



Forest History—New Perspectives for an Old Discipline

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The scientific field of forest history studies the development of woodlands and their interrelationship with past human societies. During the last decades, the subject has experienced a constant decrease of importance, reflected in the loss of representation in most universities. After 200 years of existence, an insufficient theoretical basis and the prevalence of bibliographical and institutional studies on post-medieval periods have isolated the field and hindered interdisciplinary exchange. Here we present possible new perspectives, proposing wider methodological, chronological, thematic, and geographical areas of focus. This paper summarizes the development of the field over time and recommends content enhancement, providing a specific example of application from Roman France. Furthermore, we introduce a topical definition of forest history. Following the lead of other fields of the humanities and environmental sciences focussing on the past, forest history has to adapt to using other available archives in addition to historical written sources. In particular, historical and archeological timber as well as pollen are essential sources for the study of past forests. Research into forest history can substantially add to our understanding of relevant issues like societal responses to climate change and resource scarcity in the past and contribute to future scenarios of sustainability.

Keywords: forest history, dendroarcheology, environmental history, interdisciplinary research, historical wood utilization

INTRODUCTION

After the Last Glacial Maximum (~21 ky ago) and from the start of the Holocene (ca. 11.7 ky ago; **Figure 1A**), forests recolonized large parts of Europe (**Figure 1**; Giesecke et al., 2017; Marquer et al., 2017). Forests provided the basis for the development of civilizations and have remained a key factor for human societies until today (Küster, 1998, 2010). Throughout the Holocene, forests had to serve multiple purposes for human societies, providing food and raw material, particularly wood, for construction and tools. Furthermore, wood was one of the most important sources of energy for domestic and productive processes until the nineteenth century (Schmidt, 2009; Mosandl et al., 2010). Growing human impact on natural forests evolved with the development of sedentism (Dow and Reed, 2015) and agriculture (Bogucki, 1996; Pryor, 2003; Dow et al., 2005; Pinhasi et al., 2005), when human societies started reaching out for wood resources, settlement areas and farmland. In Europe, this process started during the Early Neolithic period, around 6000 BCE, associated with the Starčevo culture in south-eastern Europe and the Cardial culture in the

Mediterranean (Gyulai, 2007; Shennan, 2018) and expanded to areas north of the Alps during the 6th millennium BCE, manifested in the Linear Pottery culture (Tegel et al., 2012; Lipson et al., 2017). The anthropogenic influence has been shaping cultural landscapes ever since (Bradshaw, 2004; Krzywinski et al., 2009; Mercuri et al., 2015).

The invention of metallurgy, most importantly of bronze, starting in Eurasia during the 5th millennium BCE (Radivojević et al., 2013) and iron, developed around 2000 BCE in Anatolia (Souckova-Siegelová, 2001; Akanuma, 2008) and spread to large parts of Eurasia during the early 1st millennium BCE (Pigott, 1999), significantly increasing the demand for wood for charcoal production. The exploitation of woodland resources by human societies has reshaped environments, and vice versa, as environmental conditions have had impacts on economies and societies (Ljungqvist et al., 2021). Woodland areas were cleared in times of prosperity and partially recolonized by forests during times of decline following detrimental climatic or demographic developments (Chew, 2001; Küster, 2010; Ljungqvist et al., 2018). Therefore, forest and human history are strongly interconnected. Over time, human impact intensified with growing populations, reaching a first peak in large parts of Europe during the High Medieval Period (ca. 1000–1300 CE) (Bartlett, 1993). In the following centuries, deforestation increased in large areas due to building activity and the development of proto-industrial sectors, e.g., glass and charcoal production, mining and smelting. Rising economic concerns over wood supplies, beginning in the 18th century, led to the development of modern forestry (Schmidt, 1998, 2002, cf. Hölzl, 2010; Radkau, 2012).

Traditionally, studies of forest history work mainly with historical records and focus on the last few centuries (e.g., Franz, 2020), which is a strong limitation to the most recent periods of human history (Figure 1C). In this paper, we address the potential of dendroarcheological analyses as a source for forest history studies and furthermore, discuss possible interdisciplinary concepts. The combination of (dendro) archeological and palynological data enhances our understanding of demographic changes, settlement dynamics and general vegetation history, providing a wider temporal scope for future studies of forest history.

