataset. On the whole, the largest portion of wood, 23.6 per cent, was provenanced by the Salzburg-Hallein chronology (SbH) representing the catchment of the Salzach River, closely followed by the much larger region of the Northern Alpine Forelands (Avn), which produced 23.4 per cent of the samples. Of the 32 Gothic-period samples, 40 per cent originated in the Northern Alpine Forelands. The 66 Renaissance-era samples came mostly from the Northern Alpine Forelands and the Northern Limestone Alps (Anr), which each accounted for 22.7 per cent; it should be noted that these sites overlap with foreland and Alpine sites (Table 2). Many Baroque buildings have been preserved in Vienna's inner city. Of the 425 samples from this era, 24.2 per cent have been provenanced to the Northern Alpine Forelands and more than 20 per cent to the Salzach catchment. The importance of the Salzach watershed as a region of origin for construction wood peaked during the Classicist period, when it provided 36.9 per cent of samples, whereas in the

28 Grabner, M., Wächter, E., Jeitler, M. 'Historic transport of logs and timber in Austria – and how to trace back their origin', in Štih, P., Zwitter, Ž. (eds.), *Man, Nature and Environment between the Norther Adriatic and the Eastern Alps in Premodern Times*, (Ljubljana University Press, Faculty of Arts, Historical Association of Slovenia, 2014), pp. 352–361.

Gründerzeit period (only 71 samples) the proportion of wood from northern Burgenland and the *Thermenlinie* (represented by the OsS chronology) was higher than in any other era, but still lower than the 31 per cent of wood from the Northern Alpine Forelands.

Table 4: *Numbers and percentages of dendrochronologically dated samples assigned to a region of origin by dendro-provenancing.*

	Samples	Samples with provenance assigned	
		#	%
Complete dataset (1142–1895)	1421	779	54.8
fir	515	379	73.6
spruce	906	400	44.2
Hofburg	228	142	62.3
Gothic (1257–1523)	59	32	54.2
fir	38	25	65.8
spruce	21	7	33.3
Hofburg	14	8	57.1
Renaissance (1532–1648)	121	66	54.5
fir	57	39	68.4
spruce	64	27	42.2
Hofburg	24	14	58.3
Baroque (1649–1780)	722	425	58.9
fir	257	199	77.4
spruce	465	226	48.6
Hofburg	115	79	68.7
Classicism (1781–1848)	379	176	46.4
fir	110	76	69.1
spruce	269	100	37.2
Hofburg	65	34	52.3
Gründerzeit (1849–95)	122	71	58.2
fir	43	32	74.4
spruce	79	39	49.4
Hofburg	10	7	70.0

The provenancing results of the fir subset (Fig. 3B) closely resemble those of the entire dataset (Fig. 3A). In all periods studied, the greatest amount of fir came from the Alps (Alp chronology). Otherwise, the changes in provenancing results of the entire dataset and the fir subset over time are similar.

