

PRECONTACT MIGRATION AND WARFARE ON THE NORTHERN PLAINS

by

TRAVIS WEYMAN JONES III

(Under the Direction of JENNIFER BIRCH)

ABSTRACT

This dissertation investigates the intersection of migration and warfare by examining the conditions leading to peaceful or violent interactions between migrant and local populations sharing the same landscapes. It focuses on two regions of the Missouri River Trench of the North American Plains, where archaeological evidence indicates that migration and warfare occurred between the thirteenth and sixteenth centuries AD. A high-resolution radiocarbon chronology is constructed to identify the timing and locations where migration and warfare overlap. The analysis reveals two distinct cases: one in which migration occurs without concurrent warfare and one where migration coincides with warfare. Multiple internal (intragroup) and external (intergroup) conditions contributing to migrant-local interactions and occurring at multiple socio-spatial scales are identified and tested across the two cases to understand how various conditions may produce violent or peaceful outcomes.

It is found that commonly identified factors, such as social distance and incongruent ideologies, can contribute to violent migrant-local relations. However, group-specific conditions, particularly practices and traditions that integrate collective violence into social identity by sanctioning and incentivizing warfare, also play a critical role in shaping these relationships. Ultimately, this research argues that a multiscale approach, grounded in historical narratives and attentive to conditions throughout and between

societies, is essential for fully understanding migrant-local relationships in a given social and cultural context.

INDEX WORDS: North American Plains, Radiocarbon, Bayesian chronology, Warfare, Migration, Traditions of War

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DEDICATION

To my beautiful and brilliant wife, KC Jones. You are my person.

To Zac. The vibrant tapestry of life has grown greyer since your passing from it.

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CHAPTER 1

RESEARCH DESIGN AND CONCEPTUAL FRAMEWORK

This dissertation uses high-resolution chronological information to investigate the intersection of migration and warfare and the historically contingent processes under which peaceful or violent interactions may occur when migrants enter new landscapes inhabited by local groups. Two case studies are presented from the Missouri River Trench of modern-day North and South Dakota between the thirteenth and sixteenth centuries AD (Figure 1.1). Over 400 radiocarbon dates and excavation data from 44 village sites are used to refine the region's current settlement chronology (Appendices A–D). The new regional chronology allows for the contextualization and historicization of the region's sociopolitical and cultural landscape during periods associated with migration and warfare. In the case studies, interactions between migrants and locals produce two disparate outcomes. In one instance, migrants and locals appear to have integrated over a brief period of time, with little evidence of violence. In the other, migrant-local interactions devolve over time, resulting in warfare and one of the largest known pre- European contact massacres in North America. This research demonstrates the need to historically contextualize inter and intra-group processes that structure migrant-local interactions.

Migration and war are themes of perennial interest among archaeologists due to the enduring impacts each has on shaping human societies and social dynamics throughout history (e.g., Cabana and Clark 2011; Robinson 2010; Scherer 2021; Turchin et al. 2022). In the modern era of archaeological discourse, functional models related to demographic, economic, and environmental variables strongly influence our understanding of the conditions contributing to warfare and migration (e.g., Anthony

1990; Baker and Tsuda 2015; Cabana and Clark 2011; Haas 2001; Keeley 1996; Kohler et al. 2014; LeBlanc and Register 2003). Such variables are only a few among many interrelated processes contributing to specific wars and migrations. This research expands on work emphasizing the historicity of migration and war, revealing the complex, contingent, and relational nature of these processes when considered in a larger historical whole (e.g., Birch et al. 2021; Clark et al. 2019; Fernández-Götz and Arnold 2019; Hegmon et al. 2008; Mills et al. 2015).

Investigating the intersection of migration and war is timely in twenty-first century academic discourse. In an era when large groups of people throughout the world are being displaced at ever-growing numbers (UNHCR 2024), identifying the dimensions and processes of interaction between different social groups is vital to understanding the emergence of collective violence. One has only to look to the geopolitical conflicts of the late twentieth and twenty-first centuries throughout Africa, Eastern Europe, the Middle East, and South America to appreciate the effects warfare and migration have on individuals, communities, and societies (Agier et al. 2002; Can 2017; Hermenau et al. 2013; Knudsen et al. 2013; Knudsen and Hanafi 2010; Kononov 2024; Kronfeld 2008; Peteet 2010; Rellstab and Scholte 2015; Toal and Dahlman 2011). Today, as war and the threat of war increase in intensity throughout the world, migrant and refugee crises are simultaneously compounding (UNHCR 2024). In the United States, unsubstantiated rhetoric in the news and social media is driving increased anti-migrant and anti-minority violence (Conzo et al. 2021; Medel-Herrero et al. 2021). Abroad, similar processes are occurring alongside the re-emergence of brutalist politics meant to villainize and dehumanize migrants and refugees (Kim 2024; Noury and Roland 2020).

This study only scratches the surface of these complex issues. The case studies presented here consist of pre-modern, non-state societies that never participated in the

global media, economies, geopolitical relations, and military-industrial complexes of the present day. However, if we can accept that many of the fundamental stimuli driving people to fight or flee are the same for any sedentary society with claims on territory and participation in regional social, political, and economic interactions, then the archaeological record becomes a deep well from which we can draw (*sensu* Clark et al. 2019; Cobb 2005). This study contributes to anthropological understandings of migration and war by stressing the importance of internal and external conditions and historical context when examining human interaction across migrant and local groups. Decisions to migrate among these societies are mostly related to uneven sociopolitical and economic factors (Anthony 1990; Clark 2001; Clark et al. 2019). Similarly, individual choices to participate in war range from simple protection from external threats to the fulfillment of duty and opportunities for prestige and capital gain (i.e., social, economic, and political goals) (Fearon and Laitin 2000; Glowacki et al. 2016; Haas 1996; Keeley 1996; Mann 2023; Otterbein 2009; Roscoe 2008). Broader explanations of war incorporating political and economic relationships among these types of societies suggest that competition and cooperation go hand-in-hand and that collective violence is as much a form of communication as trade and exchange (Blyth 2012; Brooks 2002; Dye 2009; Haas 1996).

Case Studies

The case studies analyzed herein focus on migrants from two precontact village societies occupying the Missouri River Trench of the North American Great Plains between the thirteenth and sixteenth centuries AD (Figure 1.1). These groups are referred to archaeologically as the Middle Missouri (AD 1000–1500) and Coalescent (AD 1300–1560) Traditions (Table 1.1) (Ahler 2007; Johnson 2007a; Lehmer 1971; Lehmer

and Caldwell 1966). According to the current regional chronology, prior to the thirteenth century, Middle Missouri villages clustered primarily south of the Cheyenne River, while Late/Terminal Woodland groups (AD 700–1200) occupied areas north of this (Figure 1.2)(Johnson 2007a). By the fifteenth or sixteenth century, only Middle Missouri settlements occupied the north, and new migrant groups associated with Coalescent villages occupied the central and southern sections of the Trench (Figure 1.3). It is evident from the shift in settlement that two migrations occurred between the thirteenth and sixteenth centuries. Middle Missouri groups migrated north, displacing or integrating with Woodland locals (see Ahler 2007), while Coalescent newcomers migrated into southern areas previously occupied by Middle Missouri groups. The current chronology demonstrates that much of the archaeological evidence for intervillage warfare found throughout the region at both Middle Missouri and Coalescent villages (e.g., fortified villages, burned villages, and human remains bearing signs of perimortem trauma) also appears during these centuries. The stark contrast in settlement patterns before and after this period, the disappearance of northern Woodland villages, and evidence of violent conflict suggest that the arrival of migrants in both the north and south may have been tumultuous.

The ultimate goal of this study is to understand the social, political, economic, and environmental processes that may have contributed to peaceful or violent interactions between migrants and locals. Sufficient evidence exists in the region's archaeological record to identify specific historical processes that may contribute to varied interactions between migrants and locals. However, an understanding of how these relate to one another cannot be achieved until the events related to these processes can be placed in time relative to one another. The current regional chronology lacks the temporal resolution to identify when war and migration occur relative to one

another (Chapter 2). The existing chronology essentially groups village occupations into 100-year periods (Johnson 2007a). This presents the past in a step-wise sequence where all villages in a single period will always overlap, while villages from different periods cannot. Although evidence of war exists among Middle Missouri migrants in the north, when this conflict occurs relative to their migration north requires a finer chronological resolution than a 100-year period of time. Similarly, while evidence demonstrates that collective violence occurs at some Coalescent villages after their migration into the south, the lower chronological resolution prevents assessment of whether Middle Missouri groups resided in the area when the migrants arrived.

This study will analyze the nature of migrant-local relations in the Missouri River Trench by increasing the resolution of the regional chronology and thus our understanding of when migration and warfare occurred between the thirteenth and sixteenth centuries through a two-phased approach. First, general conditions promoting violent or peaceful interactions are identified (discussed below) and existing archaeological evidence from the region is used to determine if these conditions existed among Middle Missouri and Coalescent groups. Second, the material conditions for the presence or absence of warfare coinciding with each migration are identified and compared to the previously established conditions suggesting peaceful or violent interactions. This comparative assessment identifies the theoretical and material conditions contributing to migrant-local interactions during both groups' migrations and implicitly tests them against actual evidence for warfare.

It is also important to note that while these historically contingent processes of migration and intervillage conflict played out in the Missouri River Trench, multiple periods of severe and prolonged drought simultaneously occurred both within and outside the region. In the Missouri River Trench, periods of drought occurred in the

thirteenth, latter half of the fourteenth, and beginning of the fifteenth centuries (Trabert and Hollenback 2021:91, 118). At a continental scale, prolonged droughts contributed to the movements of people throughout the continent and were particularly severe in areas east of the Missouri River Trench like the southeastern and midwestern “Vacant Quarter” and in the vicinity of the Mississippi-Ohio River confluence (e.g., Benson et al. 2009; Cobb & Butler, 2002; Cobb et al. 2023; Krus and Cobb, 2018; Meeks and Anderson, 2013; Williams 1983, 1990). Although human agency is a necessary factor in the production of warfare, the contribution of environmental factors as a proximal cause should not be overlooked. Though climatic factors may not have contributed directly to migrant-local violence in terms of natural resource shortages, edge effects—social, political, or economic changes at the boundaries of depopulated areas—may have resulted in the breakdown of competitive exchange networks among Middle Missouri locals as influxes of Coalescent groups migrated into the south.

Conceptual Framework: Migration and War

Much of this dissertation investigates the intersection of migration and war. However, it should be noted that both are complex, generative processes in their own right (e.g., Robinson 2010; Turchin et al. 2022). Before discussing how these phenomena articulate, it is important to first briefly discuss how this study uses the terms migration and war. A commonly used definition of migration, and one adopted by this study, is a process whereby people cross a political, social, and/or environmental boundary with the intention of long-term relocation (Anthony 1990; Cabana and Clark 2011; Pluckhahn et al. 2020; Tsuda et al. 2015). In this study, war is a state of being that exists within and between emically defined groups, where individuals participate in socially sanctioned competitive and cooperative acts with the intent to organize and

produce collective violence (including threats of violence; *sensu* Bamforth 2018; Ferguson 1984; Galtung 1990; Lambert 2002; Pauketat 2009; Roscoe 2009).

While war and migration are complex human processes individually, neither migration nor warfare are monolithic phenomena and are often causally linked (Knudson et al. 2013). Nor are they two axes of a cartesian plane in which one affects the other in a vacuum. Migration and war are always embedded within multiscalar fields of historical processes that range from regional social and political structures existing across generations to the daily strategies of individuals seeking to make a living (Burmeister 2017; Cabana and Clark 2011).

In archaeology, the processes of war and migration are frequently mentioned in a study but are rarely treated as equal parts of a historic whole (e.g., Cameron 2013; Cobb et al. 2023; Fernández-Götz and Arnold 2019; Owsley 1994). These studies contribute to our understanding of migration or war as analytical concepts, but often rely upon one or the other for explanatory purposes. However, by applying these concepts synergistically within a field of human relations, we may better understand the complex interactions migrants and locals must navigate when sharing space. Other social and behavioral sciences (including the subdisciplines of cultural and biological anthropology) provide theoretical frameworks and empirical studies that examine the intersection of war and migration from a contemporary perspective, including today's global refugee crisis and ethnic violence (Agier et al. 2002; Fearon and Latin 2000; Frey 2021; Can 2017; Knudsen et al. 2013; Kononov 2024; Kronfeld 2008; Peteet 2010; Rellstab and Scholte 2015; Toal and Dahlman 2011).

Below, conditions affecting migrant-local relations are presented. These conditions range from broader environmental, social, and political processes structuring violent interactions to the agency of individuals participating in the violence. The arrival

of newcomers into a place can be a source of apprehension and tension when migrants and locals interact. However, this is not always the case; certain conditions can contribute to peaceful interactions. Placing these conditions in their historical context allows for a more nuanced understanding of when (or even if) these conditions can contribute to the production of large-scale violence between migrants and locals.

The Migrant Paradox

Group size, travel time, distance from origin, relation to destination, and intentionality of movements are all components of migrations (Anthony 1990; Baker and Tsuda 2015; Burmeister 2000, 2017; Cabana and Clark 2011; Cameron 1995, 2013; Pluckhahn et al. 2020; Schachner 2012). While some migrations can occur relatively rapidly, others may occur over multiple generations as groups continually detach from place and place-making in new social and physical environments (Cobb 2005; Lamoureux-St-Hilaire and MacRae 2020). The results of these variable processes are that the arrival of migrants in a new area frequently results in complex processes of interaction, precipitating simultaneous and often paradoxical outcomes (Cabana and Clark 2011; Cameron 2013; Clark et al. 2019; Mills et al. 2016; Stone 2015). This is especially true when migrants arrive in an area already populated by a local group.

Clark and colleagues discuss migrant-local interactions in the context of what they deem the “migrant paradox” (2019). Briefly, they use two case studies from the Puebloan Southwest to explore the conditions under which migrant groups and local host societies may integrate into new, pluralistic cosmopolitan societies. Although members of host societies might initially see migrant groups as alternatively beneficial or disruptive, the ultimate integration of both groups can yield social and economic benefits. Multiple conditions contribute to these views and how resistant locals and migrants will

be to integration. Although this study focuses on conditions favorable to peaceful and integrative interactions between migrants and locals, it can be reasonably assumed that the lack of these conditions can equally lead to contentious and possibly violent interactions.