DEVELOPMENT OF THE FIELD

In Europe, interest in the historical development of forests began with the progression of forest sciences, primarily in Germany, during the eighteenth and nineteenth centuries. Consequently, early forest history studies were predominantly published in German-speaking countries (e.g., Stisser, 1737; Walther, 1816; Behlen, 1831; Pfeil, 1839; Bernhardt, 1872, 1874, 1875; Roth, 1879; Meister, 1883; Schwappach, 1886; Seidenstricker, 1886), but also in France (Baudrillart, 1824) and Italy (Di Bérgegener, 1859). The Anglo-American research advanced with the foundation of the Forest History Society (FHS) in 1946 (originally: Forest Products History Foundation, cf. Anderson, 2018).

The forester and conservationist Felix von Hornstein suggested a theoretical and methodological separation

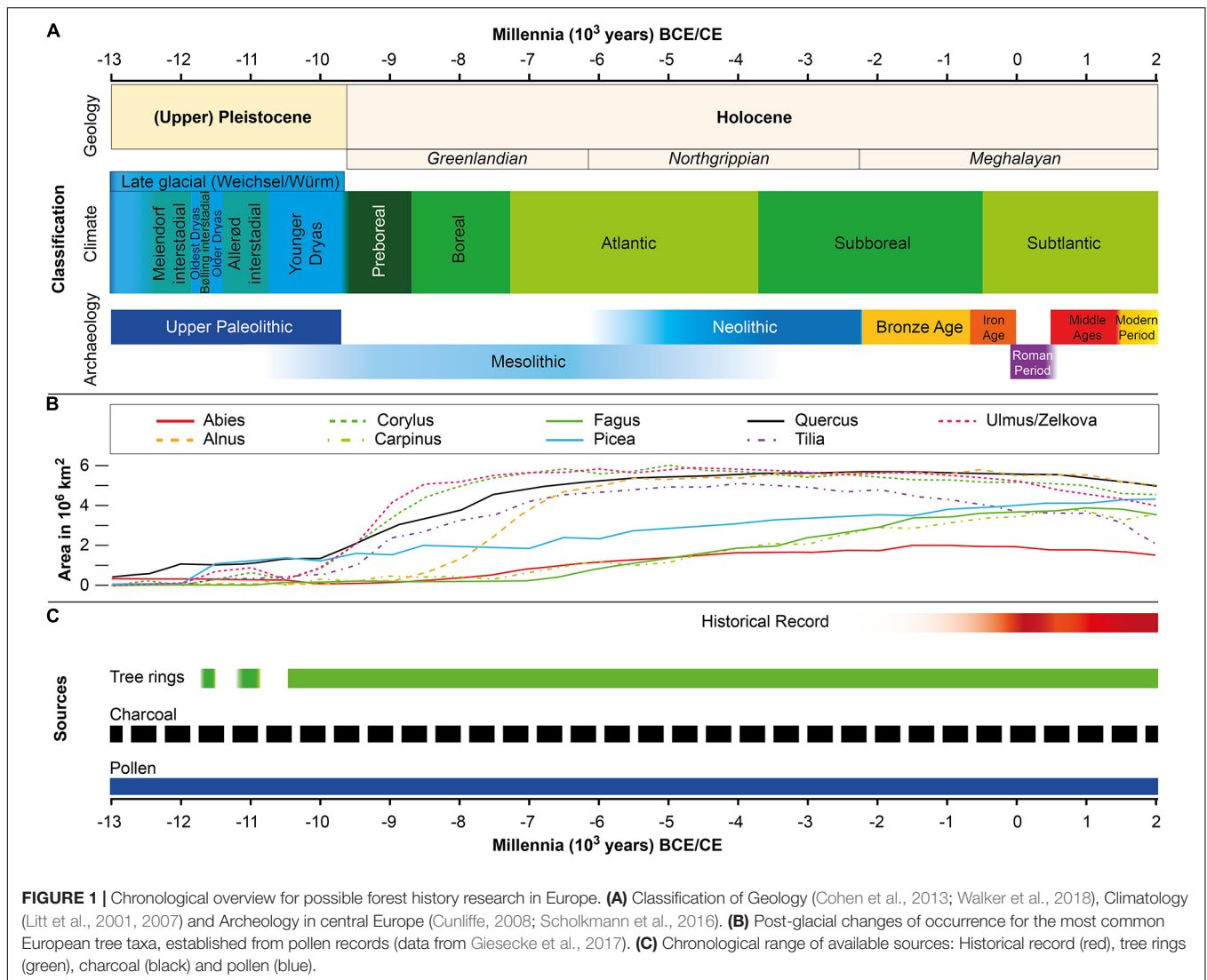
between the history of forestry (German: “Forstgeschichte”) and the history of human-nature relationships (German: “Waldgeschichte”) (von Hornstein, 1951). The International Union of Forest Research Organizations (IUFRO) Forest History Group, formed in the early 1960s, provided different definitions for the concepts of forest history *sensu stricto*, i.e., the history of forestry, and *sensu lato*, i.e., a synthesis with the history of (natural) forests and human impact (IUFRO, 1973). The forest scientist Kurt Mantel (1990) excluded pre-historic periods from forest history (German: “Forstgeschichte”), whereas Karl Hasel defined it as the study of the changing relationship between forests and human societies over centuries and millennia, yet distinguishing it from history of natural forests (German: “Waldgeschichte”), which is mainly studied with palynological methods (Hasel and Schwartz, 2006).