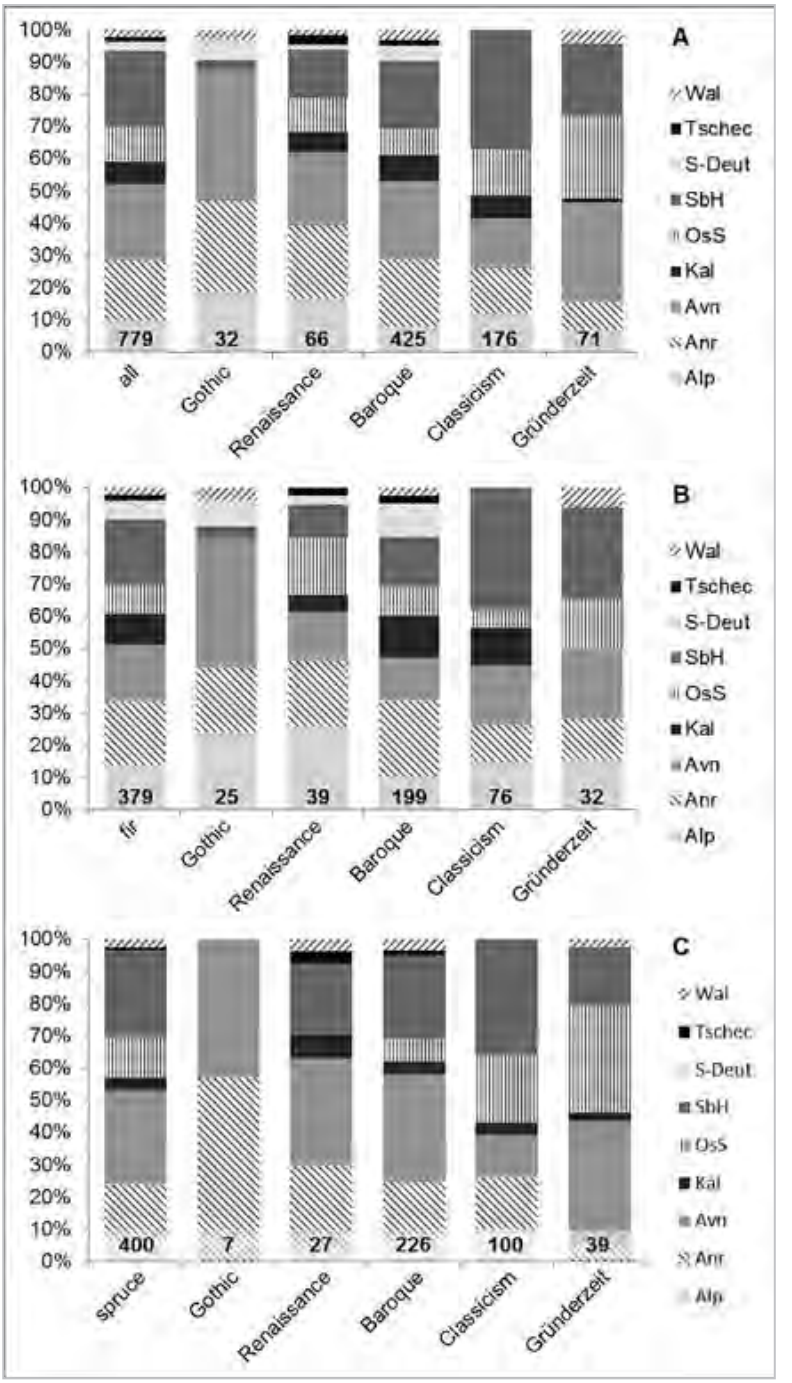

Figure 3: Provenancing results for timber contained in roof trusses in Vienna's city centre for the complete dataset (panel A) and separately for fir (B) and spruce (C). For the timeframes of each historic period, see Table 3. Shading and hatching correspond to the regions depicted in Figure 2. The numbers at the bottom of the bars represent the number of provenanced samples for each period.

For spruce (Fig. 3C), we determined fewer regions of wood origin, which indicates a spatial difference between spruce and fir.

No significant findings were made that would indicate that spruce was imported from Germany. Though, the potential area of origin belonging to Germany is not as well represented with chronologies as the area within Austria. Surprising was the fact that the percentage of Alpine spruce is comparably small.

As dendroprovenancing is giving hints on the area of origin, the obtained results should be interpreted in a wider geographical context. The background of dendrochronology and therefore of dendroprovenancing is the climate. For the most part of the catchment area of the Danube the climate is not differing much (except for temperature due to altitudinal changes). One exception is the "far east" – the Weinviertel region, were the climate is characterized by drought. Due to the results we already obtained a differentiation between "far west" (mainly the catchment area in Germany, up to the river Salzach), "west" (from the river Salzach to the east – including the Northern Alpine Forelands (Avn) and the Northern Limestone Alps (Anr)) and "east" (mainly represented by OsS – the area south-east of Vienna). The origin of timber of the Hofburg mentioned in archives – the Steyr-region is within "west" (Avn and Anr).

