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Archaeobotany – a tool to explore the past

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Abstract

Archaeobotanical research, based on plant remains found from archaeological sites, is among the fundamental tools to study long-term interactions between humans and nature. Plant remains (i.e. plant finds) are as important as any other archaeological finds, as they reflect the past human activities and can be studied from diverse perspectives and with diverse methods. Archaeobotanical finds performs a unique and fragile part of our ancient heritage. They are prone to deterioration in the soil but also when stored in the collections; therefore, they need to be studied for the future before important information of past vegetation is lost. Archaeobotanical remains preserved at archaeological sites provide invaluable evidence for investigating past populations, their subsistence strategies, agricultural practices and environment. Moreover, through the paleo-archives formed in the soil it is possible to explore history of Finland's changing vegetation, climate and biodiversity resulting from the human impact on nature. Also, archaeobotanical finds can give answers to future demands of resilient plant-based food production.

Keywords: Archaeobotany, biodiversity, environment, paleo-archive, plant-based food.

33.1 Introduction

People have changed the environment, influenced biodiversity, and utilized vegetation throughout the history. One of the largest changes on landscape was the establishment of a symbiotic relationship between humans and crops. Transition from Mesolithic to Neolithic was a complex, long durée process from mobile hunting, fishing and gathering giving way to sedentary agricultural practices (e.g. Barker 2006). Human exploitation of nature accelerated with the intensification in farming practices that took place across large parts of Europe ca. 800 AD and ca. 1000 AD (Hamerow et al. 2020). Finally, the most crucial causes of change in the biodiversity in Europe have been the unprecedented increase in agricultural production from the 16th century onwards and the growing use of genetically modified crops since 1940s (e.g. Tscharntke et al. 2005).

Due to human activity, plant and animal species are disappearing at an accelerating rate (IPBES 2019). Safeguarding biodiversity is ranked high on the international policy agenda (Dietl & Flessa 2017). Effective action must be based on reliable predictions and evidence-based solutions (Dawson et al. 2011). Archaeological contexts (anthropogenic soils) form excellent paleo-archives in which organic materials i.e. bioarchaeological evidence – such as plant finds (e.g. grains, seeds, fruits, pollen, wood, bark, and plant fibres) – can be preserved in favourable conditions for thousands of years (e.g. Heidgen et al. 2020). These paleo-archives provide excellent long-term data also for biodiversity research (Hjelle et al. 2012). However, these archives are in danger of being destroyed. The rapid collapse of ecosystems has also been recognised as a significant crisis for archaeological heritage, due to the potential loss of unique organic materials (Brunning 2007). This fragile organic material is prone to deterioration and destruction caused by changes to the acidity, temperature and micro-organisms in the soil and during storage. Therefore, surviving archaeological plant finds and the data they contain should be studied systematically from the excavations. This (pre)historic information is vital to safeguarding our current natural resources and to addressing present and future ecological challenges. Therefore, the aim of this article is to present the possibilities, that archaeobotanical material may offer to e.g. to archaeological research as well as to ecological and biodiversity studies. In addition, the aim is to raise the awareness concerning the fragile nature of these archives i.e. archaeobotanical materials (Fig. 33.1).

33.2 Biodiversity loss in the past

The present plant species in Finland are quite well known, but ancient species have only been marginal subjects in research to date. Furthermore, the long-term impact of human activity on different plant species in Finland is not well understood (Suominen & Hämet-Ahti 1993). One reason for this is that most of Finland's earliest flora and fauna collections were destroyed in the Great Fire of Turku at 1827, and crucially therefore comparative research between contemporary and extinct species is ordinarily only conducted with specimens younger than 1827. Archaeological sites, their paleo-archives, provide valuable material to fill this gap. However, this resource could be exploited more extensively in Finland. In other words, the amount of soil samples for archaeobotanical studies from wider archaeological contexts and different sites in Finland could be taken and analysed. This would add the possibilities to scientifically relevant interpretations and statistical data. The amount of samples studied from a site is recommended to exceed 10 samples and preferably two samples from each studied context. However, this is not always possible due to the nature of the studied site or due to the financial reasons. Large-scale and systematic studies have been conducted e.g. from Turku (Lempiäinen 1989; Lempiäinen-Avci 2017; 2021), Espoo (Lempiäinen-Avci 2016), Mikkeli (Vanhanen 2012), Raasepori (Lempiäinen-Avci 2022, accepted; Vanhanen & Koivisto 2015), and Porvoo (Lempiäinen-Avci 2020). Since paleo-archives can provide information to many other disciplines, plant finds represent an endangered archaeological heritage that needs to be studied and even digitised for the future before this vital information is lost.