These definitions of forest history are contradictory, regarding methodological and chronological aspects. As they were all published in German, they were not adopted by the international research community. In the German-speaking countries, however, an increasing separation took place from the 1950s between studies on pre-historic forests (cf. German: “Waldgeschichte”), performed by experts of vegetation history (Firbas, 1949, 1952; von Hornstein, 1951, 1958; Lang, 1994), and historic forests (cf. German: “Forstgeschichte”), studied by historians (Hilf, 1938; Hausrath, 1982; Mantel, 1990). Vegetation history progressed to a modern field of science, including Holocene human impacts (e.g., Berglund, 2003; Marquer et al., 2017; Roberts et al., 2018), whereas “Forstgeschichte” mostly remained within the limits of historiography (e.g., Franz, 2020, cf. Furay and Salevouris, 2017).

Outside Germany, forest history obtained new impetus in the late 1970s and 1980s when it became the interest of geographers and ecologists (e.g., Bertrand, 1975; Rackham, 1976). A first international congress of forest history was held in 1979 in Nancy, France (Schuler, 1982). In 1981 the “Groupe d’Histoire des Forêts Françaises” was founded and, in the following years, aimed for a multidisciplinary approach, combining historical, anthropological and sociological research with ecological and economic aspects (Corvol-Dessert, 2003).

Until the end of the twentieth century, various studies on forest history have been published, analyzing written and iconographic sources and mostly emphasizing on late to post-medieval periods (e.g., Kuonen, 1993; Schmidt, 1998, cf. Rubner, 2002). Earlier periods and millennia-long developments, however, have mainly been the topic of archeological and environmental science studies (Bennett et al., 1990; Bradshaw and Mitchell, 1999; Vera, 2000; Behre, 2002; Bradshaw et al., 2003; Kramer et al., 2003; Rackham, 2003; Whitehouse and Smith, 2004; Lindbladh et al., 2013; Stephens et al., 2019).