The reasons why the regions of origin do contribute in different amounts during different building phases are manifold. The political situation, toll, overexploitation, high need of wood close to the sites (for mining, etc.) could be attributed to such changes. This will be part of upcoming inter-disciplinary projects.

Based on these results, we can infer that the sources of timber used for construction in Vienna changed over time. Our analysis, which was conducted at the scale of individual buildings, indicates that wood was not sold assorted by origin, and supports the observation that rafts were tied together or reassembled on their way to Vienna. For 86 of the 91 analysed buildings, the provenances of more than one construction element could be determined by the method described above. In 83 of these 86 cases, individual timber elements could be assigned to at least two different regions of origin.

3.2. Hofburg

Our dendro-provenancing analysis of the Hofburg data subset indicates that the distribution of regions of timber origin closely corresponds to the that of the complete dataset of Vienna's city centre (Fig. 4); thus, the Hofburg

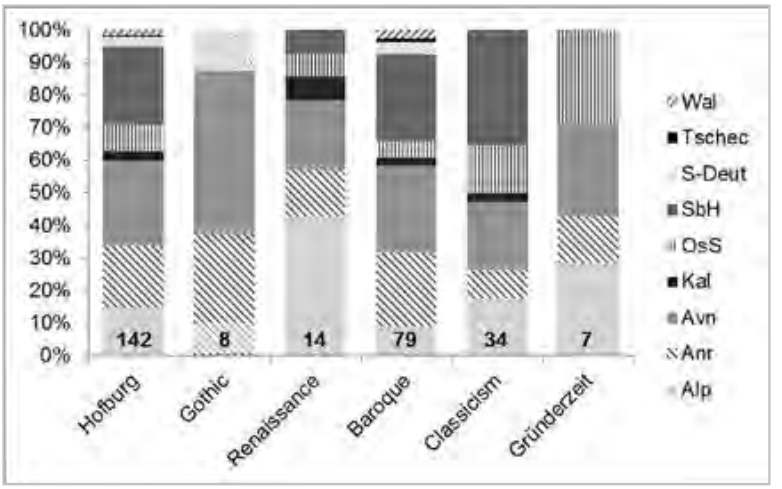

Figure 4: *Provenancing results for timber contained in roof trusses at the Hofburg, Vienna's imperial palace. For the timeframes of each historic period, see Table 3. Shading and hatching correspond to the regions depicted in Figure 2. The numbers at the bottom of the bars represent the number of provenanced samples for each period.*

subset is representative of Vienna's city centre. The most striking difference is that on average the dendro-provenancing of Hofburg samples was more successful than that of other analysed buildings as a whole (Tab. 4). This fact can be attributed to the higher percentage of fir used at the Hofburg (almost 50 per cent compared to 36 per cent in the complete dataset).

We also tested the provenancing results of the Hofburg subset to determine whether cross-dates between samples contradict the initial provenancing based on existing chronologies, that is, if samples from different regions of origin show a cross-match with a higher CDI than with their regional chronology. This was the case for only 12 of the 142 provenanced samples (less than 9 per cent), and therefore it seems as if the provenancing procedure is relatively reliable.

According to Grabner et al.,[29] materials stored in archives in Vienna and Steyr indicate that in 1616 the court of Vienna sent a request for construction timber to the seigneury of Steyr, who responded by stating that 27 rafts (*Schachadillenflöße*) accounting for 405 logs would leave for Vienna as soon

29 Grabner, M., Wächter, E., Jeitler, M. 'Historic transport of logs and timber in Austria – and how to trace back their origin', in Štih, P., Zwitter, Ž. (eds.), *Man, Nature and Environment between the Norther Adriatic and the Eastern Alps in Premodern Times*, (Ljubljana University Press, Faculty of Arts, Historical Association of Slovenia, 2014), pp. 352–361.