Clark and colleagues identify numerous conditions affecting local-migrant interactions (2019). The conditions most relevant to this study can be distilled into five categories: migration scale, identity persistence and social distance, inclusive institutions and ideologies, migrant specialization, and destination conditions. Although other context-dependent influences can contribute to interactions between migrants and locals, those identified below are inclusive and general enough to be evaluated by analyzing archaeological evidence from the Missouri River Trench.

Migration Scale

The size and rate of migration into an already populated region can significantly impact local-migrant interactions (Clark et al., 2019). The abrupt arrival of a high volume of migrants can often intensify other conditions and create real or imagined political and economic strains (Anthony 1990; Baker and Tsuda 2015). Similarly, the rapid arrival of numerous migrants can contribute to resistance among resident populations, resulting in persistent (often oppositional) group identities (Baker 1980; Becker 1977; Cheek and Friedlander 1990; Clark et al. 2019; Evans 1980; Kus and Raharijaona 1990; Lechtman 1977)

Identity and Social Distance

Identity persistence and social distance are related concepts in this study. Here, identity persistence is how likely or willing local or migrant groups are to continue practices and adhere to structures unique to themselves and possibly exclusionary to another group. The persistence of certain practices related to migrant- or local-specific

identities over time can be evidence that groups are unable or unwilling to integrate (Clark et al. 2019). If migrant and local interactions fail to promote a shared sense of identity through community-building practices, then the groups' independent traditions and cultural practices persist.

Social distance is a qualitative measure of difference in practices and ideologies between two groups (*sensu* Braun and Plog 1982; Lyons and Clark 2008). If shared traditions with similarities in fundamental social structures and everyday practices exist, there will likely be more precise communication between migrants and locals. Without this, misunderstandings and perceptions of impropriety are more likely to occur with every interaction. Over time, promoting these commonalities can create closer bonds between migrants and locals, replacing persistent, exclusionary practices (Clark et al. 2019).

Inclusive Institutions and Ideologies

Another condition identified by Clark and colleagues (2019) is the existence of heterarchical, inclusive institutions and ideologies. Migrants and locals can utilize these to diminish intergroup tensions by facilitating interactions on equal social and political grounds. Similar to groups with shared traditions, practices, or histories (closer social distance), heterarchical, inclusive institutions can create situations that bring migrants and locals together for shared experiences. Similarly, inclusive ideologies can also produce shared experiences by promoting frequent and balanced interactions.

Valued Skills

Specifically, Clark and colleagues (2019:268, 272) identify migrant skill among Kayenta potters as a possible factor in creating less contentious migrant-local relations. In a study by Mills and colleagues (2016), the ceramic skills of Kayenta potters and their connections with locals in their destination area allowed for more peaceful interactions

upon arrival. Kayenta potters producing high-quality Roosevelt Red Ware pots are thought to be part of inclusive ideologies that contribute to shared identities.

Destination Conditions

The timing of migrant arrival at their destination in relation to social, political, and environmental conditions can affect how migrants and locals interact (Clark et al. 2019). Suppose groups arrive in a region stressed by climatic instability. In that case, the arrival of newcomers may be seen by some locals as an increased burden or threat to available resources (real or perceived). Likewise, if migrants arrive during a time of social or political upheaval, they can become entangled in the factionalism of local groups. This can contribute to uncertainty and resentment among all groups involved.

Paths to War

The conditions identified by Clark and colleagues (2019) are useful for analyzing migrant-local relations. The migrant paradox only describes external (intergroup) practices that may structure migrant-local relations. Lack of integrative interaction does not unilaterally dictate that warfare will always follow. Among societies with little evidence for hierarchical structures that enforce participation in organized violence, a minimum threshold of individuals must agree (implicitly or explicitly) that a specific instance of collective violence is justified or sanctioned.

Alongside external factors like social distance or incongruent ideologies, some researchers attribute community-level competition and cooperation to the production of collective violence (e.g., Birch 2010; Fearon and Laitin 2000; Glowacki et al. 2016; Glowacki et al. 2017; Mitchell 2007; Williamson 2007). Collective violence is a form of cultural expression and communication that exists within a field of cooperative and competitive interactions (Ikehara 2015; Mitchell 2007, 2013; Nirenberg 1996; Whitehead

2004). As a form of cultural expression, violence has generative properties that drive internal competition and cooperation and underwrites external relations (*sensu* Birch 2010; Blyth 2012; Brooks 2002, 2016; Mitchell 2007, 2018). Birch finds “that for Northern Iroquoian peoples warfare was traditionally an essential part of the construction and maintenance of social relations, perceptions of masculinity and spiritual beliefs” (2010:30). Brooks identifies that violence and slavery, though destructive, also produced persistent economic and social relationships between and among the Indigenous, Mexican, Spanish, and American actors in the Southwest Borderlands (2002). Likewise, Blyth demonstrates that violence and the threat of violence produced peaceful negotiations between the communities of Janos and Chiricahua (2012). In the Missouri Trench, Mitchell identifies that the basis for relationships between late-precontact Middle Missouri villages was warfare as much as trade and exchange (2007, 2018). This suggests that violence is not just a result of intolerance or the outward manifestation of competitive relationships in societies, but one of many strategies that individuals might choose to interact with others.

There are instances when justifications and incentives for participation in collective violence become embedded within the social fabric of a group, creating what I refer to here as *traditions of war* (described below). These traditions can reinforce and generate competitive internal conditions that perpetuate violent conflict with outsiders. In Chapter 2, I identify longstanding practices linked to warfare that were embedded in Middle Missouri and later Mandan and Hidatsa social lives. In Chapter 5, I argue that these practices encouraged individual participation in sanctioned acts of collective violence and reinforced warfare as a sanctioned and productive form of communication with other groups. This enduring *tradition of war* would have generated internal competition in villages as individuals sought prestige and status through war as well as

driven external interactions with members of other Middle Missouri villages and later Coalescent migrants.

Traditions of War

Multiple researchers use the term tradition of war or traditions of war in various ways (e.g., Caldararo 2004; Fortune 1939; Mead 1935, 1968; Nabulsi 1999; Roscoe 2003; Timasheff 1965). Although never fully defining what a “tradition of war” is (but see Nabulsi 1999; Timasheff 1965), all of these researchers are referring to societies that frequently participate in war. Mead (1935, 1968) and Fortune (1939) used the term somewhat loosely while debating whether the Mountain Arapesh of Papua New Guinea were truly pacifists (see also Caldararo 2004; Roscoe 2003). Discussing modern and colonial states, Nabulsi focuses on different political ideologies that the author refers to as “traditions of war” that focus on the legality of warfare (1999). Timasheff’s conceptualization of a “tradition of war” is the closest to how this study uses the term (1965). Timasheff identifies three conditions for war, the second of which is a cultural tradition of war in which leaders use participation in previous wars as a historical precedent for using war to deal with current disputes with outside groups. Here, I use the term *traditions of war* to discuss how cultural logics contribute to continued cycles of violence. In traditions of war, warlike ideologies and incentives for personal participation in war exist. In these societies, previous acts of sanctioned violence (e.g., revenge) are often used as historical precedent to justify further acts of war.

An immense body of literature examining the production and justification of violence crosscuts the humanities and the social and behavioral sciences (e.g., Barker 1993; Birch 2010; Brown and Osterman 2012; Elias 2000; Fearon and Latin 2000; Galtung 1990, 1969; Göçek 2015; Hermenau et al. 2013; Marsella 2012; Mosse 1990; Otto et al. 2006; Timasheff 1965; Vergerio 2020; Whitehead 2004; Wood 2004, 2007a,

2007b). Within this body of literature is an area that examines the processes of legitimizing, sanctioning, and socializing specific acts of violence that involve all forms of structural and physical violence in society.

This study focuses specifically on the production of structural (e.g., nationalism) and physical (e.g., combat) violence directed at outside groups (i.e., war). The socialization process consists of participation in practices and ideologies that normalize violence through virtually any aspect of society (e.g., language, religion, art, economic practices, politics) (*sensu* Galtung 1990). Participation includes private and public interactions ranging from tacit acceptance (e.g., ignoring genocide) to active glorification (e.g., victory parades) and mythologization (e.g., warrior rite de passage) (Arnold 1996; Göçek 2015; Mosse 1990; Resic 2006; Vergerio and Bruneau 2024; Vergerio 2020). These practices reciprocally reinforce ideologies and social identities that are embedded with references to and expectations of violence. When discussing war, Resic refers to these as “warrior values” like honor, loyalty, duty, and obedience (2006:424). Importantly, this process also tends to place victims and enemies in a category of outsider or ‘other’ that allows members of a society to normalize victim-blaming, villainization, and dehumanization (e.g., Can 2017; Mosse 1990; Zíla 2022). Brutalization—involvement in violent acts that produce new thresholds for the acceptance of violence and future violent acts—is one process by which this may occur (e.g., Athens 1992; Bowers and Pierce 1980; Bailey 1998; Mosse 1990)

There is also a material and spatial aspect to embedding and legitimizing violence within societies (Wood 2007b). Among colonial powers, the physical encoding of laws for the conduct of war is a common practice to justify the annihilation of non-state entities (Vergerio and Bruneau 2024; Vergerio 2020). Political entities attempt to publicly forward and control historical narratives of war (including its glorification) with veteran’s

memorials or war monuments (Gegner and Ziino 2012). The glorification of combat signaled by the display of war trophies (e.g., enemy scalps) and weapons (e.g., captured artillery pieces) would signal that past wars were an acceptable form of communication and a way of attaining prestige and status (Chacon and Dye 2007). Similarly, the labor necessary to establish fortifications, as well as their constant presence at the edges of a village or town, would be enduring reminders to its residents that preparation for violence is a part of everyday life. As Mitchell puts it, fortifications “helped perpetuate the social conditions for war” (2013:192).

Within societies that promote and participate in collective, intergroup violence, group-specific stimuli (e.g., rewards and expectations) can further incentivize participation in violence. It may be expected that members of a society participate in war or that duty demands that they avenge actions committed by other groups (e.g., revenge killing; Lowie 1913:248-249; Otto 2006; Resic 2006; Trigger 1976:69; Wiessner 2007). Other expectations may require individuals to demonstrate success in war as a prerequisite for participating in activities like holding political office or hosting certain ceremonies (e.g., Bowers 1991:33-34, 68-74; Feinman and Neitzel 1984). Beyond the fulfillment of responsibilities, there are other incentives of war: social (prestige), economic (spoils of war), and political (ability to hold office) (e.g., Helbling 2006:116-118; Kristiansen 1999). Participating in combat is a common pathway of social progression among many village societies (e.g., Birch 2010; Chacon and Mendoza 2007; Keeley 1996; Lewis 1942:53-59; McGinnis 1990; Mitchell 2007, 2018; Snow 2007). Ideological frameworks related to warfare play a role in incentivizing individuals as beliefs about honor, obedience, courage, and duty can act as both personal rewards and social expectations. Ultimately, the occurrence of these stimuli can contribute to competitive

environments in which individuals in groups compete to attain rewards and fulfill expectations (e.g., Birch 2010).

These shared structures, practices, and ideologies essentially generate cultural logics that continually normalize, justify, and incentivize participation in war (i.e., *tradition of war*), mutually reinforce one another, and perpetuate war as an accepted form of interaction and communication with outside groups. Helbling refers to a similar process as one of socialization “through a system of reward and punishment, disapproval and indoctrination” that is associated with societies in continual or prolonged states of war (2006:117-118). Godelier, when discussing the Maring of New Guinea, demonstrates that legitimate reasons to attack another group (e.g., revenge) may be intentionally created by provoking outsiders to attack, thus justifying a return attack (1986). Fearon and Laitin, in a meta-analysis of case studies focusing on ethnic war, suggest that both political leaders and those enacting violence on the ground often use sanctioning practices and ideological notions of violence as proxies for personal interests (2000). Thus, previous acts of violence can be used as proximal causes to justify future acts of violence (*sensu* Timasheff 1965). That is, previous reasons to attack an enemy (e.g., murder, abduction, broken agreements, perceived slights or threats) can be used as a historical precedent to sanction future attacks, regardless of other underlying causes or motivations.

Environmental

In contemporary archaeological discourse, understandings of the conditions fostering warfare and migration are often influenced by functional models relating environmental conditions to demographic and economic pressures to fight or flee (e.g., Anthony 1990; Baker and Tsuda 2015; Cabana and Clark 2011; Haas 2001; Keeley

1996; Kohler et al. 2014; LeBlanc and Register 2003). A similar trend occurs in the Missouri River Trench. Multiple studies have estimated climatic volatility and drought in the Trench (Fritz et al. 2000; Laird et al. 1998; Weakly 1965; Woodhouse and Overpeck 1998). Others have incorporated these studies into explanations of intervillage warfare, suggesting that climate, and thus resource stress, were primary contributors to warfare (e.g., Bamforth 1994, 2006; Kay 1996; Zimmerman and Bradley 1993; Zimmerman 1985). The new chronology presented in this study will implicitly test previous researchers' assumptions alongside more recent climatic data. While climatic instability may have stressed resources enough to create tensions, such situations were likely bound up in social identities and individual strategies for self-preservation.

Research Design

Below are five questions related to when and if warfare and migration cooccurred in the Missouri Trench. They serve two purposes. First, they help answer questions about conditions favorable to peaceful or violent interactions between migrants and locals that cannot be answered without chronological refinement. Questions about the relative timing of warfare and migration in each region are key. Second, when taken as a whole, these questions serve the larger task of reconstructing the historical context of migrant-local relations in the region.

Question 1: Does Middle Missouri migration into the northern areas of the Trench coincide with evidence for violence?

Northern Middle Missouri villages with the presence and absence of warfare are dated to see when and where warfare occurred during migration into the north. The presence or absence of violence during Middle Missouri migration is tested against

existing archaeological evidence for the external and internal conditions for warfare discussed above (see Chapter 2).

Question 2: Does the adoption of inclusive institutions (that would facilitate inclusive ideologies and shared identities) cooccur with the migration north?

Northern Middle Missouri villages are typically much larger and less numerous than southern Middle Missouri villages (Winham and Calabrese 1998). Some villages also contain plazas and adjacent ceremonial lodges. This evidence suggests that Middle Missouri groups began aggregating into larger villages and engaging in practices related to building inclusive institutions and ideologies while resettling in the north. However, some villages with evidence of inclusive institutions also contain heavy fortifications surrounding them, suggesting that warfare may have existed between some villages participating in these practices (Winham and Calabrese 1998).