Archaeobotany, the research of archaeological plant finds, can provide information about past societies, their subsistence strategies, environmental settings as well as drivers in the loss of plant species and climate change (e.g. Hjelle et al. 2012). Moreover, interdisciplinary research in archaeobotany, paleoecology, paleoclimatology and paleogenomics has revealed the mechanisms that shaped cultures and biodiversity in the past and in the present (Fordham et al. 2020). Biodiversity loss in Finnish nature is already clearly visible in archaeobotanical material. For instance, water chestnut (*Trapa natans* L.) has become extinct in Finland since ca. 600 calBC due to the currently prevailing climate, overgrowing and acidification of lakes (Korhola & Tikkanen 1997). In addition, corncockle (*Agrostemma githago* L.) is frequently present in prehistoric and medieval archaeobotanical material, but is today lost in Finland, due to changes in farming methods during the beginning of 20th century (Hyvärinen et al. 2019).

In Finland, archaeology has a long tradition with pollen and plant macrofossils, having been studied since the 1970s (e.g. Vuorela 1970) combined with C14 AMS dating's. However, rather often plant finds and paleoecology have been considered of secondary importance within archaeology, their analyses being laborious and expensive. Therefore, integrated research concerning plant materials from Finnish archaeological sites has not been undertaken systematically and extensively as in other countries in Scandinavia and Europe. Furthermore, the fact that archaeobotanical data can shed light on past populations daily life, subsistence strategies and agricultural practices it can also provide answers to many wider archaeological questions e.g. concerning medicines, fuel sources, and feasting. Additionally, archaeobotanical data can be used to establish chronological contexts through AMS radiocarbon dating. For example, chronologically dated cereal grains identified to species level can reveal cultural changes and innovations in the past. However, far too often charcoal (without tree species identification) is dated instead of identified plant remains.

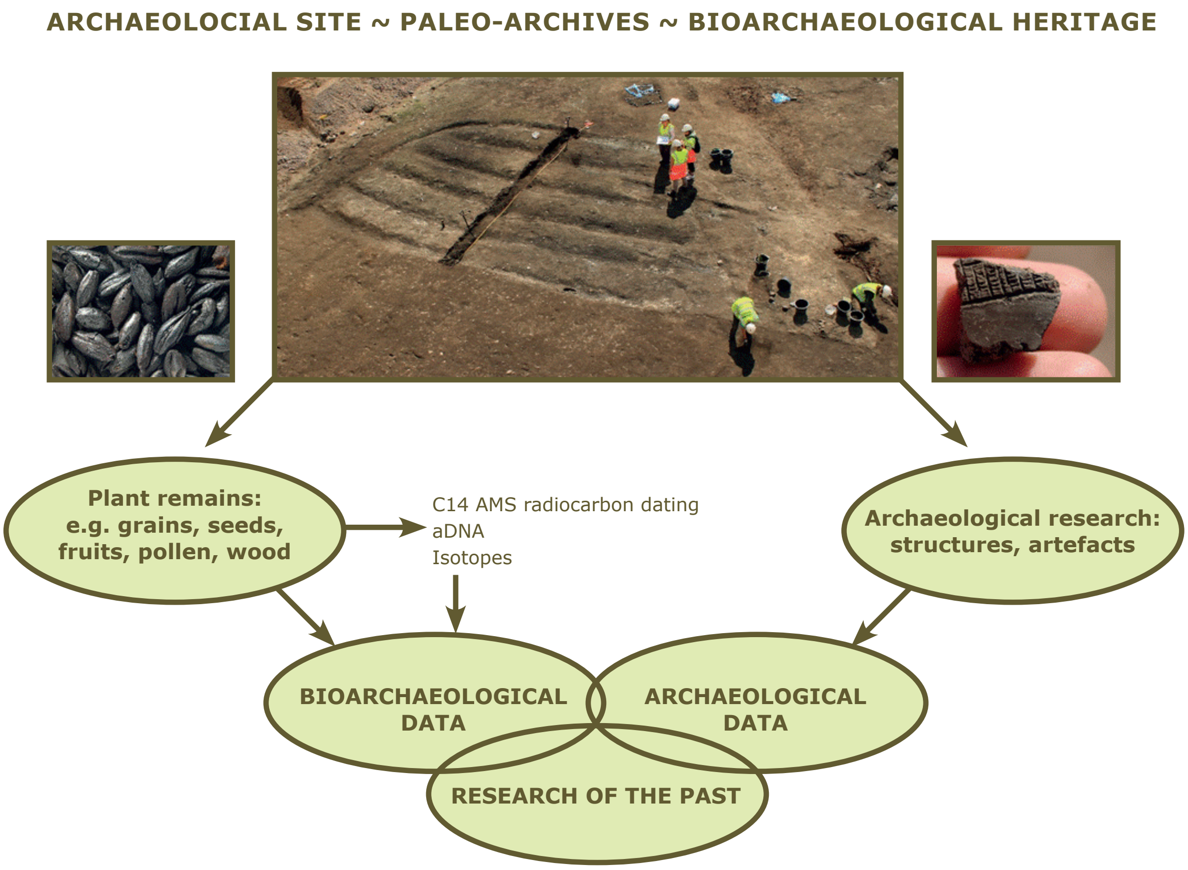

Figure 33.1. Archaeological sites, their paleo-archives, performs an invaluable part of our bioarchaeological heritage answering questions concerning e.g. long-term human-nature interactions, past societies, diet, cultivation, climate and vegetation. This information is vital – it can provide us information of the past and answers to future challenges. Additionally, plant finds provide valuable resources to many other disciplines such as C14 dating, isotope and genetic analysis. Photos: Excavations in 2013 at Lahti market place, Finland. Photo credit: Lahti City Museum. Charred barley grains and a piece of a ceramic found from archaeological context. Photo M. Lempiäinen-Avci.