as the wood was acquired from merchants. In 1691, 80 *Schachadillenflöße* were ordered for ceilings and two roof constructions (the equivalent of 1,200 logs). Steyr (Fig. 2) is situated at the confluence of the Enns and Steyr Rivers, whose catchments cross the Northern Limestone Alps (Anr) and the Kalkalpen National Park (Kal) and also extend into the Alpine area (Alp). These requests for construction timber for the Hofburg were made in the late Renaissance and the Baroque period, when these three regions of origin account for more than 85 per cent (Renaissance) and over 60 per cent (Baroque) of the dendro-provenancing results. Additionally, provenancing results indicate that the Salzach catchment (represented by SbH) was an important source region of construction wood for the Hofburg.

3.3. An Estimation of Timber Demand

The demand for timber to construct roofs in Vienna's centre varied greatly over time (Fig. 5). In our model area, the highest amount of wood per square metre can be found in the Gothic Hofburgkapelle (9.94 running metres) and the early-Renaissance Franziskanerkirche (9.31 running metres). Later roof constructions used less wood. During the Baroque period the amount of timber used to build roofs was relatively constant at between four to five running metres per square metre. In the first half of the nineteenth century, the general lack of wood due to the exploitation of Austrian forests for the production of charcoal for iron production, rapid population growth, and the expansion of agricultural land at the expense of forest boosted wood prices[30] and also led to the enactment of the first Austrian Forest Act of 1 January 1853. This seems to be reflected in the roofs of Vienna, too.

The presented method for calculating the wood needed for a single roof truss and comparing changes over the centuries has some weaknesses: Taking into account one principal rafter truss plus its corresponding (paired) common rafters probably underestimates the amount of wood needed because this approach implies that simple saddleback roofs were used to cover entire buildings and does not take into account corners, dormers, or any other elements complicating the roof structure. Another issue impeding the comparability of individual roofs over the centuries is the distance roofs have to span. Wood demand does not increase linearly with span because

30 Wessely, J. *Die Österreichischen Alpenländer und ihre Forste: Zweiter Theil. Forststatistik der Österreichischen Kronländer: Kärnten, Krain, Salzburg, Steiermark, Tirol und Vorarlberg*, (Vienna: Wilhelm Braumüller, 1853).

