



Chronology and ecology of late Pleistocene megafauna in the northern Willamette Valley, Oregon



Daniel M. Gilmour^{a,b,*}, Virginia L. Butler^b, Jim E. O'Connor^c, Edward Byrd Davis^{d,e}, Brendan J. Culleton^f, Douglas J. Kennett^f, Gregory Hodgins^{g,h}

^a Willamette Cultural Resources Associates, Ltd., 623 SE Mill Street, Portland, OR 97214, USA

^b Department of Anthropology, Portland State University, P.O. Box 751, Portland, OR 97202, USA

^c U.S. Geological Survey, 2130 SW 5th Avenue, Portland, OR 97201, USA

^d Museum of Natural and Cultural History, University of Oregon, 1680 E. 15th Ave., Eugene, OR 97403, USA

^e Department of Geological Sciences, 1272 University of Oregon, Eugene, OR 97403, USA

^f Department of Anthropology, Pennsylvania State University, 409 Carpenter Building, University Park, PA 16802, USA

^g NSF-Arizona AMS Facility, Department of Physics, University of Arizona, Physics Building, 1118 East Fourth St., P.O. Box 210081, Tucson, AZ 85721, USA

^h School of Anthropology, University of Arizona, USA

ARTICLE INFO

Article history:

Received 14 January 2014

Available online 22 October 2014

Keywords:

Megafaunal extinctions

Pleistocene

Pacific Northwest

Stable isotopes

Younger Dryas

Overkill

ABSTRACT

Since the mid-19th century, western Oregon's Willamette Valley has been a source of remains from a wide variety of extinct megafauna. Few of these have been previously described or dated, but new chronologic and isotopic analyses in conjunction with updated evaluations of stratigraphic context provide substantial new information on the species present, timing of losses, and paleoenvironmental conditions. Using subfossil material from the northern valley, we use AMS radiocarbon dating, stable isotope ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) analyses, and taxonomic dietary specialization and habitat preferences to reconstruct environments and to develop a local chronology of events that we then compare with continental and regional archaeological and paleoenvironmental data. Analysis of twelve bone specimens demonstrates the presence of bison, mammoth, horse, sloth, and mastodon from ~15,000–13,000 cal yr BP. The latest ages coincide with changing regional climate corresponding to the onset of the Younger Dryas. It is suggested that cooling conditions led to increased forest cover, and, along with river aggradation, reduced the area of preferred habitat for the larger bodied herbivores, which contributed to the demise of local megafauna. Archaeological evidence for megafauna–human interactions in the Pacific Northwest is scarce, limiting our ability to address the human role in causing extinction.

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Introduction

The Pleistocene/Holocene transition in North America is marked by the earliest unequivocal evidence for humans as well as the demise of ~35 genera of mostly large mammals. For decades, discussion has continued as to whether these two events were related or coincidental, essentially asking if climate change, human “overkill”, or some combination were responsible for megafaunal extinction. The matter remains unresolved (Barnosky et al., 2004; Koch and Barnosky, 2006; Grayson, 2007; Lorenzen et al., 2011; Grund et al., 2012; Boulanger and Lyman, 2014). Grayson (2007) suggests that the lack of resolution in the debate over both the timing and the causes of the extinctions in North

America results from a deficiency in understanding local histories of individual taxa, coupled with close analysis of paleoenvironmental and archaeological findings.

To develop such a history for one region, we studied Pleistocene megafauna from paleontological contexts in the Willamette Valley, Oregon. We synthesized available information on fossil remains including species present, conducted radiocarbon and stable isotopic analyses for twelve latest Pleistocene specimens post-dating about 15,000 cal yr BP, and evaluated geologic context and regional paleoenvironmental and archaeological records. Robust estimates for the timing of local extinctions will require larger sample sizes. Nonetheless, our analyses suggest that extinction timing and trends in species type and isotopic composition correspond to regional paleoenvironmental changes leading up to the cold Younger Dryas stadial of 12,900–11,600 cal yr BP (Grootes et al., 1993; Alley, 2000; Stuiver and Grootes, 2000). Extinction also post-dates first known occupation of the Pacific Northwest at about 14,000 cal yr BP (Jenkins et al., 2012), indicating that humans and megafauna co-existed. Archaeological evidence for megafauna–human interactions in the Pacific Northwest and the Willamette Valley in

* Corresponding author.

E-mail addresses: danny@willamettecra.com (D.M. Gilmour), virginia@pdx.edu (V.L. Butler), oonnor@usgs.gov (J.E. O'Connor), edavis@uoregon.edu (E.B. Davis), bjc23@psu.edu (B.J. Culleton), djk23@psu.edu (D.J. Kennett), ghodgins@physics.arizona.edu (G. Hodgins).

particular is scarce, however, thereby limiting conclusions for the human role in megafaunal extinctions.

Setting and Willamette Valley Quaternary history

The specific setting of the Willamette Valley of northwestern Oregon is ideal for investigating terminal Pleistocene megafauna. The wide flat-bottomed valley (Fig. 1) occupies a broad structural depression between the volcanic arc of the Cascade Range to the east and the uplifted marine sedimentary and volcanic rocks of the Coast Range to the west (Gannett and Caldwell, 1998). The valley bottom extends 190 km south to north, from Eugene to Portland, averages about 40 km wide, and is chiefly underlain by Pleistocene and Holocene alluvium deposited by the Willamette River and its major tributaries (O'Connor et al., 2001).