At the turn of the millennium, several authors critically addressed the position of traditional forest history and provided suggestions for a new orientation in the twenty-first century, e.g., the adaption of methodological innovations from cultural history research, social sciences, historical ecology, the inclusion of natural sciences or a shift toward a general environmental history (Seling, 1998; Agnoletti, 2000, 2006; Schmidt, 2000; Bürgi et al., 2001; Hürlimann, 2003; Johann, 2006). Several new national



publications have come out in recent years (e.g., Agnoletti, 2018; Bonan, 2019; Gallé and Quérue, 2019; Huth, 2019; Franz, 2020). International publications on the field have been issued in different journals by the FHS, i.e., “Forest History” (1957–1974), the “Journal of Forest History” (1975–1989), and “Forest and Conservation History” (1990–1995), before merging with the journal “Environmental History Review”, published by the American Society of Environmental History, in 1996 (Rothman, 1996). Since then, the quarterly journal “Environmental History” has been co-published.¹ Alongside, the FHS has published the monthly magazine “Forest History Today” since 1995.

Nevertheless, the loss of representation of the scientific field in most universities or their integration into institutes of forest policy, especially in the German speaking countries, reflect a constant decrease in the importance of traditional forest history during the last decades (Johann, 2006). Recent advances of environmental history research and particularly

dendroarcheological and palynological studies, call for fundamental reconsiderations of theories and methods of traditional forest history.

A TOPICAL DEFINITION OF “FOREST HISTORY”

As demonstrated above, previous definitions of forest history are contradictory and need further consideration. The Food and Agriculture Organization of the United Nations (FAO) defines land areas larger than 0.5 ha with more than 10% crown cover of trees, which are higher than 5 m as “forests” (FAO, 1999). Some traditionally managed or treeline stands might not fulfill the FAO criteria for forests but can still be research subjects of forest history. Hence, a topical definition for the field must consider all types of woodlands.

Therefore, we propose a general definition for the field of forest history as “the investigation of past woodlands and past

¹<https://environmentalhistory.net>

human-woodland-interaction,” combining research into both natural forests and anthropogenic influences.

Our new definition aims at the inclusion of methods from archeological and environmental sciences (Figure 2). Furthermore, it repeals the temporal limitations of earlier definitions. A prevailing focus on the Holocene is acknowledged, as significant human impact on forests is restricted to the post-glacial period (Figure 1A). However, some sedentary societies had developed long before the invention of agriculture, influencing their local environment more strongly than mobile groups (Dow and Reed, 2015; Arranz-Otaegui et al., 2016; Alenius et al., 2020). Accordingly, the new definition is deliberately not restricted to the Holocene.

READING FOREST HISTORY FROM DENDROARCHEOLOGICAL SOURCES

A case study from Roman Gaul illustrates the potential of dendroarcheology for forest history research: The city of *Divodurum (Mediomatricorum)*, today's Metz in north-eastern France, was one of the largest cities in Roman Gaul with about 40,000 inhabitants (Vigneron, 1986). Archeological excavations on Boulevard Paixhans in 1995 discovered the remains of wooden Roman quay structures (Rohmer, 1996, 1999). Dendrochronological analyses of 53 oak piles specified the structures' age and allowed the distinction of four construction phases between 119 and 249 CE (Figure 3A; Rohmer and Tegel, 1999). The oldest phase (g 1) exclusively used split wood for the piles felled in 119 CE, whereas roundwood was utilized during the other phases (g 2–g 4), dating between 164 and 249 CE. The trees used as piles of the youngest construction phase were approximately 70 years old, while the trees from older phases show different age distribution, mostly between 80 and 120, with some individuals up to more than 170 years. The temporal proximity of the felling dates for construction g 3 and the initial growth onset of trees from g 4 suggests the successive use of a nearby woodland (Figure 3).

All piles were anatomically identified as oak (*Quercus* spp.) and when synchronized, generate a mean chronology of 346 years (Rohmer and Tegel, 1999), permitting the reconstruction of several stages of work processes and at the same time, the local forest history between 97 BCE and 249 CE:

(1) A local oak dominated uneven-aged broadleaf or mixed forest had been growing during the first century BCE until it was cut in 119 CE for the initial construction phase of a pile row (g 1). As the old-grown trees provided large stem diameters, the timber was split radially, i.e., along the rays, to obtain smaller piles.

(2) Roughly 50 years later, two more rows of piles were assembled (g 2 and g 3). Higher annual growth rates indicate less dense forest stand conditions (Figure 3C). The distribution of felling dates between 164 and 177 CE suggest a decreasing availability of local timber resources (cf. Hughes, 1994).