During the dating of northern Middle Missouri villages, the existence of population aggregations, plazas, and ceremonial lodges relative to both warfare and migration are determined. If the adoption of plazas and ceremonial lodges coincides with a specific temporal range during the migration, this may signal attempts by migrants and locals to create peaceful interactions and possible integration. Their use relative to evidence of war can also signal either a breakdown in relations or shifts toward more peaceful relations.

Question 3: Does Coalescent migration occur while some Middle Missouri groups still occupy the southern extent of the study region?

Coalescent and southern Middle Missouri villages with evidence of warfare are dated to determine if villages from both groups overlap temporally. There is proxy

evidence for warfare during Coalescent migration because the first Coalescent villages were fortified (Kivett and Jensen 1974; Steinacher 1984; Toom and Kvamme 2002). However, it is unclear if both Middle Missouri and Coalescent groups lived in the south simultaneously. There is some evidence that at least some Middle Missouri villages were occupied at the time of Coalescent arrival (Johnson 2007a:179), but the number of villages, the extent of their temporal overlaps, and their occupational durations relative to Coalescent arrival and warfare must be answered by the new chronology. If both groups occupied the south simultaneously, then the evidence of warfare may be due to migrant-local interactions.

Similar to Question 1, this question also answers other questions the existing archaeological evidence cannot address, specifically migration and destination conditions. While dating southern Middle Missouri villages, the presence or absence of warfare in the region immediately preceding Coalescent migration is determined. This provides some understanding of the nature of violence in the south prior to migrant arrival.

Question 4: Do Coalescent groups abandon the practice of building fortifications after Middle Missouri groups leave the area?

The practice of building large, fortified villages is relatively rare among Coalescent groups and is attributed to the first Coalescent villages established in the south (Johnson 1998). The practice is rare among their ancestors or close descendants. This suggests that Coalescent groups were fortifying for a specific reason (e.g., ethnic violence or resource scarcity from drought or population increase)

If fortifications among Coalescent villages are constructed only in the context of the earliest stages of migration, this may indicate initial tensions declined over time. If

these fortifications were constructed while Middle Missouri groups also occupied the south, then migrant-local warfare could explain their presence.

Question 5: Does evidence for intervillage warfare and/or migration among either Middle Missouri or Coalescent groups coincide with evidence for climatic shifts like drought cycles?

The last question in this study compares reported climatological data for the Missouri River Trench and surrounding areas to the processes of migration and warfare identified by the previous questions. As discussed throughout this study, stressful climatic conditions like droughts and drought cycles do not dictate the occurrence of war, but that does not mean that they cannot contribute to decisions to go to war.

Conclusion and Organization of The Dissertation

The remaining chapters in this study address the archaeological evidence, chronological data, and their integration to better understand how migrants and locals interact under certain conditions. Chapter 2 discusses the relevant archaeological evidence related to the social groups analyzed in this study. Descriptions of pertinent material culture and practices associated with warfare are followed by a discussion of the current regional chronology and archaeological interpretations of migration and warfare. The chapter closes with a discussion of how a newer, high-resolution radiocarbon chronology can inform existing narratives of warfare and migration through a more detailed historical narrative.

Chapter 3 discusses the methodological underpinnings of the new radiocarbon chronology. The two primary methods discussed in the chapter are radiocarbon dating and Bayesian statistical modeling. This chapter identifies the sites dated and general

justifications for particular site choices, archaeological dateable materials, and Bayesian techniques.

Chapter 4 presents the new chronology. The results of individual village models and regional trends are presented. The five primary questions in this introductory chapter are discussed in relation to the chronological results. The chapter closes with an evaluation of the efficacy of the new chronology for answering these questions.

Chapter 5 combines the archaeological evidence from Chapter 2 with the chronological results from Chapter 4. During this portion of the analysis, the context for migrant-local relations among villagers of the Missouri Trench is brought together into a historical narrative.

The concluding chapter addresses future directions and new questions this research invites. The chapter closes with how the new narrative of warfare and migration in the Missouri River Trench can contribute to broader anthropological understandings of these processes worldwide.

Chapter 1 Tables

Table 1.1: Currently accepted date ranges for Late Woodland, Middle Missouri, and Coalescent Traditions. Dates taken from Johnson (2007a) and Ahler (2007).

Tradition	Variant	Calendrical Date Ranges (AD)
Middle Missouri	<i>Initial</i>	1000–1300
	<i>Extended</i>	1200–1500
Coalescent	<i>Initial</i>	1300–1500
	<i>Extended</i>	1400–1650
Woodland	<i>Late</i>	700–1200

Chapter 1 Figures

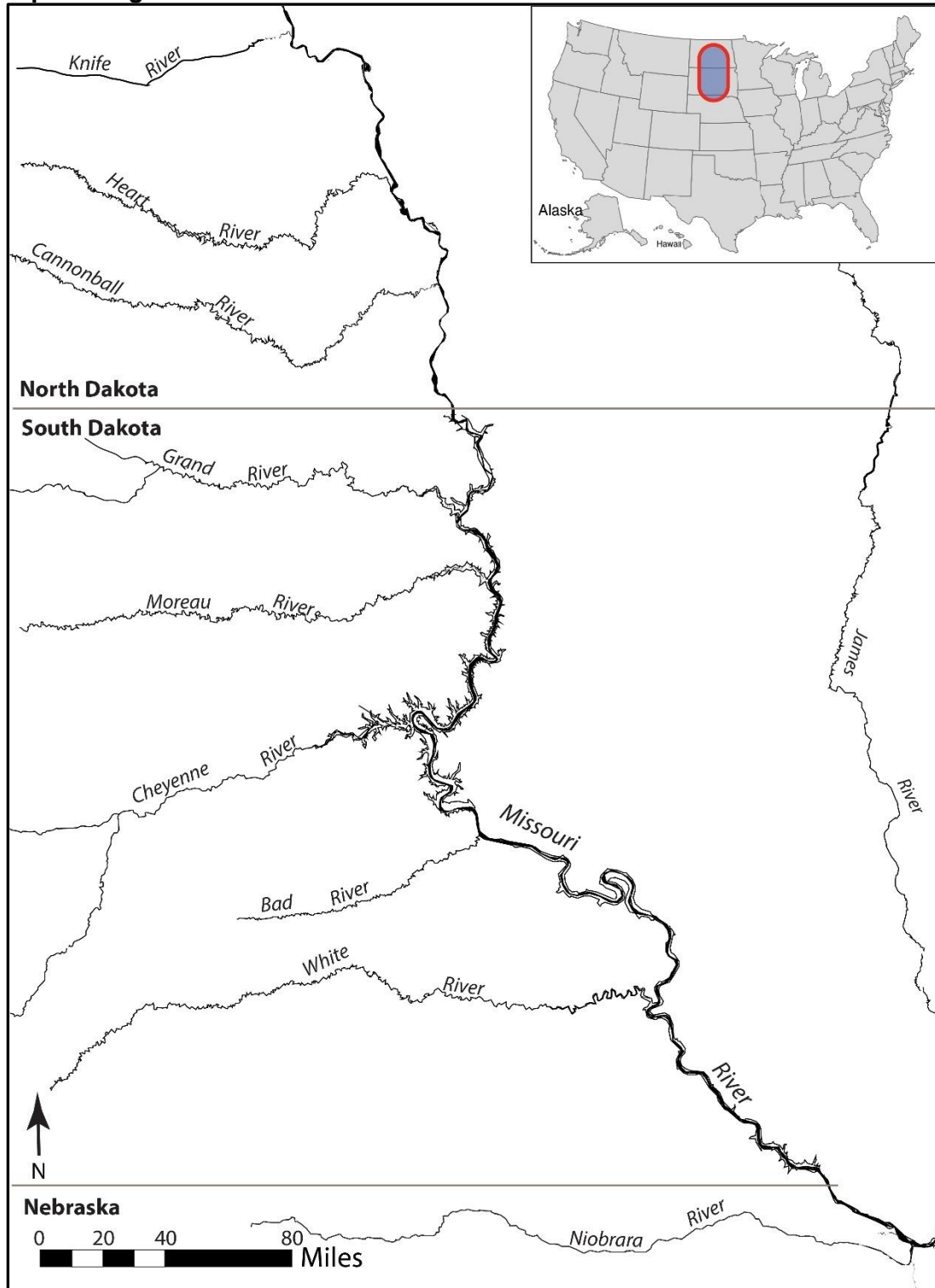


Figure 1.1: Map of the Missouri River Trench. Map of North America inset in the top right. Note that the area in blue is the general location of the Trench.

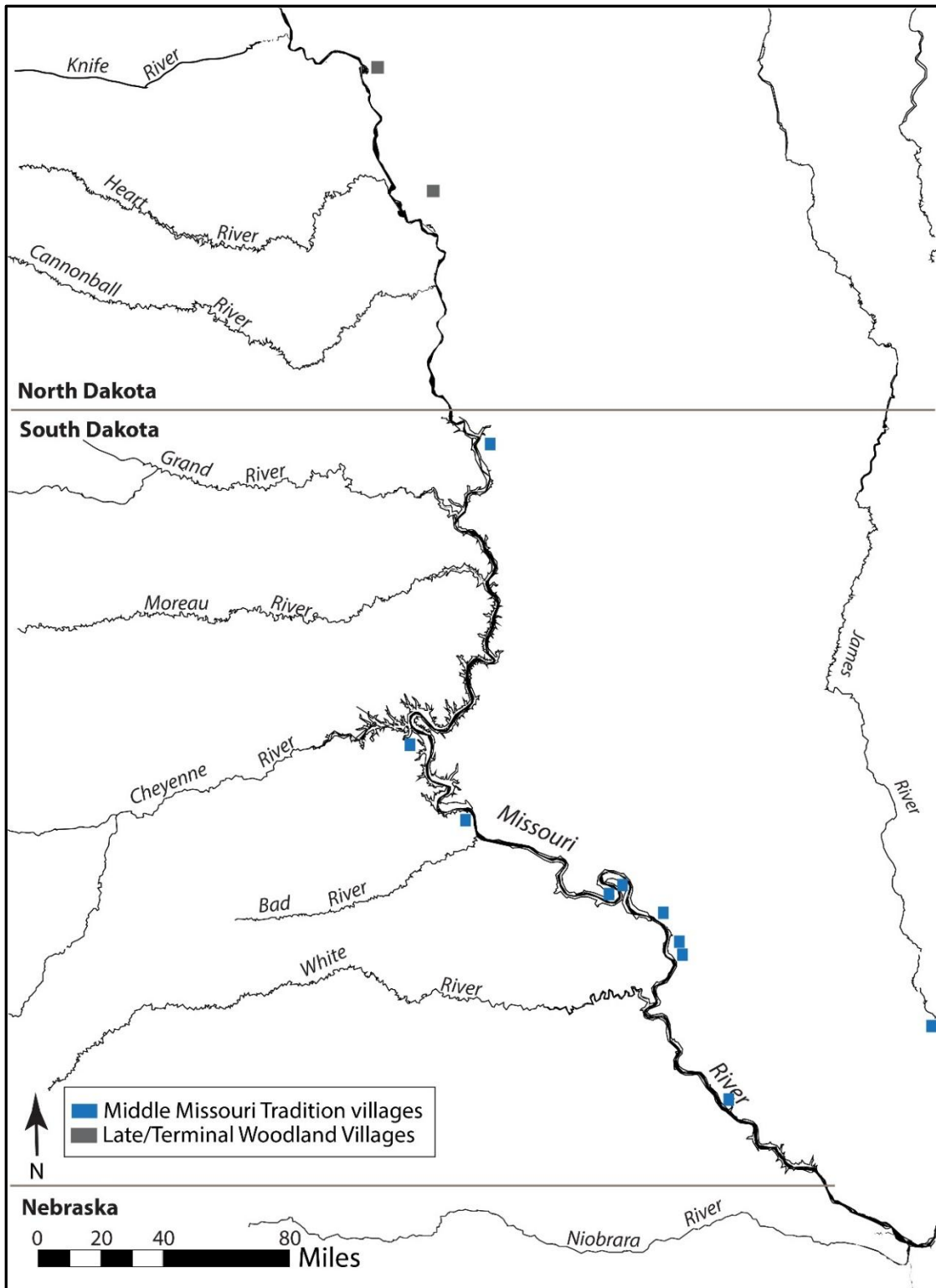


Figure 1.2: Settlement pattern on the Missouri Trench prior to the thirteenth century (adapted after Johnson 2007a).

