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Degradation of the wetland sediment archive at Star Carr: An assessment of current palynological preservation

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ABSTRACT

This paper presents the results of an investigation into the preservation status of pollen and other microfossils in the organic sediments at the wetland Mesolithic site of Star Carr. This study assesses the degradation of the pollen record in a profile at the edge of the archaeological site, adjacent to previous pollen work carried out from 1989 to 1991 and using it as a benchmark for comparison. There has been a severe degradation of pollen grains since the earlier work, with the upper peat devoid of pollen and the lower part of the organic profile badly affected. Only the very basal sediments retain well preserved pollen. Comparisons with hydrological and geo-chemical data obtained by other workers during the assessment of the Star Carr site suggest that oxidation caused by drainage and dessication of the organic sediments, perhaps originating in fissures in the drying peat, is a primary cause of the observed severe deterioration of the pollen record. Non-pollen palynomorphs (primarily fungal and algal spores) appear to be better preserved than pollen in the present bio-stratigraphic record, showing little surface degeneration, but are not recorded in the earlier work. The pollen archive in organic sediments at the Star Carr site is now badly damaged. Any further pollen work there should be undertaken urgently but is probably not justifiable.

1. Introduction

It is now six decades since the publication of Grahame Clark's monograph on excavations at the early Mesolithic archaeological site of Star Carr in the eastern Vale of Pickering in North-East England (Clark, 1954). It was the location of the Mesolithic settlement that first drew Clark to the site, as it lay on the edge of an Early Holocene lake (Candy et al., 2015; Palmer et al., 2015), now termed Lake Flixton, and so promised to provide the palaeoenvironmental data that he needed for his research on Mesolithic economy and land use. The iconic status enjoyed by Star Carr since Clark's work, therefore, is due not only to the prolific flint assemblages (Conneller and Schadla-Hall, 2003; Conneller et al., 2009), but also to the remarkable preservation and diversity of organic material associated with the site, which extended into the wetland sediments (Milner et al., 2011a). The organic components of Early Mesolithic material culture, which do not survive on dry sites, were found in abundance and in an excellent state of preservation, stratified within the waterlogged organic deposits that accumulated in the palaeolake margin and in the reedswamp, fen and carr wetland habitats associated with it. This stratification has allowed the use of palaeobotanical analyses, including both macrofossil (Dark, 2004; Taylor, 2011) and pollen (Walker and Godwin, 1954; Cloutman and Smith, 1988; Dark, 1998a, 1998b, 1998c; Cummins, 2000), to reconstruct the vegetation history around the site, providing an environmental context for the settlement at Star Carr (Innes et al., 2011; Milner et al., 2013). This combination of preserved organic cultural remains and multi-disciplinary study has made Star Carr the 'type' site for the British early Mesolithic, and a model for subsequent studies in wetland archaeology (Milner et al., 2011a). Not only could questions of site function, economy and seasonality of occupation be addressed, but the deeper understanding of the activities carried out at Star Carr allowed the site to be the hub of conceptual models of early Mesolithic land use, territoriality and interactions with the wider landscape (Clark, 1972).

1.1. Condition of the sediments

The continued existence of the palaeoenvironmental archive at Star Carr, and the potential for further multi-disciplinary analyses there, depends upon the quality of preservation of the waterlogged sediments and organic remains. Excavations in the mid 1980s (Schadla-Hall, 1987; Schadla-Hall and Cloutman, 1985; Mellars and Dark, 1998), however, showed that organic preservation had deteriorated since Clark's work in 1950, and excavations since 2004 (Conneller, 2007; Milner

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et al., 2011b) have shown that the faunal and wood remains are now severely degraded. Drying, shrinkage and weathering of the peat has occurred and it is clear that modern land-use practices, particularly land drainage, have had an adverse effect on the hydrology and chemistry of the site and its environs (Brown et al., 2011), and therefore on the preservation of the organic material (Holden et al., 2006; Milner, 2007; Milner et al., 2011b). Installation of highly effective land drains in the last decade (Brown et al., 2011; Vorenhout, 2011) has accelerated this process, and the level of the peat surface has dropped considerably. Although the water level and the position of the edge of Lake Flixton fluctuated during the Early Mesolithic (Taylor, 2011), the edge remained a narrow zone and it is the deposits that formed in this lake-edge ecotone adjacent to the Mesolithic settlement (Dark, 1998a; Mellars, 1998) that today contain the archaeological organic remains. These shallow lake-edge peats are vulnerable to modern hydrological change, however, and are suffering the effects of drainage and falling watertable. The vulnerability of wetland archaeology to such damage is a problem at a national level, and many such sites and wetland landscapes are at risk (e.g. van de Noort et al., 2002; Brunning, 2013; Davis et al., 2015). At Star Carr, a national flagship site for wetland archaeology, the dessication of the organic sediments, and thus the degradation of the materials and information they contain, appears to have accelerated in the last decade, to the point where the archive of archaeological material is badly damaged (Milner et al., 2011b). Recent research at Star Carr, therefore, has concentrated on assessing the present condition of the organic sediments on and close to the archaeological site itself, to provide a benchmark to inform decisions regarding its future management and study (Emerick, 2011). Brown et al.'s (2011) work on the hydrology of the site and its catchment has shown that recent land drainage has been the cause of the dessication and oxidation of the peat causing chemical changes and promoting extreme sediment acidity. Boreham et al. (2011a, 2011b) performed a series of physical and geochemical analyses at the site that also showed severe acidification of the sediments due to lowered and fluctuating water tables. Oxidation and acidification have caused very serious and rapid decay of the antler, bone and wood remains (Milner et al., 2011a). In theory this very high acidity might not have such a severe effect upon pollen grain preservation, but watertable fluctuation, and associated peat dewatering, could well cause their corrosion (Lowe, 1982), and so the palynological record at Star Carr may be in as much danger as the rest of the organic material there. An assessment of current pollen preservation was therefore urgently required.