(3) After the harvest, a coppice-like forest of even-aged oak shoots was growing from the older stools, probably reaching a dense stocking after 20–30 years, as indicated by a visible decrease of annual growth rates (Figure 3C). These were felled

after approximately 70 years in 249 CE to provide timber for the last construction phase (g 4).

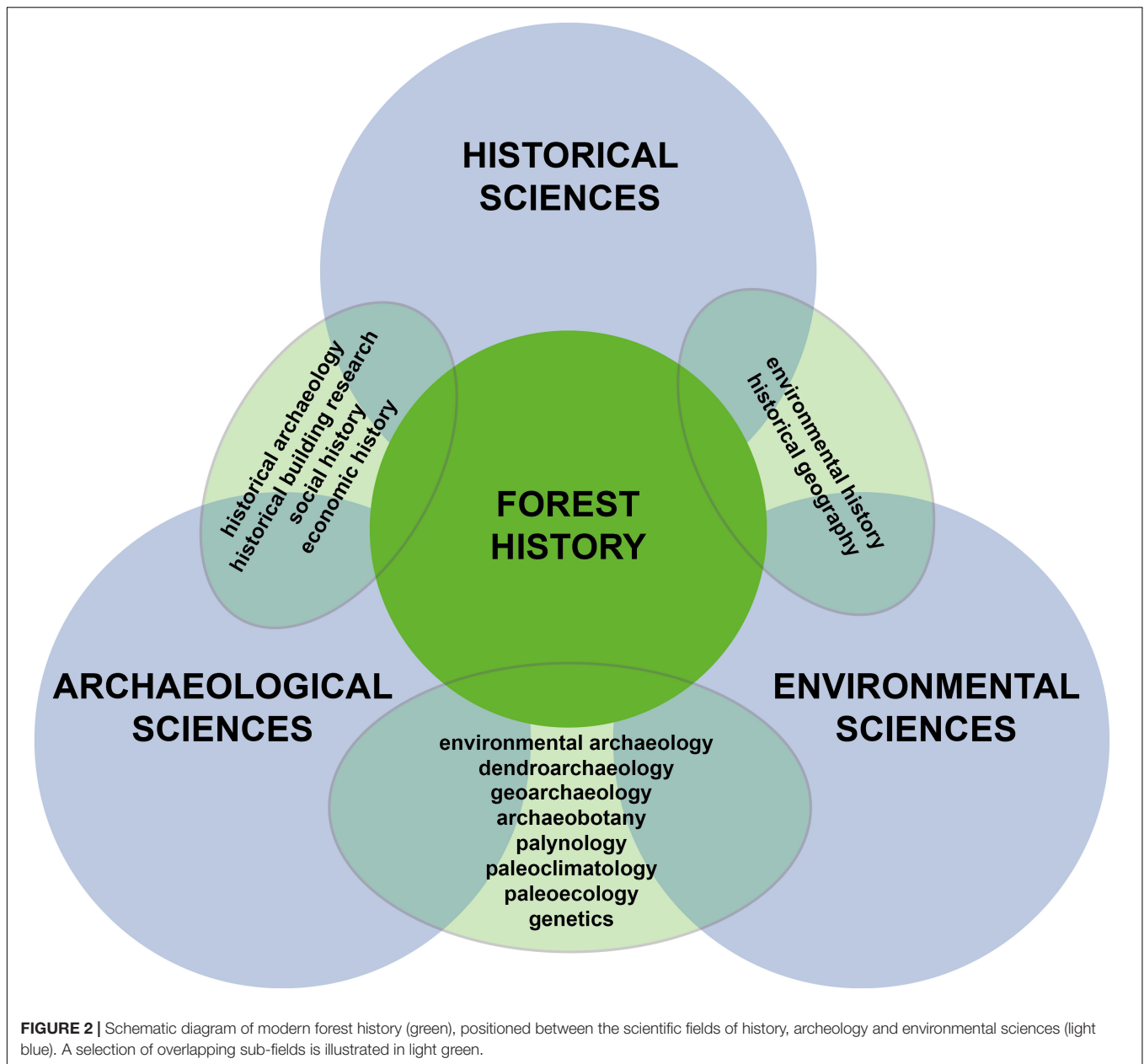
Characteristic growth patterns in the studied oak samples of phase g 2 and g 3 during the mid-second century CE, identified cyclic cockchafer (*Melolontha melolontha* L.) outbreaks in 152, 155, 158, and 161 CE (Figure 3B) and provide evidence for the local preponderance of open vegetation (arable land, pasture meadows, orchards), as these insects require such vegetation for their 3–4-year larva stadium (Huiting et al., 2006; Švestka, 2010; Kolář et al., 2013; Billamboz, 2014a). The constantly large proportion of open vegetation, also displayed in local pollen records (Brkojewitsch et al., 2013), indicates a limited amount of local woodland area in Roman times and thus, further supports the model of successive exploitation of consecutive forest generations originating from the same nearby forest area (Rohmer and Tegel, 1999).