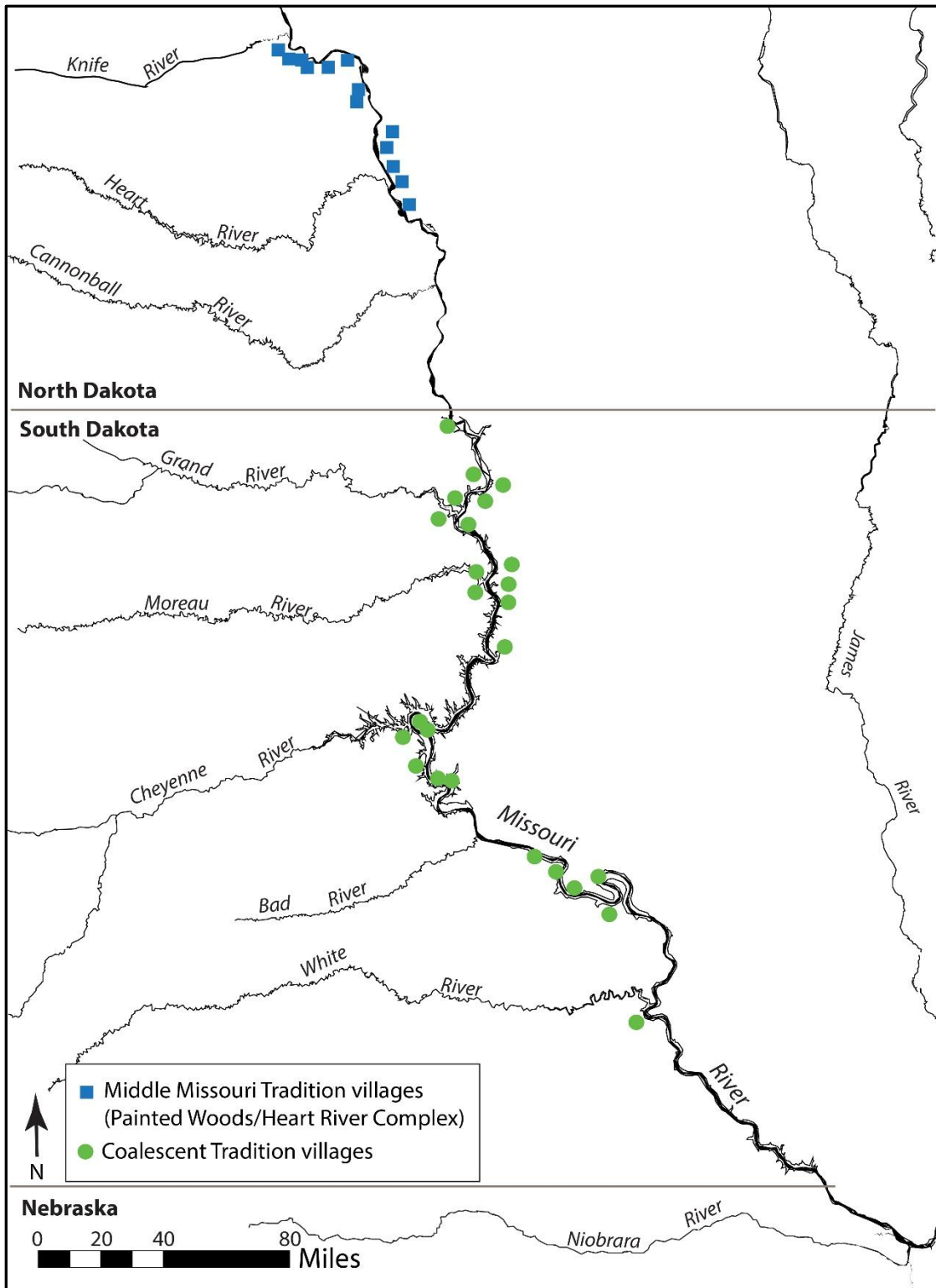


Figure 1.3: Settlement pattern on the Missouri Trench post-sixteenth century (adapted after Johnson 2007a).

CHAPTER 2

VIOLENCE AND MIGRATION IN THE MISSOURI TRENCH

This chapter discusses relevant background information, including the environmental setting, archaeological data, and ethnographic evidence related to Middle Missouri and Coalescent Tradition groups. A section on warfare provides archaeological and ethnohistoric evidence demonstrating Middle Missouri groups engaged in collective intergroup violence at a level that likely contributed to cycles of violence through time among Middle Missouri villages and between Middle Missouri villages and outsiders. The last sections of this chapter discuss the state of the current regional chronology and a framework for contributing to the narrative of war and migration in the Missouri River Trench.

Setting

The cultural area discussed in this study occurs in the North American Great Plains and encompasses the portion of the Missouri River Valley running through central North and South Dakota (Figure 2.1). This includes the Missouri River itself, the Missouri River Trench, and small portions of the Missouri Plateau uplands on either side of the Trench (Lehmer 1971). Archaeologically, it is often referred to as the Middle Missouri region or culture area (e.g., Lehmer 1971; Wedel 1961). However, as one of the primary archaeological cultures discussed in this study also retains the name "Middle Missouri," the terms "Missouri River Trench," "Missouri Trench," or just "Trench" will be used where possible to avoid confusion.

Although surrounded by relatively "flat" uplands on either side that constitute the Missouri Plateau, the section of Missouri River that runs between North and South Dakota is deeply incised, with wide floodplains (Lehmer 1971:49-53). This area consists of four physiographic zones (uplands, breaks, terraces, and floodplains) on either side of the river. Prior to the construction of hydroelectric dams and subsequent flooding in the mid-twentieth century, the difference in height between the river and the uplands on either side ranged between 200 to over 400 feet. Intermediate terraces between the river and uplands were as high as 100 feet in some areas. The floodplain in the Trench could stretch up to 2 miles in width in some areas.

Also, prior to the damming, vegetation along the Trench virtually matched the four physiographic zones listed above (Lehmer 1971:54-55; Rijord 2012:6-7). Dense stands of trees, including cottonwood, willow, and juniper covered the floodplain. The terraces and breaks above the floodplain consisted of grassland and few trees. The plateau on either side of the Missouri Trench favors different grasses. With its drier climate due to moisture loss from the Rocky Mountains, the High Plains to the west favor short grass or buffalo grass varieties. From the east bank of the James River to the Eastern Woodlands, the Prairie Plains gets moisture from the Gulf of Mexico that supports tall grass varieties and a greater number of animal species. The transitional zone between the Missouri River's eastern shores and the James River's western shores is an ecotone where mixed grasses grow and animal life from both prairie and plain converge.

Lehmer (1971) further subdivided the region based on the tributaries feeding the Missouri River, including the Big Bend, Bad-Cheyenne, Grand-Moreau, Cannonball, Knife-Heart, and Garrison River subregions, with Johnson (2007a:3) later adding the Ft. Randall subregion. These divisions are most helpful for dividing landscapes in the

Missouri River Trench into manageable subregions that can be easily referenced and compared (Figure 2.2). The localities of particular interest to this research are the Grand-Moreau and Bad-Cheyenne River valleys, between which a conspicuous occupational break occurs that divides the northern and southern study areas, specifically between the mouths of the Moreau and Cheyenne Rivers (Figure 2.3).

During the last millennium, Mandan, Hidatsa, and Arikara (also called the Three Affiliated Tribes), their ancestors, and other Indigenous groups occupied the Missouri River Trench (Trabert and Hollenback 2021:119-121). Throughout this time, these groups founded and abandoned hundreds of villages up and down the Trench. Archaeological research suggests that the daily lives and broader sociopolitical landscape of the village societies that existed there between AD 900–1887 were fluid, mobile, and highly interactive (Bamforth 2021; Mitchell 3013; Trabert and Hollenback 2021). Prior to European encroachment (ca. AD 1500), villages were typically short-lived (10–50 years with an average of 25 years; Lensink 2005), populations were semi-mobile, and intervillage warfare was common (Clark 2017, 2018; Mitchell 2013, 2018).

Archaeological Traditions: Middle Missouri and Coalescent

The current taxonomic system used to identify villages in the Missouri River Trench was a direct outgrowth of the archaeological salvage operations funded by the National Park Service and coordinated by the Smithsonian Institution during the River Basin Survey Program, which ran from the 1950s to 1970s in this region (Lehmer 1954, 1971; Lehmer and Caldwell 1966). Although taxonomies in the Missouri River Trench initially followed the Midwestern Taxonomic System, the current system is an adaptation of Willey and Phillips (1958), adopted for its utility in differentiating spatial trends in settlement and material culture (see Lehmer 1971 and Toom 1992a for overviews). The

taxonomic classifications referred to in the following paragraphs are meant to capture not only temporal but also spatial and cultural trends.

Revisions and additions to these taxonomies have been ongoing since the adoption of the Willey and Phillips system (e.g., Ahler 1993; Johnson 1977; Lehmer 1971; Lehmer and Caldwell 1966; Tiffany 1983; Toom 2004; Wood 1969). The nomenclature broadly encompasses ceramic and architectural practices grouped into two broad archaeological traditions: The Middle Missouri Tradition and the Coalescent Tradition. Archaeologists interpret the material culture associated with each to represent at least two distinct social groups (e.g., Johnson 1998, 2007a:91-137; Lehmer 1971; Lehmer and Caldwell 1966; Steinacher and Carlson 1998; Tiffany et al. 2011). Both traditions can then be further divided into subgroups, or 'variants,' representing temporal and geographic differences in material culture (i.e., Initial and Extended variants of the Middle Missouri Tradition or Initial and Extended variants of the Coalescent Tradition) (Table 1.1). Additional taxonomic subdivisions exist within these traditions (see Toom 1994a); however, they lack comparative utility in the current study and are not referenced herein.

This study acknowledges the limitations of the cultural-historical paradigm and resulting archaeological taxonomies (*sensu* Feinman and Neitzel 2020). The reification of these frameworks can homogenize and delimit the past in ways incongruent with current understandings of the fluid and complex processes that produce culture and society. Even the use of archaeological labels produced by these paradigms can produce "imaginary pasts" that privilege some research questions while limiting others (Beaudoin 2016:7).

The current culture history and taxonomic frameworks for the Missouri River Trench are not always ideal when one's objective is to identify and explain variability at

the subregional and community levels. When analyzed at the site level, it is apparent that artifact assemblages, villages, house groups, and houses often do not adhere unequivocally to the taxonomic structure. Despite their culture historical baggage, the labels "Middle Missouri" and "Coalescent" are retained throughout this study to refer to specific villages and the broad range of practices that are similar enough to read as an archaeological "culture." The most apparent reason for this continuity is that inhabitants of Middle Missouri and Coalescent villages participated in distinctly different practices and ideologies. This is demonstrated below. These groups also participated in two separate migrations at various times and places. Therefore, the two general terms are maintained to clarify to the reader which general group the text references at any time.

This study uses variant-specific terms (Initial and Extended) sparingly. They are utilized most frequently in this chapter for two reasons: for the sake of parity and alignment with how the regional literature references these groups (e.g., Mitchell 2013, 2018; Trabert and Hollenback 2021) and to delineate apparent differences between practices visible archaeologically in Middle Missouri and Coalescent villages. Without the high-resolution chronology presented in Chapter 4, referring to either Initial or Extended Middle Missouri or Coalescent villages is useful to signal their general temporal and material culture differences. Chapter 5 mostly abandons Initial or Extended qualifiers as they become irrelevant within a narrative underwritten by a high-resolution chronology.

This study also acknowledges that despite the similarities, those material signatures referred to as Middle Missouri or Coalescent, Initial or Extended, do not determine how individuals and groups in these communities responded to changing social and historical circumstances during the period in question. These terms are not meant to suggest that memberships in individual villages or other social groups would have been constant or bounded. Both group memberships and personal identities are

socially constructed and fluid inasmuch as individuals and groups continually negotiate their place within broader social and geographic landscapes (Chapman 2020; Fearon and Laitin 2000; Gerritsen 2003; Kuijt 2000; Varien and Potter 2008).

On the Plains, it was common that multiple levels of group membership (e.g., age societies, sodalities, or clans) formed networks of relationships that crosscut multiple scales of social interaction, including households, villages, and larger sociopolitical formations such as intervillage alliances (Mitchell 2013:14-17). At the individual level, identities were constantly negotiated based on daily interactions, kinship ties (e.g., exchange partners or marriages), and institutional membership (e.g., shifting memberships among village-level societies). In larger sociopolitical formations, networks often based around constructing kinship ties created an ever-emerging multiethnic landscape of exchange networks, loose political alliances, ethnogenesis, and wars (Mitchell 2013:16-17). People residing in thirteenth-to-sixteenth century villages along the Missouri River Trench were clearly more than just Middle Missouri or Coalescent villagers. In reality, the ways that past peoples related to one another in terms of the negotiation of identity, affiliation, and sources of tension may have taken place within, between, and among Middle Missouri and Coalescent villages in ways more complex and changeable than some archaeological constructs permit.

The Middle Missouri Tradition: Southern Locals, Northern Migrants

The oldest of the two primary archaeological traditions analyzed in this study is the Middle Missouri Tradition (ca. AD 1000–1500). This taxonomic toponym is sometimes conflated with its regional referent, the Middle Missouri region. The individuals inhabiting Middle Missouri villages are associated with the Siouan-speaking ancestors of the Mandan, or Numakaki, and possibly the Hidatsa (Bamforth 2021:339;

Mitchell 2013; Trabert and Hollenback 2021; Wood and Irwin 2001). Archaeologically, this cultural tradition is defined by ceramic types, house construction, village layouts, and lithic raw materials (Johnson 2007a; Lehmer 1971).

Middle Missouri houses are rectangular, semi-subterranean gabled structures with southeast-facing entrances. The archaeological literature refers to these structures as earthlodges (Johnson 2007a; Lehmer 1973; Winham and Calabrese 1998; Wood 1967) (Figure 2.4). Houses are typically organized into irregular rows in villages (Figure 2.5). Approximately one-third to one-half of Middle Missouri villages have fortification systems comprising palisade-backed ditches and, occasionally, integrated bastions (Bamforth 2006, 2021; Wood 2001). Middle Missouri ceramics are characterized by grit-tempered vessels with decorated, flared, and S-shaped rims (Lehmer 1971:72; Tiffany 2007:6; Wood 1967:128). Lithic assemblages comprise notched triangular points of Knife River Flint from northern North Dakota and local raw materials (Ahler 1977a, 2007; Johnson 1984).

Regional archaeologists further subdivide Middle Missouri villages into Initial and Extended variants (Lehmer 1971; Lehmer and Caldwell 1966). They attempt to differentiate these variants according to ceramic frequencies, trends in house size, village layout, lithic raw materials, and sometimes the abundance of extra-regional exchange goods common to a specific variant (discussed below). Although both Initial and Extended Middle Missouri variants are characterized by grit-tempered ceramics with flared and S-shaped rims, quantitative differences in the frequencies of surface treatments are observed. Ahler succinctly points out that "the primary ceramic features distinguishing [Initial] and [Extended] variants are the use of a cord-wrapped paddle in [Initial variant assemblages] versus a grooved (simple-stamp) paddle in [Extended

variant assemblages], and differences in decorative motifs (but not particularly decorative technique or vessel form) between the two variants" (2007:30).

A third variant, the Terminal Middle Missouri, is sometimes utilized to identify the latest Middle Missouri villages (Johnson 2007a; Lehmer 1971; Lehmer and Caldwell 1966). This variant is essentially a subgroup of the Extended variant, and most researchers referencing this taxon cannot agree upon which villages to include in this category, with the exception of Huff village (*sensu* Mitchell 2013:213-214). For the purposes of this study, those villages variously identified as Terminal variant villages are included in the Extended variant, and their relationships to other sites will be determined based on absolute dates as opposed to material patterning.

The earlier Initial Middle Missouri villages (ca. AD 1000–1300) occur in the southern Missouri River Trench (typically south of the Cheyenne River), Iowa, and Minnesota. The later Extended variant villages (ca. 1200–1500 AD) occur exclusively in the Missouri River Trench, but are found in the north and south, with most villages occurring north of the Moreau River (Johnson 2007a; Lehmer 1971; Toom 1992a; Wood 2001). Village size and population generally increase between the Initial and Extended variants. While early Extended variant villages are equal in size to Initial variant villages, many later Extended variant villages increase in size by approximately 25 percent (Mitchell 2013:63) (Figure 2.4).

