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Testing of the consistency of the sieving (wash-over) process of waterlogged sediments by multiple operators

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ABSTRACT

The sieving process has a considerable influence on the subsequently retrieved archaeobotanical data. As known from earlier work, the wash-over method is the most suitable method to extract plant macroremains from waterlogged sediments. This paper presents an experiment in which it was tested if different sievers using this method produced comparable results.

Some systematic differences between sievers were found in the larger fractions (≥2 mm), namely the varying presence of small remains. This problem can be avoided if detailed instructions are given to the sievers and guidelines for counting remains are used during analysis. In the small fraction (>0.35 mm), differences between sievers were not substantial anymore. In addition to differences caused by the sieving technique we could also show that the patchy pattern of clumpy waterlogged sediments complicates a statistically relevant subsampling. We can state that only large differences between samples should be interpreted in palaeoeconomic terms, but that it is no disadvantage if several sievers work on the same project.

It is our purpose to raise awareness of the fact that the methodology has a strong impact on the results obtained and should therefore always be revealed on a detailed level, especially if data from one site will later be used for comparisons with other sites.

1. Introduction

Waterlogged sediments allow the preservation of waterlogged (subfossil uncharred) plant remains, which would otherwise disappear from the archaeological record due to natural decay (e.g. Jacomet, 2013). Usually, plant remain densities are extremely high (over 10,000 remains per litre of sediment) and the diversity is considerable (on average over 40 taxa per sample; e.g. Hosch and Jacomet, 2004; Jacomet et al., 1989; Maier, 2001; Vandorpe and Jacomet, 2011). Nevertheless, these remains are fragile and can easily be damaged or lost if recovery methods are not appropriate. In order to recover plant macroremains from waterlogged sediments, several methods like wet-sieving, wash-over and flotation have been used (Kenward et al., 1980; Pearsall, 2000). Depending on the sieving method and the siever who processes the material, large differences in the botanical macroremain composition can arise (Hosch and Zibulski, 2003). But in large-scale projects or in situ sieving, if a large amount of sediment has to be processed within a restricted period of time, it is necessary to employ several sievers. In an experiment, Hosch and Zibulski (2003) compared samples of a Neolithic lake dwelling cultural layer wet-sieved by different operators and used an analysis of variance to identify the taxa which were influenced by the wet-sieving methods of the different sievers. They identified several taxa which were eliminated completely or partly if the wet-sieving process was too intensive. The wash-over technique, where organic material is gently separated from the inorganic, has proved to be a more appropriate method (Badham and Jones, 1985; Tolar et al., 2009; Zibulski, 2010). For this method (as described in Kenward et al., 1980 and slightly modified), the sediment is processed in portions in a small bucket or bowl. A moderate stream of water is applied and the bucket/bowl is swirled. The supernatant (consisting mainly of suspended organic remains and fine mud) is drained onto sieves of desired mesh sizes. Gentle stirring by hand can be applied if the sediment is hard to disaggregate even after pre-treatment by freezing and thawing (Vandorpe and Jacomet, 2007). This process is repeated until no further organic particles are carried off and only inorganic material and, occasionally, bones remain. Then the process is repeated for the next portion of sediment until the whole sample is processed. After packing the organic fraction, the collected inorganic fraction can be wet-sieved. For the wash-over method, the density of organic finds is greatly improved (eg. Badham and Jones, 1985), but the effect of different sievers has not yet been tested.

To fill this gap of knowledge, we designed an inter-siever-variability study, where different sievers treated subsamples of the same samples

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using the wash-over method in order to identify potential differences in the final archaeobotanical composition that could be due to the action of each operator. This work therefore aims to fill an essential gap in the methodological basis of archaeobotany. The results will be of importance for archaeobotanical research on wetland sites of all time periods.

2. Material & methods

Samples from the Neolithic lake dwelling site of Zürich–Parkhaus Opéra (Zürich, Switzerland), which was excavated during 2010 and 2011, were used in this experiment. The samples studied were taken from layer 13 (Horgen culture, dendrodated to c. 3160 BC, Bleicher personal communication). This so-called cultural layer consists of different sediment types (mostly organic sediments) of varying thickness (Fig. 1). Large-volume surface samples (5–7 l) were taken in a systematic way (for sampling of lakeshore settlements see Jacomet and Brombacher, 2005). Previous work has demonstrated that such large samples are needed in order to have a good representation of large-seeded items (e.g. Jacomet, 2013). Nevertheless, the sieving of such large volumes using a 0.35 mm mesh size would be extremely time-consuming and would produce considerable amounts of organic residues that cannot be investigated in everyday archaeobotanical work. Therefore, it was decided to take a small subsample (of 0.3 l) using the grid method (Veen van der and Fieller, 1982) to be sieved with a smaller mesh size (Fig. 2). As a result, the large subsample (3–5 l, called A-samples) was sieved only using sieves of 8 mm and 2 mm mesh sizes to recover a sufficient amount of remains of large-seeded taxa. The small subsample (called B-samples) was sieved at a later stage, using sieves of 2 mm and 0.35 mm mesh sizes. From previous work, it was known that the small-volume B-samples contained more than enough remains for reaching the required number of items in the small fraction (Hosch and Jacomet, 2001).