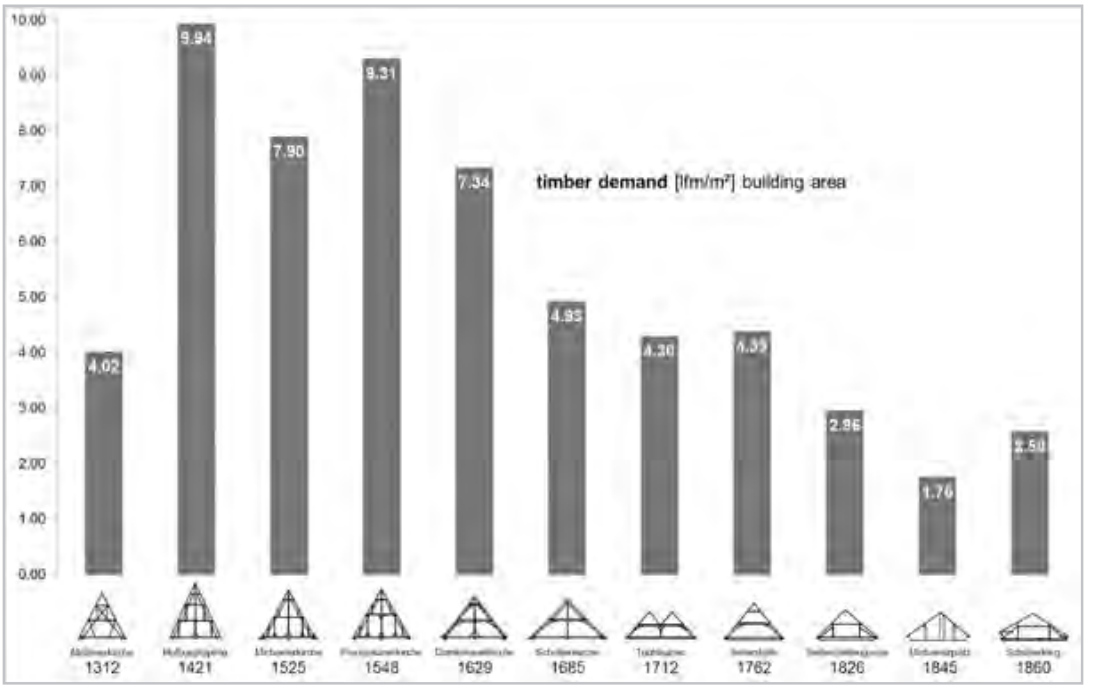

Figure 5: Timber demand (lfm/m²) for roof constructions of 11 examples representing the architectural history of the city centre of Vienna. The cross-sections of the roofs are all drawn to the same scale for comparability.

of different roof slopes and construction methods. We tried to avoid this problem by choosing roofs with comparable spans of 11 to 15 metres, but still the numbers are not fully comparable.

Next, we extrapolated these data to estimate how many trees were needed to erect the roofs of Vienna's old town. Ideally, a detailed GIS analysis of the whole area should be conducted to calculate the percentage of buildings from every architectural period preserved until today. Although such a study is far beyond the scope of our current research, it would make for an interesting future project. But even if we applied this method, we would not be able to satisfactorily determine the number of trees needed to build the roofs in the historical city centre because we would have to take into account all the roofs ever built, including ones that have been demolished, destroyed by war and fire, or replaced as additional storeys were added. It would only be able to provide a snapshot of the current situation. Therefore, to determine the number of trees that would have to have been theoretically felled to top Vienna's entire old town with roofs similar to the ones we studied, we calculated the average lfm/m² for each historical period, multiplied it by the area of the old

town and a conservative estimate of the percentage of building area in the old town, and divided the result by the maximum length of logs contained in a *Schachadillenfloß* raft (see equation and Table 5).

Using this method, we calculated that Classicism-era roofs required at least 72 hectares of forest and Renaissance-era ones, 255 hectares (Table 5).

These theoretical results impressively demonstrate that the approximate 52-hectare total roof area of Vienna's old town required timber from a much greater area of forest, which ranged from about 1.5 times larger to 5 times larger, depending on the period.

Table 5: *Extrapolations of the average number of trees needed to build the roofs in Vienna's historical city centre in five historical periods (Table 3)*

Historical phase	**Average timber demand** [lfm/m²]	# trees	Hectares of forest*
Gothic	7.29	223,470	223
Renaissance	8.33	255,314	255
Baroque	4.54	139,234	139
Classicism	2.36	72,377	72
Gründerzeit	2.58	79,124	79

* Based on an estimation of 1,017 trees per hectare of forested area in Austria.[31] This column gives the forest area needed for growing the number of trees in the column to the left.

Perhaps the most telling result presented in Table 5 is the estimate of the timber demand for Baroque roofs, because the largest percentage of the old town's preserved roofs (more than 21 per cent) are Baroque. Unlike the Gothic and Renaissance subsets, the Baroque subset is more representative because it contains many secular buildings. However, we can speculate that roof constructions of non-church buildings from the fourteenth through sixteenth centuries were less elaborate than those of churches during this time. To top 50 per cent of the area of Vienna's old town with Baroque roofs, 139,000 trees, or 139 hectares of forest, would have been needed. As this figure does not take into account any other wooden construction elements, such as ceilings, scaffolding, formworks, and floors, the actual forest area to sustain the building industry in Baroque Vienna must have been much greater.

Next to building material there was a high demand on wood for burning material. Here we have to include much more then wood for heating, i.e.