Trends in village layouts and organizational patterns also vary between Initial and Extended variants. Not only are Extended variant villages often larger, but the total number of villages identified is less than that of Initial variant villages (Mitchell 2013; Winham and Calabrese 1998). This suggests population aggregation into larger villages between the Initial and Extended variants. Regarding village organization, plazas and large, adjacent "ceremonial" earthlodges often occur in Extended variant villages

(Johnson 1999; Mitchell 2013:66,166; Winham and Calabrese 1998:287; Wood 1967:156). Excavations and geophysical surveys demonstrate that areas identified as plazas are likely community areas or maintained spaces having neither storage pits nor hearths found in their borders (Bamforth 2021:Figure 10.2; Kvamme 2008; Kvamme and Ahler 2000; Mitchell 2008, 2013:66).

At the house level, Initial variant houses are typically half the size of later Extended variant houses (Mitchell 2013:65) (Figure 2.4). Many Extended variant residential structures are large enough to house multiple families, suggesting a possible shift in household memberships (Tiffany 2007:11). The practice of building houses in irregular rows, although found in some Initial variant villages, is more common at Extended variant villages where house rows tend to be more linear and regular (Mitchell 2013:67-68). House groups—sets of two or more closely spaced houses with doorways oriented slightly toward one another—also appear in some Extended villages (Mitchell 2013:177).

Other differences between the practices of Initial and Extended Middle Missouri village inhabitants include those associated with non-local goods. Initial Middle Missouri lithic assemblages tend to contain higher percentages of Knife River Flint, a chert that outcrops hundreds of miles north of Initial variant villages (Ahler 2007; Johnson 1984). Initial variant assemblages also contain non-local exchange goods originating from the south, including marine shell from the Gulf of Mexico and Cahokian (or Cahokian-inspired) ceramics from the Eastern Woodlands (Tiffany 2003). Extended variant assemblages contain lower percentages of Knife River Flint (Ahler 2007; Johnson 2019:155-159). They also present evidence of interactions to the east (e.g., Great Lakes copper and catlinite) and west (e.g., dentalium and olivella from the northwest coast) (Hill and Neuman 1966; Lippincott 1997; Ludwickson et al. 1993; Picha and Swenson

1997; Sperry 1995; Tiffany 2007; Wood 2001). Mitchell suggests that two highly structured, competitive exchange networks existed at different times between Middle Missouri villagers and those outside the region (2007, 2013, 2018).

The evidence above suggests that Initial variant occupations comprise smaller villages, smaller houses, intervillage warfare, and competitive north-south exchange networks. Population aggregations characterize Extended variant occupations into larger villages with community-centered practices, participation in east-west exchange networks, and fewer fortified villages. This suggests that inhabitants of later (Extended) villages participated in inclusive institutions and ideologies that may have facilitated integration among aggregating villages and shifting household memberships.

Although village- and household-level changes evidently occur between Initial and Extended variant villages, the existing taxonomic categorizations and a lack of temporal resolution in the current regional chronology mask the details of such changes in terms of social practices as they played out "on the ground." The observed differences between Initial and Extended variant villages (with the exception of ceramic frequencies) are general and qualitative. Not all villages identified as Initial or Extended hold to these trends. For example, multiple Extended variant villages (e.g., Clark's Creek, Paul Brave, and Jake White Bull) are closer in size to Initial variant villages rather than other Extended variant villages. Similarly, at least one Initial variant village, Sommers, is closer in size to later Extended variant villages and contains evidence of at least one plaza and a ceremonial lodge (Figures 2.5 and 2.6) (Jensen 1965; Johnson 1979). At Sommers, the largest house excavated (XU80) is adjacent to the largest space without evidence of structures (i.e., a possible plaza) (Steinacher 1990:47-66).

The current regional chronology also limits the analysis of these social shifts. Much of the previous work creating regional chronologies for the Missouri River Trench

focuses on the relative ordering of taxonomic categories (Caldwell 1966b; Lehmer and Caldwell 1966) or identifying absolute date ranges for taxonomic units (Johnson 2007a; Thiessen 1977; Toom 1992c). Furthermore, the current regional chronology only divides time into centennial periods between the eleventh and fifteenth centuries (Johnson 2007a) (Figure 2.7). From this resolution, it is impossible to know if the changes between Initial and Extended variant villages occur simultaneously or at differential rates within various spatial, temporal, and social scales.

A Note on the Extended Middle Missouri and Integration with Late Woodland Groups

There is a long-running debate about whether the Initial and Extended variants represent two separate "peoples" or a single, emically defined society (Ahler 2007; Mitchell 2013:57-59; Winham and Calabrese 1998). The case for separate Initial and Extended "people" as different sociocultural groups relies on untenable cultural historical categories and the availability of limited numbers of radiocarbon dates.

Research suggests that Initial and Extended variant taxonomic categories overlap temporally to some degree (e.g., Ahler 2007; Caldwell 1966b; Hurt 1953:60-61; Johnson 2007a; Lehmer 1971; Lehmer and Caldwell 1966; Mitchell 2013; Tiffany 2007; Toom 1992b; Wood 2001). The most current chronology indicates that Initial and Extended variants could overlap temporally, but the resolution is insufficient to confirm this (Johnson 2007a) (see Table 1.1). The temporal overlap between Initial and Extended variant villages initially led to a longstanding interpretation that Initial and Extended villages represent different cultures, possibly descended from a shared cultural antecedent (e.g., Caldwell 1966b; Lehmer 1971; Wood 2001; but see Winham and Calabrese 1998). These arguments typically contain strict culture historical frameworks and vague concepts of culture. Wood (2001:192) states:

...the Extended variant is so ceramically distinctive it cannot represent a simple outgrowth of the Initial variant. On the other hand, its cultural content clearly demonstrates an intimate relationship to the Initial variant, and it probably derives from a common parent stock.

However, Johnson (1999) suggests that ceramic differences between Initial and Extended variant assemblages, while evident, are primarily based on frequencies of the two principal pottery types (flared and S-shaped rims) used by both groups and not on differences in form and decoration, or technology.

Although there is no reason to argue with the aforementioned observations from a taxonomic point of view, these assumptions derive from an untenable theoretical paradigm. Narratives accepting that people associated with Initial or Extended villages are culturally distinct groups run afoul of the residual culture historical mistake of equating archaeological cultures to social formations as people perceived them in the past. Approaching the argument of "who were the Extended Middle Missouri people" from a culture historical and taxonomic standpoint necessitates assuming static, bounded social formations consisting of automatons recreating norms. This study aligns with more recent research suggesting that taxonomic categorization necessarily oversimplifies questions of identity (e.g., Bamforth 2021, Bamforth and Nepstad-Thornberry 2007b; Clark 2017, 2018; Johnson 2007a; Mitchell 2013, 2018; Trabert and Hollenbeck 2021).

Ahler (2007, see also Mitchell 2013:56-59) presents the most recent arguments for Initial and Extended variant villages representing different sociocultural groups. His argument suggests that the Extended variant's material manifestations result from interactions between Initial variant peoples and northern groups from Late Woodland villages like Menoken and Flaming Arrow. In this narrative, Middle Missouri groups'

heavy reliance on Knife River Flint contributed to frequent interactions and strong relationships between Initial variant and Late Woodland groups. Ahler suggests that through these relationships a process of acculturation took place to produce the Extended variant.

Ahler's argument is based on similarities in material culture and radiocarbon dates. Although Late Woodland, Initial variant, and northern Extended variant sites are distinct from one another, there are multiple similarities, including aspects of architecture, ceramic forms and surface treatments, lithic raw materials and technology, and exchange goods (Ahler 2007:21-28; Johnson 2007a:109-111; Krause 2007; Mitchell 2013:56-59; Swenson 2003:351-352). The limited number of radiocarbon dates presented by Ahler also argues that the oldest Extended variant villages occur earlier in the north than in the south (2007:23). Ahler hypothesized that a blending of Initial Middle Missouri and Late Woodland groups occurred and, through a vague process of acculturation, produced the northern expression of the Extended Middle Missouri variant.

Similarities between these site types notwithstanding, the temporal argument for separate cultures is based on the assumption that Extended variant villages were established first in the north (possibly between the Knife and Heart Rivers) and later in the south. Scholars following this argument suggest the formation of a separate Extended variant people in the north and their subsequent migration south (Ahler 2007; Wood 2001). This interpretation is based on a limited number of radiocarbon dates yet to be critically evaluated by modern standards (e.g., Graf 2009; Pettitt et al. 2003; Spriggs 1989; Spriggs and Anderson 1993) or subjected to methods allowing for the formal evaluation of sets of radiocarbon dates (e.g., Bayliss 2009; Bayliss et al. 2011; Bronk Ramsey 2008). Without a center of emergence (i.e., the northern Missouri River Trench) spatially and temporally removed from Initial variant villages, the assumption that these

are a distinct people would seem less likely. Furthermore, the assumption that a separate social or cultural group formed in the north and migrated south begs the question, "Where did the 'Initial Middle Missouri people' go if not north?" There is little evidence for Middle Missouri villages anywhere else at this time. The radiocarbon chronology presented in subsequent chapters will ultimately test this assumption of a northern emergence and subsequent migration south by virtue of the breadth of dated villages.

The identities of Extended variant villagers are a complicated topic requiring clarification of what is meant by a "people," be it biological, social, cultural, or temporal. Such a discussion is outside the scope of this work. Although there is enough continuity in practices between inhabitants of Initial and Extended variant villages, the similarities between Late Woodland and Middle Missouri villages cannot be denied. The evidence of similarities between northern Late Woodland and Middle Missouri practices suggests a degree of integration between these people, as suggested by Ahler (2007) and Mitchell (2013:56-58).

The Coalescent: Southern Migrants

Far less work focuses on the Coalescent Tradition than the Middle Missouri Tradition. This can be attributed to two factors: (1) While there are hundreds of Initial Middle Missouri villages, only ten early, Initial Coalescent villages are known (Fox 1980; Johnson 1998; Lehmer 1971:112; Steinacher 1983); (2) Later, Extended Coalescent villages, while more numerous, produce more ephemeral archaeological signatures because they are typically smaller, unfortified, short-lived villages with fewer houses (Johnson 1998).

As with Middle Missouri villages, Coalescent villages are divided into Initial and Extended variants, representing early and later villages (Johnson 1998; Lehmer 1971). Unlike the competing narratives surrounding the identities of Initial and Extended Middle Missouri villagers, consensus among regional scholars is that inhabitants of Extended variant Coalescent villages are almost certainly the ancestors of the inhabitants of Initial variant Coalescent villages (Bamforth 2021; Caldwell and Henning 1978:133; Gover et al. 2021; Lehmer 1954:159, 1971:115, 120, 127; Ludwickson 1979:57; Spaulding 1956:109; Strong 1940:382; Zimmerman and Bradley 1993:224). People associated with Coalescent villages are believed to be descendants of Caddoan-speaking peoples from the Central Plains and the ancestors of the Arikara and Pawnee (Bamforth 2021:339; Krause 2016).

Coalescent residential structures are distinct from those of Middle Missouri, though both are generally referred to as earthlodges (Johnson 1998). Coalescent houses are semi-subterranean, round or square, four-post structures finished with wattle-and-daub (Figure 2.8). The footprints of the largest Initial Coalescent residences are approximately 117m², while the largest Extended Coalescent houses are approximately 373m², creating more size variation among Extended variant houses (Johnson 1998:318). This suggests that greater variability in residence patterns occurs through time.

The settlement patterns of Coalescent villages also differ markedly from those of Middle Missouri villages. Initial Coalescent villages are typically larger than Middle Missouri villages (Johnson 1998). These villages consist of lower-density occupations in terms of house spacing and house clusters, interpreted as possibly reflecting waves of arriving migrants adding to village populations over time. While public or communal places (sometimes defined as plazas) are present in some villages, they are rare

(Johnson 1998:318; Toom and Kvamme 2002). Most Initial Coalescent villages are located in the Big Bend locality of South Dakota (Figure 2.3). The Lynch site is an outlier among Initial Coalescent sites because it was constructed farther south than any other known Initial variant village, along the Niobrara River of Nebraska. The site is also atypical among other Initial variant villages because it is unfortified and dispersed across a much wider area than other known Coalescent villages (Lehmer 1971:114-115; Smith 1977:156; Witty 1962).

Winham and Hannus (1991:10-42) identify 26 sites with Initial Coalescent assemblages in the southern Missouri Trench. These identifications are derived primarily from ceramic types and frequencies. Only ten of these sites can be verified as actual villages instead of short-term occupations (Johnson 1998:313). All but three of these ten Initial Coalescent villages (Farm School, Medicine Creek, and Lynch) have fortifications in the form of ditches and palisaded bastions (Caldwell 1964; Johnson 1998:313), although additional investigations at Farm School and Medicine Creek would be needed to confirm this.

Conversely, Extended Coalescent villages were rarely protected by fortifications (Johnson 1998:318). Those with fortifications are found exclusively on the margins of the Extended Coalescent settlement distribution (i.e., those villages closest to Middle Missouri villages in the north and other non-Coalescent groups to the south) (Bamforth 2006:91-93; Johnson 1998:318). This suggests that concerns about violent incursions were directed away from other Coalescent villages and toward other groups to the north and south.

Initial Coalescent ceramic assemblages consist of cord-roughened, simple-stamped, or smoothed exteriors with simple or collarless rims (Steinacher 1983:71-72). Johnson (1998:316) notes that early Initial Coalescent assemblages resemble Central

Plains ceramic assemblages, while later Initial Coalescent assemblages contain higher percentages of ceramics characteristic of Extended Coalescent assemblages. Like Initial Coalescent assemblages, Extended Coalescent ceramics include simple-stamped or smoothed exteriors. Unlike Initial Coalescent assemblages, Extended Coalescent ceramic assemblages comprise thin-walled vessels with compact, sparsely tempered pastes (Johnson 1998:319). Incised or trailed rim decorations appear to decline in frequency over time, while straight or curved rims with tool impressions increase in frequency.

Lithic raw material assemblages among Initial and Extended Coalescent villages derive primarily from locally available raw material sources, unlike Middle Missouri assemblages that include large percentages of Knife River Flint. Local quartzites, cherts, and chalcedonies dominate these Coalescent raw material distributions (Johnson 1998:316). Whistling Elk, suggested to be the earliest Initial variant village in the Big Bend, contains a non-local lithic material known as Flattop Chalcedony that is also present in Central Plains assemblages (Toom 1983).