1.2. Previous palynological work

In this paper we present the results of an assessment of the current palynological status of the peat at Star Carr. We take as our benchmark the palynological analyses closest to the site itself (Day, 1993; Dark, 1998c) in the shallow lake margin peats adjacent to Clark's archaeological excavations (Fig. 1). Cloutman and Smith (1988) had earlier conducted pollen analyses on three profiles from a trench (VP85A) across the peat margin close to the site, and did not report any problems with poor pollen preservation. However, when Dark (1998c) performed more detailed pollen analyses from the same Trench (A), it was clear that the upper peats had been subject to drying and shrinkage. Dark (1998c) also noted a gradual deterioration of pollen and spore preservation with proximity to the surface, with well-preserved pollen being absent above 70 cm from the basal gravel. Dark (1998a) sampled at high resolution (approximately 2 to 4 year intervals) through the Mesolithic occupation phases, and identified phases of vegetation disturbance that coincided with increased microcharcoal percentages and also with the archaeologically-rich levels. Her interpretation that burning and significant disturbance of the local vegetation accompanied the phases of occupation at Star Carr was the first recognition of Early Mesolithic

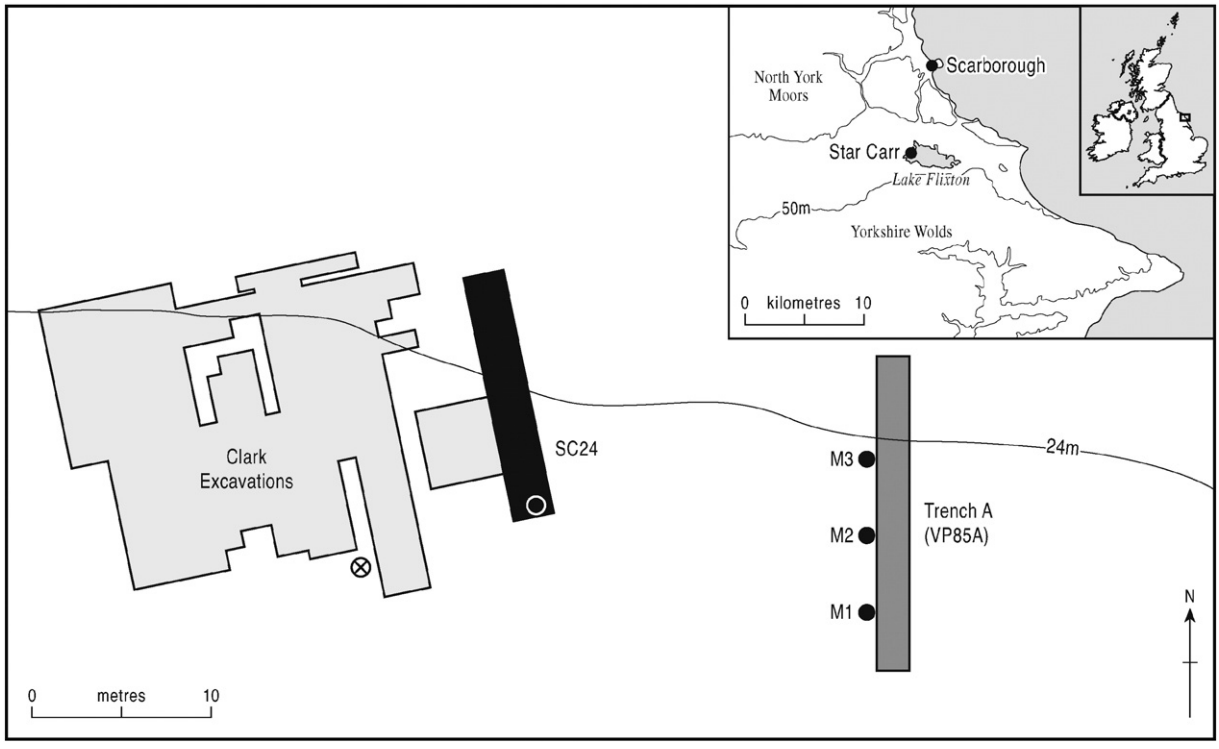

Fig. 1. Location (insets) of palaeo-lake Flixton and the Early Mesolithic site of Star Carr in North-East Yorkshire. The site of the present palynological investigation at the southern end of archaeological trench SC24 is indicated by a white circle. Also shown are the locations of Clark's original excavations (Clark, 1954) and of previous palynological work. Dark (1998a) analysed four pollen profiles, one on the southern edge of the Clark excavation area and which is marked here by a circle containing a cross. The other three, M1 to M3, were twenty metres to the east in her Trench A in a north-south transect through the marginal lake-edge deposits. Trench A is the re-opened trench VP85A of Cloutman and Smith (1988) and Dark's profiles are in broadly the same places as Cloutman and Smith's pollen diagrams A3 to A1. Geophysical core transects of Boreham et al. (2011a, 2011b) run between trenches A and SC24. The 24 m OD contour line represents the altitude of the sub-peat ground surface and the general position of the lake-edge during the Mesolithic occupation.