DISCUSSION

The short case study demonstrates the possibility to obtain precise information on forest structure and management in the past without the use of written sources and displays the advantage of preventive archeology (Laurelut et al., 2014). Furthermore, it shows the potential of gaining knowledge on forest history from a combination of dendrochronological, archeological, wood anatomical and ecological aspects. As afforestation was not practiced by Roman authorities, except for some sacred districts (Nenninger, 2001), we need to consider a shortage of wood supply in the vicinity of Metz in the mid-second century. For *Carnuntum*, a roman city of comparable size to *Divodurum* in today's Austria (Neubauer et al., 2012), 15,5 ha of forest area were required for the fuelwood for one winter heating season (Lehar, 2017), not including fuelwood for year-round domestic use (e.g., cooking) and production processes (e.g., glass, pottery, metallurgy, lime burning), timber production and other woodworking.

Local to supra-regional shortages of woodland resources occasionally appeared throughout human history and led to different consequences from the abandonment of settlements to shifts in socio-economical strategies. The last severe concerns over supra-regional wood supplies in Europe led to the foundation of forest institutes and the development of forest sciences and modern forestry in the eighteenth and nineteenth centuries (Schmidt, 1998, 2002; Hölzl, 2010). The recent decline of forest history, mentioned above, must be considered in view of a general decline of forest sciences within the last decades (Oesten and von Detten, 2006).

Following the newly formulated definition, forest history is closely connected with environmental history as well as historical ecology and historical geography, when dealing with woodlands and woodland products. Various methods allow for the investigation of past woodlands and human-woodland interactions, for example dendroarcheology, palynology or genetics (Herbig, 2006; Gugerli and Sperisen, 2010; Lindbladh et al., 2013; Billamboz, 2013, 2014b, Marquer et al., 2017; Roberts et al., 2018; Wagner et al., 2018; Dominguez-Delmás, 2020).



Other disciplines, such as paleoclimatology, paleoecology, archeology or archeobotany, have developed various data archives (Figure 1C), and successfully compared multiple proxy data to obtain new information (e.g., Jacomet, 2013; Lindbladh et al., 2013; Kimiaie and McCorriston, 2014; Tegel et al., 2020). These archives allow scholars to study the history of past woodlands across the Holocene and beyond, providing essential information to overcome temporal limitations in forest history (e.g., Jahns et al., 2019).

However, previous forest history studies have mostly worked with historical methods and are therefore restricted to periods with evolved textuality (e.g., Bamford, 1956; Appuhn, 2010). It is indispensable for future research to extend the temporal focus by consulting wood itself as a primary source for

forest history. The investigation of current vegetation can provide important information on former woodland structures. Living trees in old-growth forests can reach back several centuries to the past (e.g., Martin-Benito et al., 2020). Vast amounts of construction timber from past centuries are preserved in historical buildings, providing information for the last millennium (e.g., Hoffsummer and Mayer, 2002; Seiller et al., 2014; Haneca et al., 2020). Under waterlogged conditions, wooden constructions and objects are preserved for millennia (e.g., Tegel et al., 2012; Rybníček et al., 2020). Archeological excavations constantly unearth wooden structures from past epochs and provide new insights into woodlands in prehistoric times (Billamboz, 2003; Čufar et al., 2015; Tegel and Vanmoerkerke, 2016). Combined approaches hold valuable