Middle Missouri-Coalescent Interactions

There is limited evidence of interactions between Middle Missouri and Coalescent Tradition groups prior to or after Coalescent migration. Caldwell (1966b:84) mentions that the occurrence of Anderson ware ceramics—ceramics associated with Initial Middle Missouri assemblages and identified by the presence of straight to curved rims (Lehmer 1951)—suggests that Coalescent and Middle Missouri groups had a long history of interaction. Bamforth and Nepstad-Thornberry (2007b:151-153) demonstrate that commonalities in ceramic styles evoke relationships that crosscut migrant and local villages. According to their study, evidence of these interactions occurs among Middle

Missouri more often than in Coalescent villages, and fortified Middle Missouri villages tend to have less evidence of interactions. Interestingly, they suggest little evidence of interaction in the assemblages of the earliest migrant villages (Black Partizan, Crow Creek, and Whistling Elk; Bamforth and Nepstad-Thornberry 2007b:147). Gover and colleagues demonstrate that prior to and during migration into the Big Bend, the occurrence of simple-stamped pottery found at the Lynch site may be evidence that Coalescent migrants had previously migrated into the Big Bend, interacted with Middle Missouri potters, and subsequently brought simple-stamping back south to Lynch (2021:223). Lynch is a long-lived (ca. cal yrs 1250-1350), large (80 ha) site in northern Nebraska and may have been the origin of some Coalescent groups entering the Missouri River Trench (Gover et al. 2021; Tiffany et al. 2011).

In Bamforth and Nepstad-Thornberry's work, the percentage of migrant pottery in local village assemblages was in the single digits (2007a:146-148). Likewise, it appears that neither Coalescent groups nor their ancestors participated in the same competitive exchange networks as Middle Missouri groups. Ludwickson and colleagues (1993:160) point out that columella pendants are found in many Initial Middle Missouri villages, but only one example exists among Central Plains villages to the south. Based on the aforementioned archaeological evidence, interactions between Middle Missouri and Coalescent groups seem to have been ephemeral.

A History of Violence Among Middle Missouri Groups

Violence and warfare loom large in archaeological discourse on the North American Plains. A recent volume edited by Clark and Bamforth provides a thorough overview of the current state of research on Plains warfare (2018). Evidence of violence is documented before the first villages but is often not directly linked to warfare

(Bamforth 2018:9-14). In the Missouri River Trench specifically, archaeological and ethnohistoric evidence of collective violence and warfare is well documented for the village period, ca. AD 900–1887 (e.g., Bamforth 1994, 2006, 2018; Bowers 1991, 1992; Caldwell 1964; Clark 2017, 2018; Ewers 1975; Kay 1996; Kendell 2018; Le Beau 2018; Lehmer 1971; Lowie 1917; Mitchell 2007, 2013, 2018; Owsley and Jantz 1994; Robarchek 1994; Willey 1990, 2018; Wood 1976). Robarchek suggests that by European contact, war was a "regional cultural institution" in the Missouri River Trench (1994:312, see also Mitchell 2007:156).

Archaeological and ethnohistoric evidence suggests a long history of endemic warfare on the Plains. This tradition of war (see Chapter 1) appears to have been deeply embedded in the social and ideological structures of Middle Missouri villagers from the Woodland ancestors of Middle Missouri groups into the cultural traditions of their Mandan descendants (Bamforth 2018).

Archaeological Evidence

Evidence for intergroup conflict in the Missouri River Trench is seen in defensible village locations and investments in fortification systems. Many Middle Missouri villages were built on prominent, easily defensible areas on the riverbank (Bamforth 2006). Ditches, palisades, and bastions are recorded at many sites (Bamforth 2006; Caldwell 1964; Clark 2017, 2018; Mitchell 2018; Wood 2001). Large-scale village burning events have also been documented by archaeologists (e.g., Clark et al. 2010:262-270; Wood 1976). Though the existence of fortifications or burned villages does not conclusively demonstrate that violent acts of conflict occurred, when considered together, they should be understood as evidence for conflict (LeBlanc 1999). Fortifications that include both palisades (sometimes with bastions) and v-shaped fortification ditches (Parkinson and

Duffy 2007) suggest communities were anticipating attack at some point during the village's occupation. Violent acts and events do not necessarily need to exist for populations to feel the presence of war (*sensu* Pauketat 2009).

While the practice of fortifying settlements in the Missouri River Trench was almost as old as the settled village life itself, other practices related to violent conflict, like trophy-taking, possible combat wounds, and warrior imagery have even longer histories (Bamforth 2018; Greer and Greer 2018; Holliman and Owsley 1994; Keyser 2018; Olsen and Shipman 1994; Seeman 1988). The practice of trophy-taking, inclusive of scalping, dates to at least the Woodland period (Olsen and Shipman 1994; Holliman and Owsley 1994; Willey and Bass 1978:6). Two Missouri River Trench examples of this practice occurring between the thirteenth and sixteenth centuries come from villages dated in this study (Fay Tolton and Crow Creek) (Holliman and Owsley 1994; Willey and Emerson 1993). At Crow Creek, Bamforth indicates that scalping and removal of hands and feet (nearly 100% of victims, per Emerson and Willey 1993) is common practice among Plains groups Post-Contact, suggesting a continuation of ideologies related to violence and social standing (2021:317). This rationale could also apply to victims of violence identified at the earlier Fay Tolton site, who also exhibited signs of scalping (Holliman and Owsley 1994). Victims at both villages also showed signs of previously healed wounds from arrows and scalping attempts.

Cross-cultural and ethnohistoric evidence suggests that the ownership of enemy scalps was an insult to one's enemy and a sign of power and dominance (Hall 1997:65; Keely 1996:102; Seeman 2007:171). The ownership of noncombatant scalps (children, elderly, sick) was seen as a sign that a warrior had penetrated the defenses of an enemy village (Kendell 2018:320). Among the Mandan, scalps were also seen as items of value and prestige that marked a combatant's success in battle. Mandan warriors displayed or

gifted scalps after successful war expeditions (Bowers 1991:56, 71, 74). Scalps were often displayed during Scalp Dances or as part of a structured practice of displaying war honors and status.

Wounds from interpersonal combat are visible on human remains from the Woodland to Post-Contact periods (see Bamforth 2018 for an overview). Interpersonal violence in the form of human remains bearing perimortem trauma is seen at multiple Woodland sites (e.g., Neuman 1960). This evidence tends to coincide with possible trophy-taking and displaying of enemy body parts (Seeman 1988). Skeletal trauma during the village period is related to village raids and massacres (Holliman and Owsley 1994; Owsley 1994; Willey and Emerson 1993; Willey 1990, 2018; Wood 1976; Zimmerman et al. 1981).

Although early evidence of skeletal trauma in the northern Plains cannot always conclusively be interpreted as signs of warfare, Bamforth suggests that warfare-related imagery shows the practice was socially and ideologically embedded in many Plains groups (including those in the Missouri River Trench) as early as the Woodland period (2018:12-14, see also Keyser 2018; Keyser and Poetschat 2014; Ray 2007). He suggests that images depicting shield lines are evidence of an organized approach to combat, while images incorporating shield heraldry are possible early evidence for the warrior societies so common among Post-Contact Plains groups. Imagery of individuals counting coup is evidence of social status related to warfare. Also, Ceremonial-tradition rock art may depict individuals gaining spiritual power through their shields. These warfare motifs increase in frequency in the Missouri River Trench concomitantly with villages and fortification technology (Bamforth 2018:13).

Ethnohistoric Evidence

Ethnohistoric evidence demonstrates that war was frequent and interwoven into Plains lifeways. Ewers remarks, "It was much easier to start a war than it was to end one, and that hostilities between neighboring tribes persisted from generation to generation" (1975:398). At the village level, warfare pervaded many institutions. In the calumet ceremony—a multiday ceremony involving the creation of fictive kinship bonds that regulated intervillage exchange—military agreements were often made and mock skirmishes held between two groups meeting to initiate trade (Blakeslee 1975:152-154, 1981:776; Fletcher 1996). Age-based societies related to training for and participation in war were common among sedentary and nomadic groups of the Upper Missouri River. Among the Hidatsa, the Stone Hammer society held preannounced night-time raids in their own villages, and participants were punished or rewarded based on their capabilities to steal from lodges (Bowers 1992:134-135). For the Crow, this society taught boys combat through mock battles (Lowie 1913:186-188). Both the Mandan and Hidatsa had the Black Mouths or Brave Warrior Society (also referred to as the Soldier Society or Brave Men's Society by Maximillian [1906]), a highly organized, militaristic society of middle-aged men considered to be the bravest warriors in a village (Bowers 1991, 1992; Lowie 1913). This society wielded considerable martial power and prestige. Not only did the Black Mouths participate in village raids, but they were responsible for village defense and enforcement.

At the individual level, multiple studies highlight the importance of war medicine, war honors, and success in combat among Post-Contact Plains villagers (e.g., Bowers 1991; Ewers 1975, 1993; Lowie 1913, 1917). Alfred Bowers provides the most comprehensive evidence demonstrating that participation in war was integral to an individual's life and status in Mandan society (1991). Warfare often created a competitive

environment between individuals and between moieties. Success and leadership in the war were tied to social, economic, and political standing. Boys were taught from a young age about their fathers' war records. Fathers handed down war medicine. Gifts, celebrations, offers of marriage, and naming ceremonies were given upon a member's return from participating in their first successful war party, especially when they achieved specific goals in combat. Upon the return from successful raids, villagers held celebrations where scalp dances were performed, and the warriors who had not returned would be remembered. The recording and displaying of war honors were also formalized and scrutinized by others of authority. To be identified as a war leader was also a significant moment in one's life that brought more responsibilities, prestige, and material gain. Although not a requirement, high-ranking individuals, including chiefs, were expected to have long, successful war records. Conversely, shame was gained after unsuccessful expeditions as failure in war could inhibit social mobility for an individual or their family members. Likewise, unsuccessful war leaders might be met with opposition the next time they attempt to advance socially in any way. These unsuccessful leaders might also fast and mutilate themselves as penance for the individuals in their war party who were killed (Bowers 1991).

Causes of War: Raiding and Trading

Explanations for conflict among precontact village groups in the Missouri River Trench often cite general conditions like regional population pressure, ethnic strife, and environmental uncertainty (e.g., Bamforth 1994, 2006, 2021; Bamforth and Nepstad-Thornberry 2007b; Hollimon and Owsley 1994; Kay 1996; Mitchell 2007, 2018; Toom 1992a; Willey 1990; Zimmerman and Bradley 1993). Some studies also present the possibility of incipient warfare among villages and nomadic communities in the region,

but this hypothesis is difficult to test (e.g., Clark 2018; Hollinger 2005; Mitchell 2007). Documented ethnohistoric evidence for what sparked specific wars includes situations common to many village societies, such as revenge, jealousy, elopement, kidnappings, and establishing villages in contested areas (e.g., Bowers 1991:71, 74, 80-81, 95; Ewers 1994:191; Stewart 1974:292).

Proximate causes can always be cited for war, but there are often underlying conditions also affecting patterns of war. Among Middle Missouri villagers and their Mandan descendants, participation in expansive trade and exchange networks are practices perpetually associated with warfare (e.g., Ewers 1997; Mitchell 2007, 2013, 2018; Tiffany 2007; Wood 1967). Mitchell (2013:16-17) points out that

"...archaeological data from sites of all ages located up and down the river attest to Middle Missouri tradition communities' habitual participation in trade of various kinds (Wood 1974, 1980). However, the relations it entailed and the routes along which it flowed changed over time."

These networks were also competitive, leading either directly or indirectly to intervillage violence. It is likely that during this long history of participation in competitive exchange networks, a tradition of war embedded itself within society.

Prior to Coalescent migration, much of the early intervillage war in the region may have been structured by disputes and competition between members of different Middle Missouri villages participating in north-south exchange networks (Johnson 2019; Mitchell 2018; Tiffany 2007:13-14). These networks of exchange included extraregional items from the Eastern Woodlands (e.g., marine shell from the Gulf of Mexico, forked-eye motif ceramics, and Ramey-like red-slipped wares) and large amounts of Knife River Flint from the north (Alex 1981; Ahler 2007, 1977; Johnson 1984, 2019; Lehmer 1971:98-99; Mitchell 2010: 126-127; Tiffany 2007). This "river-focused system" of

exchange placed Middle Missouri villagers between Mississippian exchange partners to the south and Late Woodland partners to the north (Mitchell 2013:86). Competitive exchange networks appear to have evolved from these networks and members of villages competed or cooperated for access to and control over goods and networks to the north and south. The patchwork pattern of fortified and unfortified early Middle Missouri villages supports this narrative. Tiffany also suggests that wealth accumulation from early north-south exchange networks sparked increased competition and collective violence that may have been integral to forming the first Middle Missouri villages (2007:13-14, see also Lensink 2005:155; Mitchell 2018). Tiffany's scenario would fit Roscoe's conception of village formation and aggregation for protection among small-scale societies (2009:105-108).

With the emergence of later (Extended) villages, lower frequencies of Knife River Flint and extraregional goods from the south are considered evidence for a "collapse," or at least decline, in north-south exchange networks (Ahler 2007; Johnson 2019:155-159). New exchange networks among Extended variant villages developed that incorporated groups living to the west, north, and east. Extended variant assemblages like Cattle Oiler Late, Havens, and Travis I often contain Great Lakes copper and red pipestone from the east as well as marine shell from the northwest coast (Haberman 1982:363; Hill and Neuman 1966; Jones 1969:21; Lippincott 1997; Ludwickson et al. 1993; Picha and Swenson 1997; Sperry 1995; Tiffany 2007; Wood 2001). Knife River Flint in Mortlach phase assemblages (possibly ancestral Assiniboine) in the Saskatchewan River Basin also suggest northern exchange networks (Mitchell 2013:86-87). Mitchell suggests that these new, broader exchange networks eventually developed into a complex political-economic landscape of intervillage competition and strategic alliances largely based on external trade (2007, 2013, 2018).