33.3 Isotopes from plant finds

Today, research focusing on biological proxies of archaeological sites is increasing; the novel approaches being applied include a wide range of molecular studies. Besides species identifications and C14 AMS dating's recent archaeobotanical studies also use modern analyses, including aDNA and mtDNA conducted from the ancient plant materials (e.g. Alenius et al. 2017; Lempiäinen-Avci et al. 2020). Moreover, it would be interesting to combine archaeobotany and stable isotope analysis as this combination would most probably open new avenues to archaeological and archaeobotanical knowledge. In Finland, however, isotope analyses have not yet been undertaken from archaeological grains or seeds.

Stable nitrogen (δ15N) and carbon (δ13C) isotopic compositions in plant finds (grains) can indicate manuring used in cultivation (e.g. Mueller-Bieniek et al. 2019). The potential of applying isotope method is facilitated by the fact that plant material is commonly preserved in either carbonised or waterlogged form within the archaeological record and that historical grains are systematically collected by herbariums in Finland. Therefore, isotope data could add the knowledge concerning the burning questions how, when and why the agriculture developed and agricultural practices changed from the Neolithic to the Late Iron Age in Finland. It is also important to note, that as archaeobotanical and archaeological research progresses, the number of studies of environmental isotopic values is increasing and resulting excellent data from across Europe (e.g. Mueller-Bieniek et al. 2019; Styring et al. 2017).

33.4 Weeds – a resilient choice for food

Archaeobotany can contribute to current debates on climate change and influences of human actions by examining the plant migration, adaptation and resilience. It will also examine the drivers that led humans to innovations in cultivation and new ways of usage of economic plants in their changing subsistence strategies. Today, many plants are categorised as weeds because it is forgotten how they were used and utilized in the past and therefore they are not considered useful in modern societies. However, there is archaeobotanical and historical evidence that many plants have been gathered and eaten hundreds and thousands of years ago. Archaeobotany offers information about the plant species found from the archeological sites, while historical sources provide useful information how these plants would have been prepared for consumption. One of the most common plant identified from the archaeobotanical samples is fat hen (*Chenopodium album*), which is considered as a weed in fields and gardens. (Fig. 33.2) However, the seeds and leaves of this plant are edible. In historical

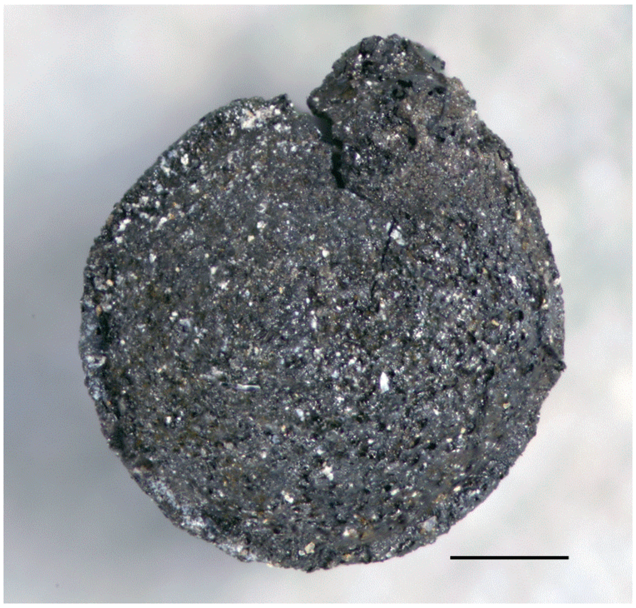

Figure 33.2. Charred and uncharred fat hen (Chenopodium album) seeds are often found from soils samples derived from archaeological sites. The seeds may indicate that fat hen was utilised in food preparation in the past. The photo shows a charred fat hen seed. The seed size is 1 mm. Photo M. Lempiäinen-Avci.

times during famines fat hen seeds were mixed with rye and baked into bread (Behre 2008) and eaten as leafy vegetable (Geraghty 1996). By looking archaeobotanical data and historical documents it is possible to find information about plants that were commonly used in the past.

As due to the climate change and biodiversity loss there will be predicted demand for food in the future. Therefore, new solutions of resilient and ecological ways of food production will be needed. Plant-based food will be a growing all over the world and most probably weeds – as we today consider certain plant groups – will be part of the answer in food production.

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