31 http://www.proholz.at/zuschnitt/51/der-oesterreichische-wald/.

production of bricks, bakery, beer brewing. It is almost impossible to get responsible data for the demand of fuel wood for the city of Vienna – due to some reasons explained below. But, Keeß (1823)[32] for example calculated the demand for fuel wood for the city of Vienna at 814.000 cubic meter (240.000 klafter) at the beginning of the 19th century. Neweklowsy (1964)[33] estimated the volume consumed in 1840 to be 1.3 to 1.7 million cubic meters. This decreased in 1870 to 470.000 to 540.000 cubic meters. The reason for the decline was the higher amount of coal burned and a more economical use of wood as a burning material.

It is almost impossible to calculate the necessary forest area, as burning material mainly consisted of branches, crooked logs and other assortments. Not the whole amount of burning material was brought by the Danube: people picked up branches, etc. at the close forest and big amounts of fire wood were flood from the mountains west of Vienna with the help of the small rivers (for example the Anzbach). The boats bringing salt from Ebensee to Vienna were dismantled and used as burning material[34]. Big amounts of fire wood were brought by boats as well as rafts on the Danube. This is for example described for the Waldviertel region[35].

4. Summary and perspectives

In this study we attempted to answer the question of where the trees for Vienna's old-town roofs grew by means of dendro-provenancing. On the whole, most of the wood was provenanced to the Salzach River catchment (23.6 per cent), closely followed by the much greater region of the Northern Alpine Forelands (23.4 per cent), although there were significant changes

32 Keeß, S. *Beschreibung der Fabrikate welche in den Fabriken, Manufakturen und Gewerben des Österreichischen Kaiserstaates erzeugt werden. Zweiter Band.* (Vienna: Anton Straß, 1823)

33 Neweklowsky, E. *Die Schiffahrt und Flößerei im Raume der oberen Donau. 3. Band.* (Linz: Oberösterreichischer Landesverlag, 1964).

34 Meißinger, O. *Die historische Donauschifffahrt. Holzschiffe und Flöße. 2. Auflage.* (Melk: Schriftenreihe des Schiffahrtsmuseums Spitz a.d. Donau, 1990); Neweklowsky, E. *Die Schifffahrt und Flößerei im Raume der oberen Donau. 1. Band.* (Linz: OÖ Landesverlag, 1952); Sarrazin, J., Van Holk, A. *Schopper und Zillen. Eine Einführung in den traditionellen Holzschiffbau im Gebiet der deutschen Donau.* (Hamburg: Kabel – Schriften des Deutschen Schifffahrtsmuseums, Bd. 38; 1996).

35 Buchinger, G., Grabner, M. (ed.), *Wald-Holz-Viertel. Historische Holzkonstruktionen vom 12. Jahrhundert bis in die Frühmoderne.* (Horn: Schriftenreihe des Waldviertler Heimatbundes Band 57, 2017)

over time. The Hofburg data subset produced similar results. Our method proved to be reliable because there was only a small percentage (< 9 per cent) of inconsistencies. We verified the hypothesis that timber was not sold assorted by origin for building projects.

The question of how many trees or how much forest area was needed to erect the roofs of Vienna's old town could not be answered because collecting the necessary data would require a separate research project, but with the approach presented here, we detected a general trend towards more moderate constructions over the course of time—with the caveat that for the Gothic and Renaissance eras only church roofs were investigated, which may not be representative of coeval secular buildings, and that the early nineteenth century was marked by a general lack of wood.

This study, like many others before it, clearly demonstrates that all research revolving around wood and history is situated at the intersection between the natural sciences and the humanities with valuable contributions from many disciplines. To refine the overall picture of timber trade along the Danube and to assess the origin of Vienna's construction wood in more detail in the future, it will be necessary to push the limits of accuracy and precision of dendro-provenancing as well as to intensify interdisciplinary collaboration in order to link the question of origin and timber demand.

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