The Current Chronology

While primarily based on culture historical terminology and reasoning, the use of radiocarbon dating to anchor regional chronologies of the Missouri River Trench has been a continued focus since the River Basin Surveys in the Missouri River Trench (Johnson 2007a; Lehmer 1971; Thiessen and Nickel 1975; Toom 1992b). The most recent and comprehensive regional chronology of village settlement is reported by Johnson (2007a). The chronology places each village into periods ranging from 100-year intervals prior to AD 1500 to 50- and 35-year intervals post-AD 1500 (Figure 2.7).

The Johnson (2007a) study, while more rigorous than preceding radiocarbon chronologies for the region, has some limitations. The chronology does not present dates at a finer resolution than centuries for pivotal points like the arrival of the first migrants associated with the Initial Coalescent or the founding of the first unfortified Coalescent villages (Figure 2.7). Placing villages into 100-year periods limits their analytical utility. It obscures the ability to demonstrate village overlap in individual periods because they all appear to exist concurrently within the same period. Similarly, this practice lacks the ability to show whether a village may have overlapped between two consecutive periods. By creating a higher-resolution chronology that more closely captures the occupational ranges of villages, this study produces a more realistic view of the flow of time in the region. Such resolution presents village occupations as corporeal events that temporally overlapped and occurred in real-time instead of confining them to arbitrary blocks of time that may not accurately represent the occupational duration of each village.

Another limitation of the current chronology is the method with which radiocarbon dates were interrogated and utilized. In that chronology, the method for producing more

manageable date ranges for individual villages was to average uncalibrated radiocarbon dates and then calibrate those averages (Ahler et al. 2007:57-87). This practice does nothing for estimating the longevity of an event (e.g., a village's founding) or phase (e.g., a village's occupational duration). Likewise, because most villages in the Missouri River Trench were likely only inhabited for a generation or less (Lensink 2005), dates with errors greater than 100 years were not included in the chronology as these errors would produce averaged date ranges so long that they would not be useful when placing a village in one of the predetermined periods (Ahler et al. 2007). A chi-square test was performed on any set of radiocarbon dates that would be averaged. The assumption was that any dates that did not pass a chi-square should be disregarded because they were not drawn from the same statistical universe and, ostensibly, not representative of a short-term village occupation. This method forced the authors to discard many radiocarbon dates that would otherwise be completely acceptable in a Bayesian model and limited the radiocarbon portion of the chronology to only those villages with short-term occupations.

This chronology has been used productively by scholars of the Plains to investigate and refine a multitude of questions and themes in the Missouri River Trench (e.g., Bamforth 2021; Clark 2018; Mitchell 2013; Trabert and Hollenback 2021). Despite its net-positive contribution to regional chronology-building, it does not provide researchers with the level of resolution necessary to answer some of the most basic and pressing questions about settlement patterns and associated cultural processes. For our purposes here, paramount among these is the contemporaneity of Middle Missouri and Coalescent variant villages. Contemporary archaeologists still do not have a clear understanding of whether Middle Missouri villagers were occupying the Big Bend and Fort Randall subregions (Figure 2.2) when Coalescent groups migrated into the area. A

related question is when groups associated with the Middle Missouri 'abandoned' the southern portion of the Trench. Archaeologists still struggle to assess the contemporaneity of fortified and unfortified villages or when Coalescent groups stopped building fortifications. All of these gaps in knowledge have a bearing on how warfare in the region is conceptualized.

Toward A New Narrative of Migration and Warfare in The Missouri River Trench

Many existing explanations for war and migration of Middle Missouri and Coalescent groups require assumptions about the contemporaneity of village occupations that cannot be verified with the resolution provided by the current chronology. One way to test these assumptions is through historical and multiscale perspectives that approach the history of migration and warfare in the region as sequential interactions between and among individuals and groups across time and space that contributed to both short-term pivot points and long-term processes. Such an approach must be underwritten by a high-resolution chronology that matches the temporal scales of the current historical narrative. The work here incorporates such a view of the past by building upon recent research on conflict and migration from a historical and multiscale perspective. This research incorporates methodological and theoretical advancements as well as ethnographic data to understand the causes and effects of conflict at multiple sociopolitical scales (e.g., Chacon and Mendoza 2007; Keeley 1996; Roscoe 2008). This perspective acknowledges conflict as resulting from the convergence of multiple social, political, environmental, and other historical processes. The key to this approach is a historical perspective supported by a high-resolution radiocarbon chronology that can achieve the detail and range of temporal scale necessary to identify the contemporaneity of villages.

A Higher Resolution Chronology

Archaeologists have always dealt with issues of time and sequence in interpretations of the past. These issues include palimpsests that truncate events and dating techniques that artificially extend them (*sensu* Bailey 2007, 2008; Bayliss and Whittle 2019; Bayliss et al. 2007, 2011; Bronk Ramsey 2008; Hamilton et al. 2015; Whittle 2018; Whittle et al. 2011). These limitations distort our interpretations of the flow of time. This lack of temporal resolution results in interpretations of archaeological pasts that appear timeless or comprise vague, generalized processes appearing to occur over centuries or more. What is needed are refined absolute chronologies that permit enhanced interpretations of cultural processes at both local and macroregional scales. In order to produce a more detailed narrative of migration and warfare in the Missouri River Trench, a method of chronology construction is required that identifies events at the appropriate temporal scales to interpret village-level histories and occupational durations. In this study, both decadal and centennial time scales are used to reconstruct histories of migration and conflict.

Since the latest revolutions in radiocarbon dating, including advances in pretreatment, measurement, calibration, and the adoption of Bayesian chronological modeling, archaeologists have been able to ask more specific questions about the past based on these more detailed temporal sequences (Bayliss 2009; Bronk Ramsey 2008; Buck et al. 1991). Such chronologies have revolutionized our understanding of the past around the world (Abel et al. 2019; Banks 2015; Bayliss et al. 2007; Birch et al. 2021; Hamilton et al. 2015; Kennett et al. 2014; Krus 2016; Krus and Peteranna 2016; Manning et al. 2018, 2019; Thompson and Krus 2018; Whittle et al. 2011; Wood 2015). Prior to the use of Bayesian modeling of radiocarbon dates, two common techniques

were employed for investigating suites of radiocarbon dates: date-averaging and "eyeballing"—stacking likelihoods from calibrated dates in a list and visually estimating the greatest probability of overlap—sets of dates. Neither of these techniques allowed for the formal introduction of a priori knowledge, like stratigraphic contexts, into the calculation of date ranges. Bayesian analysis solves these issues by allowing users to better estimate the temporal range of past events through formal modeling that includes a priori information. The specifics of Bayesian modeling in general and as employed in this dissertation are discussed in detail in Chapter 3.

The practical goal of this study is to establish not only a higher resolution sequence of village occupations and, ostensibly, the temporality of migration and warfare, but also to understand the nature of temporal overlap between these events. The chronology developed in this study is less categorical and more relational. Instead of categorizing villages as Period 1 or Period 2 (*sensu* Johnson 2007a), it places village occupations in absolute time, relative to one another. Placing the occupational histories of Middle Missouri and Coalescent villages into a sequential timeline aided by Bayesian modeling creates a framework for understanding histories of migration and warfare in the Missouri River Trench.

A Historical and Multiscalar Approach

Advancements in chronological modeling allow us to develop more detailed sequences of past events and provide a greater breadth of temporal scales to consider when answering archaeological questions. An approach to narrative construction and its conveyance is necessary to match these advancements in chronological modeling. Unlike Renfrew's (1976:53) assertion that all that is needed is an adequate radiocarbon

sample and the "science would do the rest," we must ask what types of narratives of the past we are writing with more detailed chronologies (Griffiths 2017).

As discussed above, the current chronology essentially presents a static view of the past in which the dated events (village occupations) are confined to 100-year blocks of time in which all villages in a period appear to overlap, while villages in distinct periods can never overlap. This is similar to Ingold's (1993:167) description of B-series time in which "events are strung out in time like beads on a thread... [and]...are treated as isolated happenings, succeeding one another frame by frame" (see also McTaggart 1908). The problem with such a representation of village occupations is that the temporality of migration and warfare in the region may not match the temporal resolution of the chronology. The exact timing of short-term events related to migration and warfare tend to overlap in a single 100-year period, when in reality they may have been separated by up to a century. Conversely, the same events may have overlapped with events from another 100-year period or may have been closer to the later events than events in their own period. This is not only a practical result of the methodological limitations of the current chronology, but it also affects the types of narratives produced from it.

A methodological and theoretical framework is required for interpreting results, conveying a narrative that provides for the flow of time and is appropriate to the scale of the questions being asked. Stringing together a series of dated events is a static exercise that does nothing to help us understand how dated events fit together in causal relationships. A high-resolution chronology can be an impediment to understanding historical processes that occur over prolonged periods, as the noise of irrelevant events can drown out the signal of long-term processes. An approach that many researchers find complementary to advancements in chronology building follows ontological turns in

archaeology focusing on histories and time (Bayliss et al. 2007; Bayliss and Whittle 2019; Manning et al. 2019, 2018; Robb and Pauketat 2013a; Thompson and Krus 2017; Whittle 2018). The construction of the past as history and the function of time within historicized narratives has been a discussion among social scientists for decades (Cobb 1991; Geertz 1990; Hodder 2000; Ingold 1993; Lucas 2005; Pauketat 2001; Sewell 2005; Trigger 1968, 1970, 1984, 1989, 1998).

The historical and practice-based approach chosen here follows a bottom-up perspective in which historical narratives emerge from multiple spatiotemporal scales of analysis to describe how the past proceeded through time rather than imposing generalizing, nomothetic arguments of why the past occurred which produces a timeless past and essentialize human action (*sensu* Bayliss and Whittle 2019; Bourdieu 1990; Giddens 1984; Ingold 1993; Pauketat 2001; Whittle 2018). Such approaches emphasize, or at least explicitly take into account, the very thing that gives the past corporeal form—the interactions and agency of daily life.

This study adopts a historical perspective that employs the concepts of narrative and emplotment to link events and facts ordered by the new radiocarbon chronology into a coherent history of migration and warfare. Emplotment "brings together factors as heterogeneous as agents, goals, means, interactions, circumstances, [and] unexpected results" into coherent historical events (Ricoeur 1984:67). These events are then woven into narratives that contain links, motives, agency, and plot (Bayliss and Whittle 2019:123; Whittle 2018). Specific village foundings and abandonments (representing the movements, choices, and interactions of multiple individual actors) are the historical events of interest. It is the overlaps in these village occupations that chain together the timing and temporality of migration and warfare into a coherent narrative.

Another important aspect of this study is the incorporation of multiple spatial and temporal scales. Specific processes and events in the past are better studied at their appropriate temporal, spatial, and social analytical scales (Arnold 2000; Clarke 1977; Fisher and Feinmann 2005; Gaddis 2002; Knapp 1992; Knappett 2011; Kowalewski 2005; Neitzel 1999; Robb and Pauketat 2013b). Spatial scales include the placement of villages and types of villages (i.e., Middle Missouri and Coalescent) relative to one another at the local, subregional, and regional scales. Temporal scales include both the decadal and centennial scales. Ultimately, the placement of village occupations (historical events) relative to one another and trends at multiple spatiotemporal scales that arise from these placements are the material that will be woven into a historical narrative directed at understanding the intersection of migration and warfare in the Missouri River Trench.

Conclusion

The stark differences in village and house layouts between Middle Missouri and Coalescent groups suggest that ideologies associated with daily interactions and practices likely differed between the two groups. Where many Middle Missouri villages were fortified, Coalescent groups (including their ancestors and descendants) rarely built fortifications. Where Middle Missouri villages typically had higher house density, Coalescent groups alternated between less densely populated farmsteads, unfortified dispersed villages, and large fortified villages. Middle Missouri villages also appear more structured in layout than Coalescent villages. While houses in most Middle Missouri villages were built in irregular rows, Coalescent houses seem not to have as discernible a pattern aside from possible house groups. This evidence suggests that daily life and interactions between members of each group were structured differently.

Traditions of war can be seen when practices, ideologies, and incentives for participation in intergroup violence are enduring and embedded in the social fabric, creating competitive environments in the group and perpetuating conflict with outside groups. The archaeological and ethnohistoric evidence presented above show that such traditions existed, likely for hundreds of years. The practice of war began as early as the inception of the first Middle Missouri villages and endured until after European contact. As is common among many middle-range village communities, participation in war would have contributed to a competitive environment as individuals worked to earn prestige and status through war (Birch 2010; Chacon and Mendoza 2007; Keeley 1996:Table 8.1).

Social processes, including village-level conflicts, migrations, and society-wide structural changes, occurred among groups living in the late precontact Missouri River Trench. Village-level violence between the thirteenth and fourteenth centuries was likely more complicated than "us versus them" intergroup conflict. As with most grand narratives in archaeology, the realities of everyday life in the Missouri River Trench were complex, as historical events played out among individuals and family groups with their own sets of collective or competing interests and strategic goals. If Coalescent migrants did arrive while Middle Missouri groups were still occupying the Big Bend subregion, then individual, family, and village-level interactions between Coalescent and Middle Missouri groups likely varied across spatial and temporal dimensions. Understanding this history of violence requires a more detailed understanding of when and where conflict occurred (or the anticipation of it).