For the Parkhaus Opéra project, it was necessary to sieve around 450 samples within a span of 2 years. For this, several sievers were needed. Being aware of differences found in previous projects due to the inconsistency of sieving technique performed by different operators (Hosch and Zibulski, 2003; Zibulski, 2010), it was considered necessary to check whether the results obtained by all the sievers within our project were fully comparable. For this purpose, we split four samples into four A-subsamples, the so-called siever-A-samples (Fig. 2). In addition, we took three B-samples each from three other samples, the so-called siever-B-samples. For both we used the grid method (Veen van der and Fieller, 1982) (see the location of the samples on the site plan in Fig. 1). This method should ensure a random subsampling of the contents of the sample, making the two inter-siever-variability studies largely comparable (at least for the best-represented taxa). However, chances for producing subsamples with a diverse composition are relatively high, given that the nature of the cultural layers in waterlogged context is very patchy and the sediment is usually found in clumps, which cannot be disaggregated without damaging the contents before freezing, thawing and sieving. It is for this reason that another study was carried out, so as to observe the effects of subsampling in wet sediments and this will not be discussed in detail here.

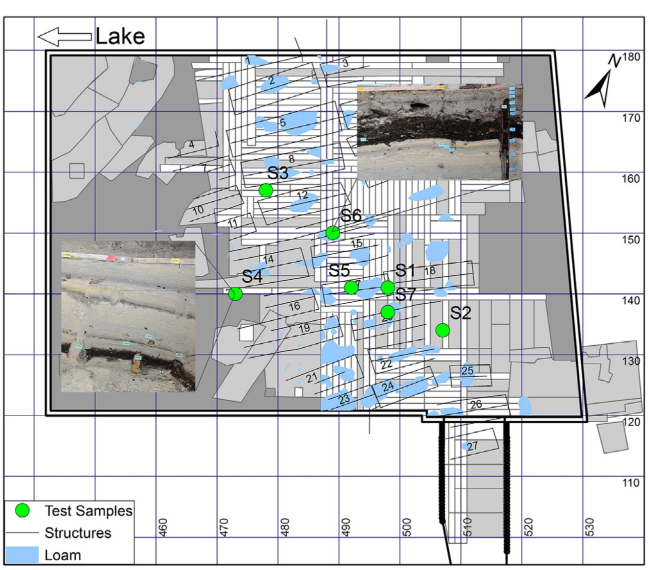

Fig. 1. Site plan of the lake dwelling site Parkhaus Opéra (Zürich, Switzerland) with the location of the examined samples and pictures showing two sections of the cultural layer in two different locations. (Picture credit to the Office for Urbanism, City of Zürich.)

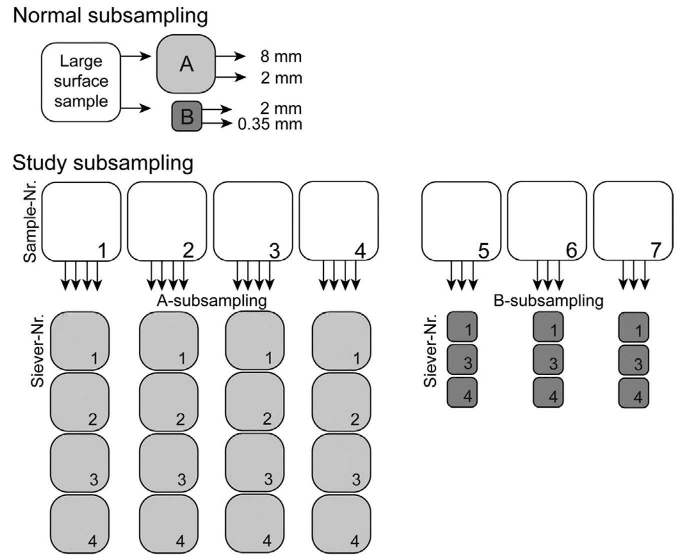

Fig. 2. Subsampling strategy used for the project in general and for this study.

Cultural layers at lakeshores contain different sediment types like strongly organic layers of different compositions, charcoal layers, loamy sediments etc. (see e.g. Ismail-Meyer et al., 2013; Jacomet et al., 1989). This was also the case for layer 13 of the Zürich-Parkhaus Opéra site (Fig. 1). Therefore sediment samples of different nature were chosen for this inter-siever-variability study. Siever-A- and siever-B-samples were not taken from the same samples because these two parts of the study were separated chronologically for reasons of practicality (feedback was given to the sievers after the first study with the siever-A-samples).

After a process of description of the composition of the sediment sampled and the subsampling of it, A- and B-samples were sieved using the wash-over technique combined with freezing and thawing as pre-treatment (Vandorpe and Jacomet, 2007) to facilitate the disintegration of the highly clumpy material. Four operators sieved one subsample of each of the four siever-A-samples and three operators sieved one subsample of each of the three siever-B-samples, all following the same precise instructions (besides a training session with one of the more experienced sievers, there were also written guidelines about how to handle obvious fragile materials, when to empty the sieves into bigger bowls so that there is no overflow, how to subsample the fractions etc.). The subsequent 2 mm-fraction of the A-samples and 0.35 mm-fraction of the B-samples were subsampled with the grid method in order to minimize the time needed for analysis. Then, in both cases, one or more subsamples were analysed in order to reach 384 items (per fraction), which is the amount of remains considered to give a reliable representation of the most important taxa in the right proportions and not targeting a maximum number of taxa (following Veen van der and Fieller, 1982, modified by Hosch and Jacomet,