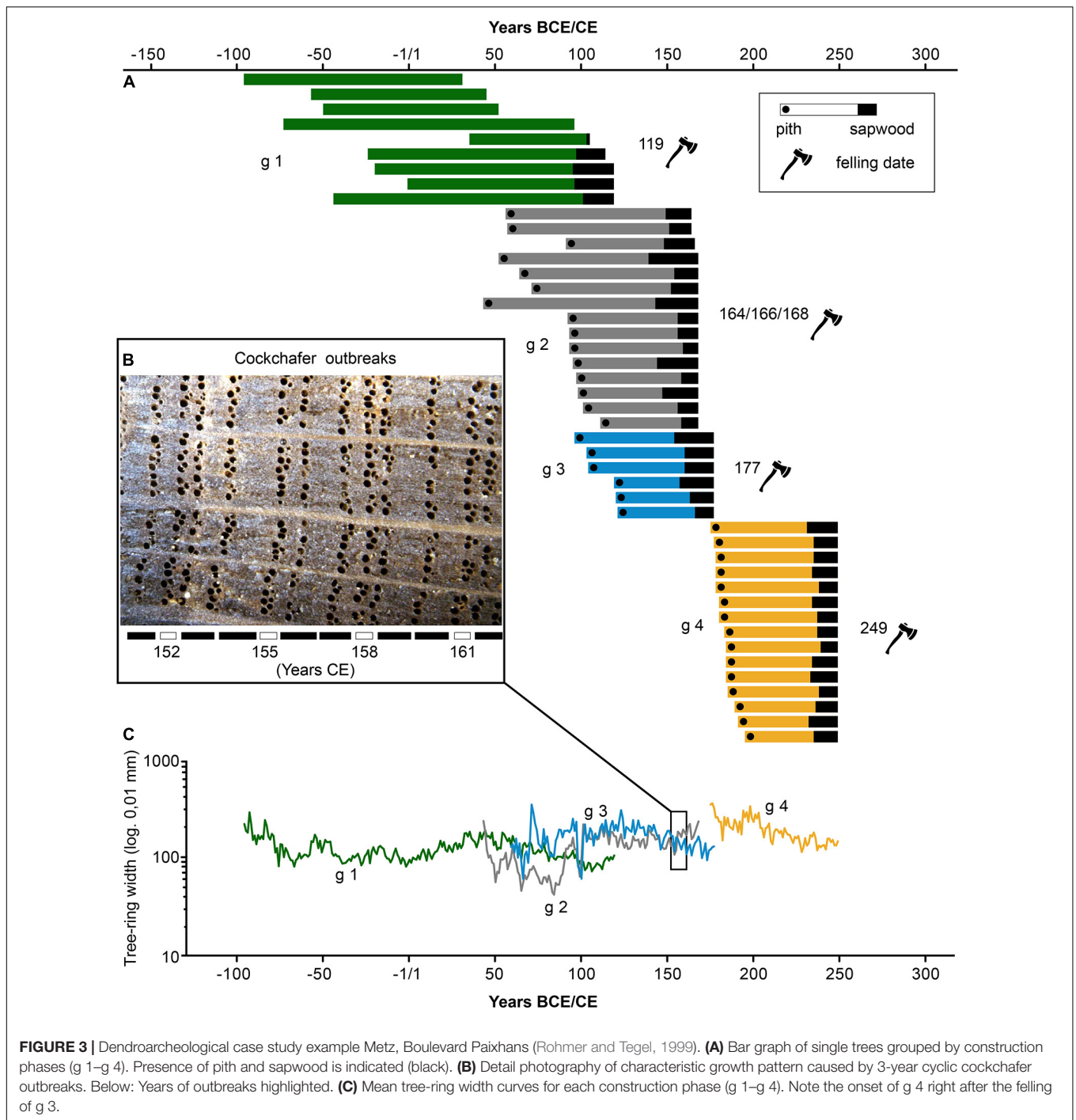


FIGURE 3 | Dendroarcheological case study example Metz, Boulevard Paixhans (Rohmer and Tegel, 1999). **(A)** Bar graph of single trees grouped by construction phases (g 1–g 4). Presence of pith and sapwood is indicated (black). **(B)** Detail photograph of characteristic growth pattern caused by 3-year cyclic cockchafer outbreaks. Below: Years of outbreaks highlighted. **(C)** Mean tree-ring width curves for each construction phase (g 1–g 4). Note the onset of g 4 right after the felling of g 3.

sources for forest history studies (e.g., Jamrichová et al., 2013; McGrath et al., 2015).

The field of dendrochronology offers millennia-long and annually resolved data yielding extensive information on forest composition, structure and possible management as well as anthropogenic species selection, felling activities, timber transport, wood technology and climate (e.g., Kuniholm, 2001; Baillie, 2002; Briffa and Matthews, 2002; Tegel and Vanmoerkerke, 2014; Tegel et al., 2016; Billamboz et al., 2017;

Ljungqvist et al., 2018; Haneca et al., 2020; Muigg et al., 2020). Age/diameter models, also suitable for young individuals with few tree rings, might contribute additional information on forest management (Out et al., 2018). Palynological studies provide vast amounts of data for previous forest vegetation and innovative models for spatio-temporal landscape development on local to supra-regional scales (Waller et al., 2012; Lindbladh et al., 2013; Marquer et al., 2017; Roberts et al., 2018). Archeobotany and anthracology can contribute specific evidence for resource

management strategies by comparing on-site and off-site pollen, charcoal and macrofossil data (Jacomet, 2013; Kabukcu and Chabal, 2020). Recent advances in ancient plant DNA research hold great potential for reconstructing the dynamics of reforestation and species distribution (Wagner et al., 2018).