An important interruption in the Quaternary record of Willamette Valley aggradation was deposition of locally thick accumulations of fine-grained sediment of Columbia River provenance (Glenn, 1965; O'Connor et al., 2001). This sediment, deposited in rhythmically bedded sequences totaling as much as 35 m thick, was deposited between 20,000 and 15,000 cal yr BP by dozens of Missoula floods (Glenn, 1965; Waitt, 1980, 1985; O'Connor et al., 2001; O'Connor and Benito, 2009). These massive floods, derived from failure of ice-dammed Glacial Lake Missoula in northwestern Montana, coursed down the Columbia and backflooded 200 km up the Willamette River, reaching as far south as Eugene and elevations as high as 120 m above sea level (O'Connor et al., 2001; Minervini et al., 2003). Each of at least 40 sediment-charged floods left a layer of slackwater sand, silt and clay, forming the rhythmically bedded deposits that underlie most of the valley bottom outside of the latest Pleistocene and Holocene floodplains (Glenn, 1965; O'Connor et al., 2001). These deposits, left near the end of the Pleistocene, provide a distinctive stratigraphic unit allowing identification of post-flood, therefore post-15 ka, megafauna.

Fossil megafaunal sites and material

The Willamette Valley contains a long-known but little-studied record of Pleistocene-aged megafauna. Early accounts date to the 1840s (Perkins, 1842; Wilkes, 1844: 385; Simpson, 1942), and by the early 20th century reported taxa included mammoth (*Mammuthus*), mastodon (*Mammot*), ground sloth (*Paramylodon*, *Megalonyx*), bison (*Bison*), horse (*Equus*), and camel (*Camelops*) (McCornack, 1914, 1920; Hay, 1927). Finds have continued, chiefly by archaeologists searching for Pleistocene-aged cultural sites (Cressman and Laughlin, 1941; Cressman, 1947; Reese and Fagan, 1997; Lysek, 1999; Stenger, 2002; Connolly, 2003a,b) and by amateurs and community groups (Stenger, 2002; Addington, 2006; Yamhill River Pleistocene Project, 2010). Despite the lengthy history of finds, few of these remains have been closely analyzed.

Our analysis of latest Pleistocene megafauna in the Willamette Valley began with collecting all known records of remains of extinct mammalian herbivores reported for the valley. We reviewed published and unpublished reports and catalogs at the University of Oregon Museum of Natural and Cultural History (UO MNCH) and solicited knowledge from professional and amateur researchers and community groups known to have worked on Pleistocene-aged faunas over the past 40 years. Our search identified 87 fossil finds of various types, including single skeletal elements, parts or almost complete skeletons, or multiple individuals (Supplementary Table 1). The actual skeletal materials from over half of these finds could not be located; for example, we found none of the specimens first reported by McCornack (1914) and Hay (1927). But we did locate fossil remains from 33 of the reported finds, including multiple examples from amateur collections that are in the process of being cataloged and brought into the UO MNCH curation system. Judging from available records and the stratigraphic context as determined from site visits, many of these remains pre-date the Missoula floods (Supplementary Table 1) and are not further considered in this report.

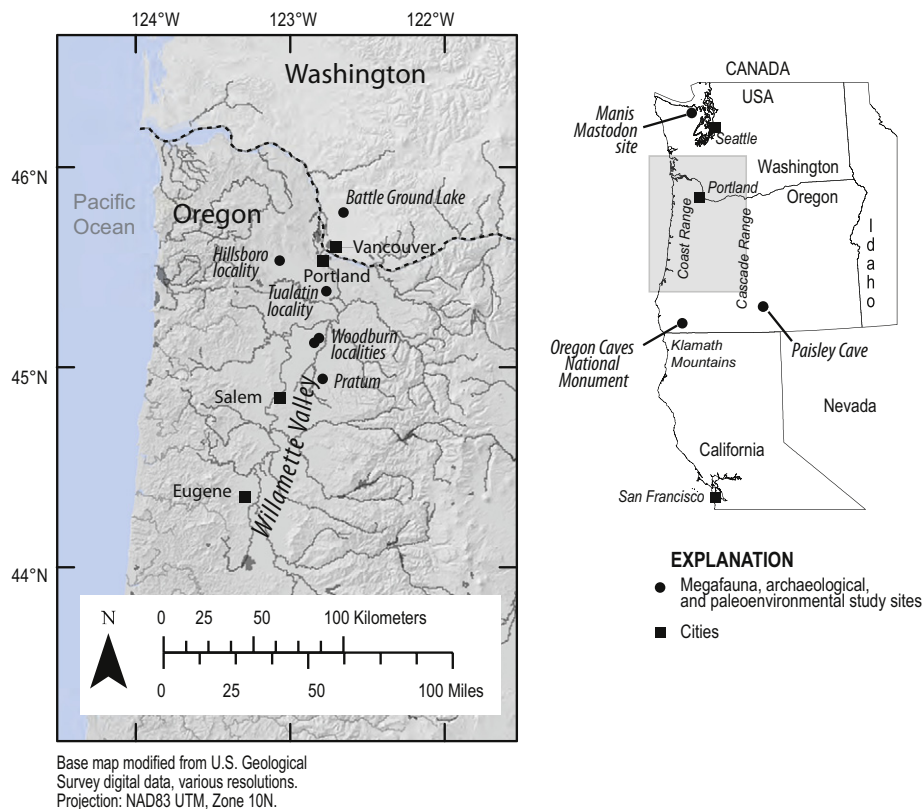


Figure 1. Map of Willamette Valley and larger regional context, showing locations of paleontological, archaeological and paleoenvironmental sites noted in study.

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