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Holocene floodplain palaeoecology of the Humberhead Levels; implications for regional wetland development

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ABSTRACT

The acquisition of high quality, well-dated local site records is essential for progressing regional environmental reconstructions. As part of a wider study designed to examine intra- and extra- site ecosystem responses to environmental change, this paper presents new palaeoecological data from the floodplain of the River Torne in the Humberhead Levels, South Yorkshire. The sampling site lies adjacent to the lowland raised mire of Hatfield Moors, a location with a long history of palaeoecological investigations. The potential of using floodplain records to reconstruct local variations in ecosystem response to environmental change is also considered. Coleoptera and pollen are used to reconstruct floodplain ecosystem dynamics, whilst chronologies are established using Bayesian age–depth modelling. Between 10,200 cal BP and 2300 cal BP, the floodplain experienced multiple phases of ecological change. At 10,200–9910 cal BP, a cut-off channel began to infill with peat, while the surrounding floodplain remained relatively dry with *Pinus* forest growing nearby. Between 9630–9500 cal BP and 7270–7020 cal BP, a depositional hiatus occurred in the sedimentary record. By the end of this period, the local woodland had diversified and expanded to mixed deciduous tree cover. A wet shift identified at 6870–6160 cal BP was shortly followed by a rise in *Alnus* and *Tilia* from 6410–6160 cal BP. At this time, widespread floodplain paludification had occurred in the Humberhead Levels, which was largely controlled by relative sea-level (RSL) rise and the associated rise in regional water tables. Floodplain expansion also resulted in the widespread occurrence of *Alnus* dominated fen woodland. The local Torne floodplain experienced varying levels of wetness that influenced the decline and subsequent regeneration of the woodland from 5870–5640 cal BP. At this time, the *Ulmus* decline is identified in the pollen stratigraphic record. Floodplain hydrology appears to have been controlled by a combination of water table fluctuations and changes in channel pattern/flow, both of which can be linked to RSL variations recorded in the Humber Estuary. Floodplain alluviation, also linked to rising water tables, is dated to 4360–4160 cal BP. Anthropogenic woodland clearance further upstream may have further compounded this event.

1. Introduction

Raised mire systems have long been recognised as important proxy archives for the reconstruction of environment change during the Holocene (e.g. Aaby, 1976; Blackford and Chambers, 1993; Barber et al., 1994, 2003; Charman et al., 1999, 2009; Hughes and Barber, 2003). Although frequently overlooked, floodplain records also provide insights into past environments, with particular emphasis upon fluvial processes and their relationship to both natural and anthropogenic factors of change (e.g. Brown and Barber, 1985; Macklin and Lewin, 2003; Smith and Howard, 2004; Foulds and Macklin, 2006; Macklin et al., 2010). This paper emphasises the usefulness of using floodplain palaeoecological archives to produce detailed environmental records for the early to late Holocene. We also emphasise the importance of utilising well-dated, local reconstructions based on nearby mires and floodplains so that regional climate and environment reconstructions can be improved (Charman et al., 2006), and where they are adjacent to each other, as here, allowing an exploration of connections between ecosystems and their responses to change.

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A detailed palaeoecological reconstruction from the former floodplain of the River Torne is presented, which lies adjacent to the southern edges of the raised mire of Hatfield Moors in the Humberhead Levels, Northern England (Fig. 1). Palaeoenvironmental analyses of peat sequences from both Hatfield and nearby Thorne Moors have identified phases of wetter/colder conditions during the mid to late Holocene (Whitehouse, 1999, 2004; Smith, 2002). Records from these mires have been used to investigate the wider landscape development in the region, which has been linked to forcing factors such as human activity, sea-level and climate change (e.g. Buckland and Kenward, 1973; Gaunt, 1987; Whitehouse, 2000, 2004; Smith, 2002). A particular emphasis has been placed on the influence of relative sea-level (RSL) rise upon fluvial systems. Impacts of RSL rise in the region include impeded drainage of the rivers which initially resulted in increased sediment deposition in the channels and on the floodplains, which in turn resulted in limited sediment supply into the Humber Estuary (Dinnin and Weir, 1997; Metcalfe et al., 2000). Channel geometry was also likely affected as rivers began to widen in the context of a low energy system. Instances of over-bank flooding probably increased, in addition to raised water tables as drainage was impeded (e.g. Gaunt and Tooley, 1974; Long et al., 1998; Metcalfe et al., 2000, 2001; Buckland and Smith, 2003). Thus, rising sea-levels may have influenced commencement of floodplain paludification and ultimately the adjacent raised mire systems (e.g. Buckland and Sadler, 1985; Smith, 2002; Whitehouse, 2004). These regional studies have provided us with a number of hypotheses regarding patterns and processes of wetland development. However, at times these studies have suffered from chronological uncertainties and have mostly taken place without the full utilisation of the palaeoenvironmental information contained within the neighboring floodplain deposits (e.g. Buckland and Kenward, 1973; Buckland and Sadler, 1985; Whitehouse, 2000, 2004; Smith, 2002; Buckland and Smith, 2003). Recent re-assessment and integration of previous palaeoenvironmental studies on Hatfield Moors, including Bayesian modeling of associated chronologies and additional radiocarbon dating of basal peat deposits, have provided a number of testable models of the spatial and chronological patterns of peat inception and spread (Chapman and Gearey, 2013).