A general geographical scope for the field of forest history must include all areas with woodland vegetation as well as regions where forest products have been imported by humans (e.g., Hellmann et al., 2013, 2015; Shumilov et al., 2020). Despite earlier attempts for an international approach (Johann, 2006) and occasional studies from Asia (e.g., Liu and Cui, 2002; Sheppard et al., 2004) and Africa (e.g., Stahle et al., 1999; Campbell et al., 2017), the current field of forest history has a strong focus on Europe (e.g., Smith and Whitehouse, 2010; Eckstein et al., 2011; Novák et al., 2019; Wiezik et al., 2020) and North America (e.g., Mackovjak, 2010; Anderson, 2018; Gajewski et al., 2019). Considering that only 14% of today's global forest lie within temperate zones and 61% of the world's primary forests are located outside this area (FAO, 2020), a global perspective should generally be the aim of future forest history research.

CONCLUSION

In the last decades, several disciplines from the fields of humanities have adapted and opened up to novel methodological concepts and research designs, leading to new interdisciplinary sub-fields like “environmental archeology” (Branch, 2015; O'Connor, 2019) or “environmental history” (Simmons, 1993, 2008; Hoffmann, 2014). Other fields have traditionally used a combined historical approach, e.g., “historical ecology” (Crumley, 1994; Balée, 1998, 2006; Bürgi and Gimmi, 2007) and “historical geography” (Baker, 2003; Schenk, 2011; Haffke et al., 2011).

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Following their lead, the field of forest history will have to (i) open up to multilateral discussions with adjacent fields of both humanities (history, archeology) and sciences (paleoclimatology, paleoecology), (ii) approach research questions with a multidisciplinary spectrum of methods, (iii) position itself in the context of new research fields, e.g., environmental history, and (iv) integrate itself into the wider research context of paleoenvironmental sciences, following the concept of consilience (Wilson, 1998; McCormick, 2011; Izdebski et al., 2016).

DATA AVAILABILITY STATEMENT

Datasets are available on request.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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