Here, we build upon these previous investigations by presenting a new detailed palaeoenvironmental record from the Torne floodplain. We use a combination of sub-fossil Coleoptera, alongside pollen analyses, to produce robust local environment reconstructions. An extensive radiocarbon dating program and Bayesian modelling provides a strong chronological foundation for the site (Bronk Ramsey, 2005, 2008, 2009a, 2009b). Coleoptera have generally been under utilised as sensitive indicators of change in Holocene wetland contexts, especially floodplain environments (Dinnin, 1997; Brayshay and Dinnin, 1999; Whitehouse, 1999; Smith and Howard, 2004; Greenwood and Smith, 2005; Smith et al., 2005; Davis et al., 2007). This represents a significant gap in knowledge as Coleoptera may respond rapidly to variations within their environment (Elias, 1994, 2009). Here, we demonstrate the appropriateness of using Coleoptera, alongside pollen analyses to reconstruct floodplain dynamics and biotic changes.

2. Study site and methods

The Humberhead Peatlands National Nature Reserve is situated in a low-lying area of wetlands in eastern Yorkshire and Lincolnshire, UK, and comprise the raised mires of Thorne and Hatfield Moors (NGR SE 7006) (Fig. 1). Both mires have been designated as Sites of Special Scientific Interest (SSSI), and together form the two largest surviving examples of ombrotrophic lowland raised mires in eastern England (Rogers and Bellamy, 1972). The mires are closely associated with the floodplains of the surrounding rivers Torne, Idle, Don, and Went. Prior to drainage in the 17th century, these rivers meandered frequently, changing courses north-eastwards

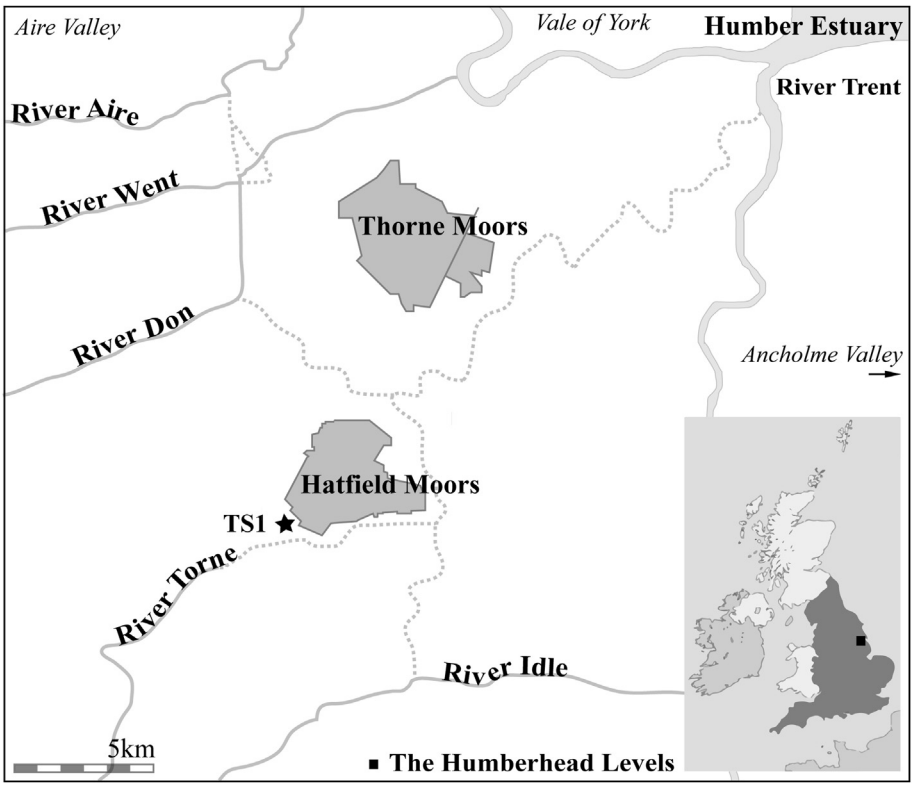

Fig. 1. Location of the Humberhead Levels (highlighted) and the main sampling site (TS1). River courses prior to drainage are denoted by a dashed line.

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