Chapter 2 Figures

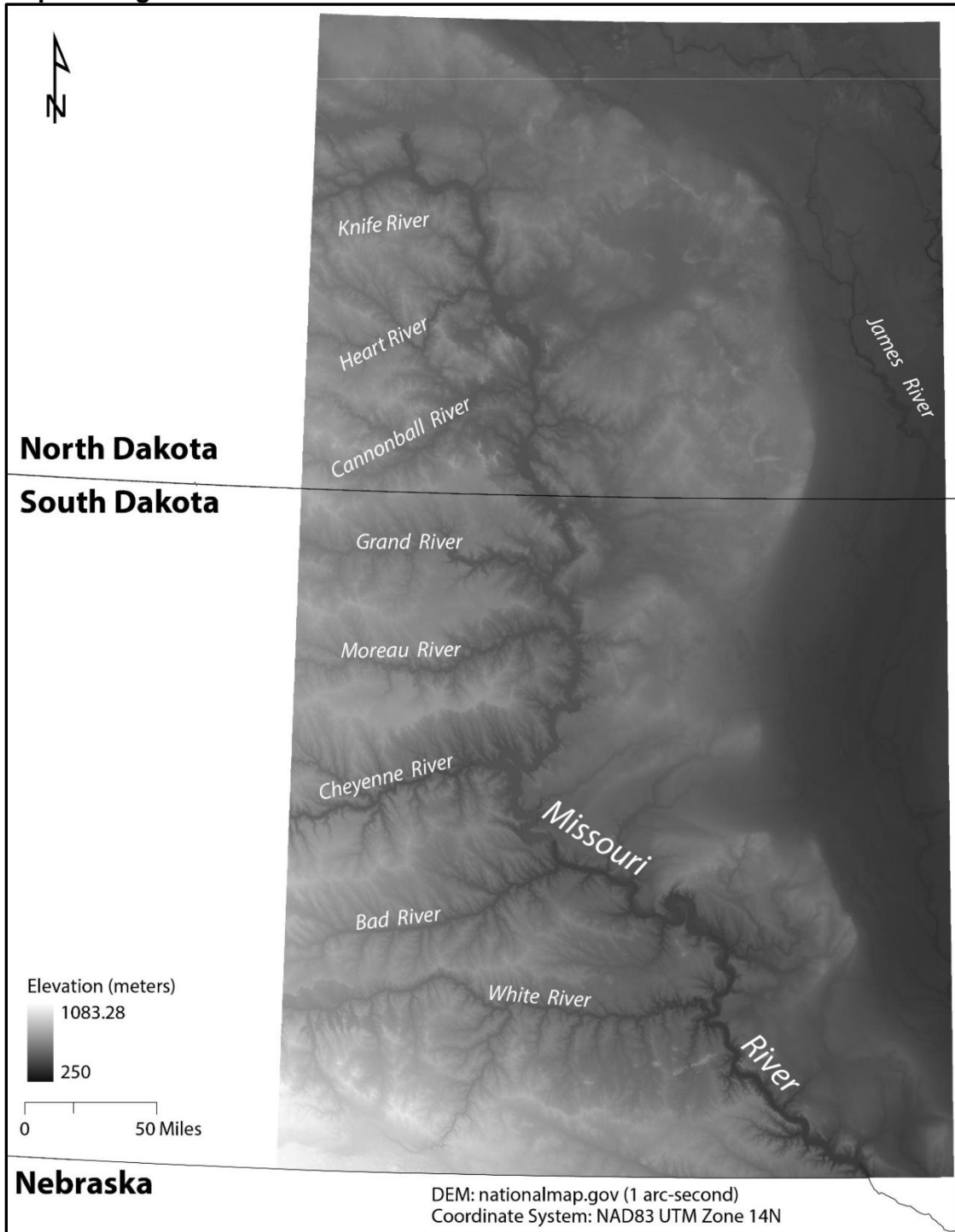


Figure 2.1: Elevation map depicting the Missouri River, Trench, and Plateau. The river and trench are black and the plateau is grey and white.

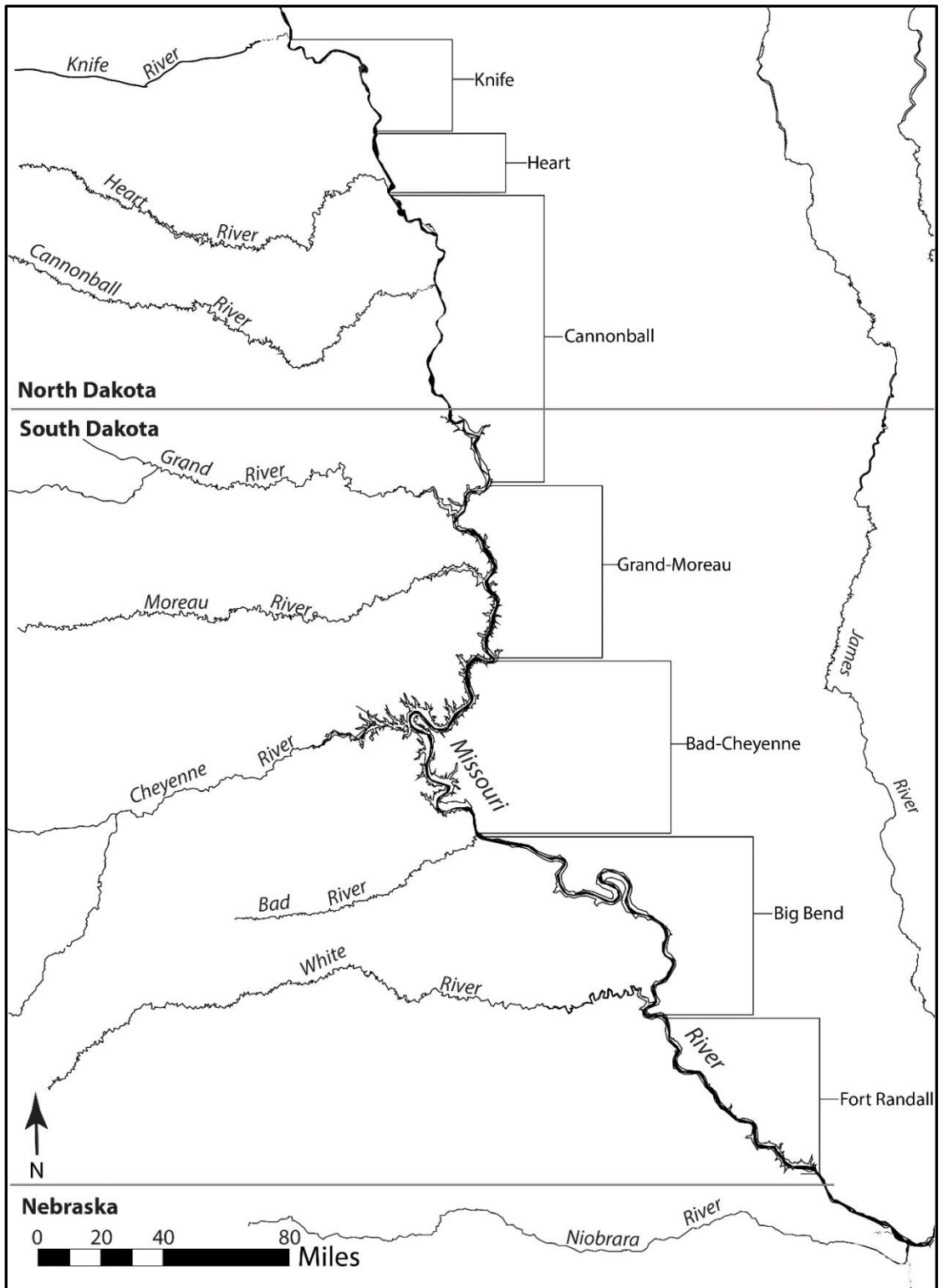


Figure 2.2: Map depicting all of the subregions referred to in this study.

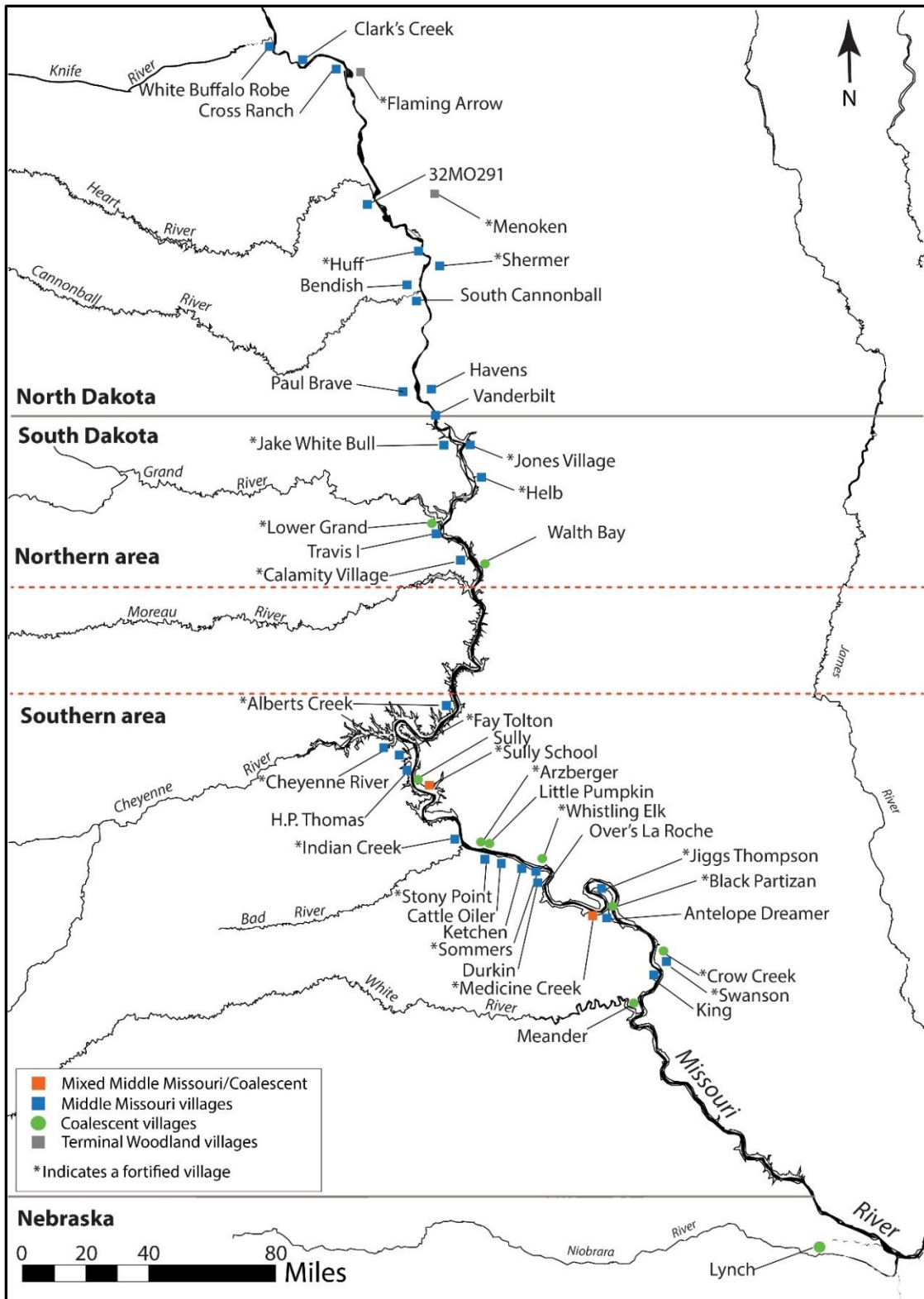


Figure 2.3: Map of villages dated or mentioned in this study. Northern and southern demarcations show geographic gap between settlements south of the Cheyenne and north of the Moreau Rivers.

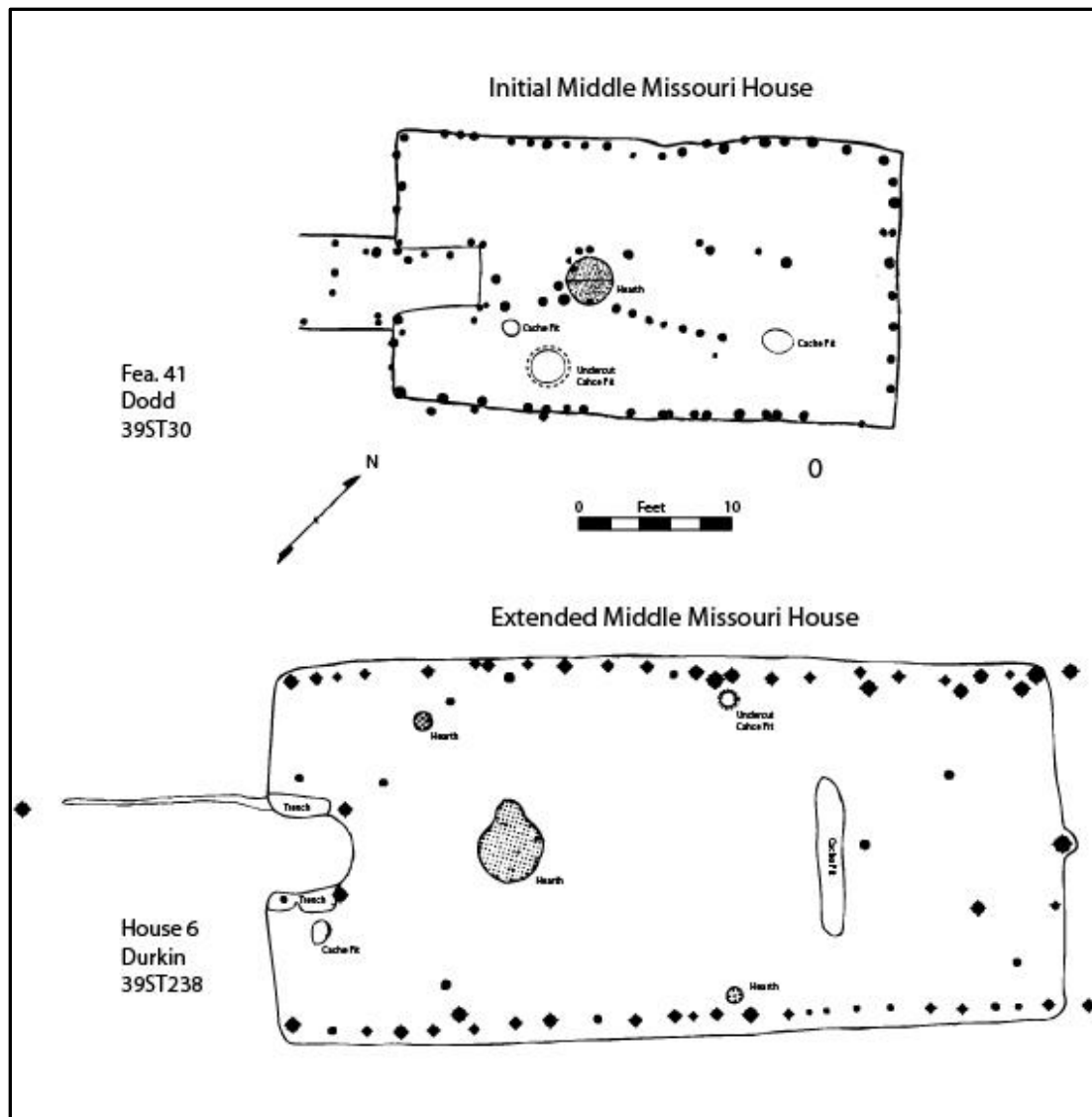


Figure 2.4: Middle Missouri Tradition house floor plans (39ST30 adapted from Lehmer 1954:28 and 39ST238 adapted from Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 362, 39ST238-R64).

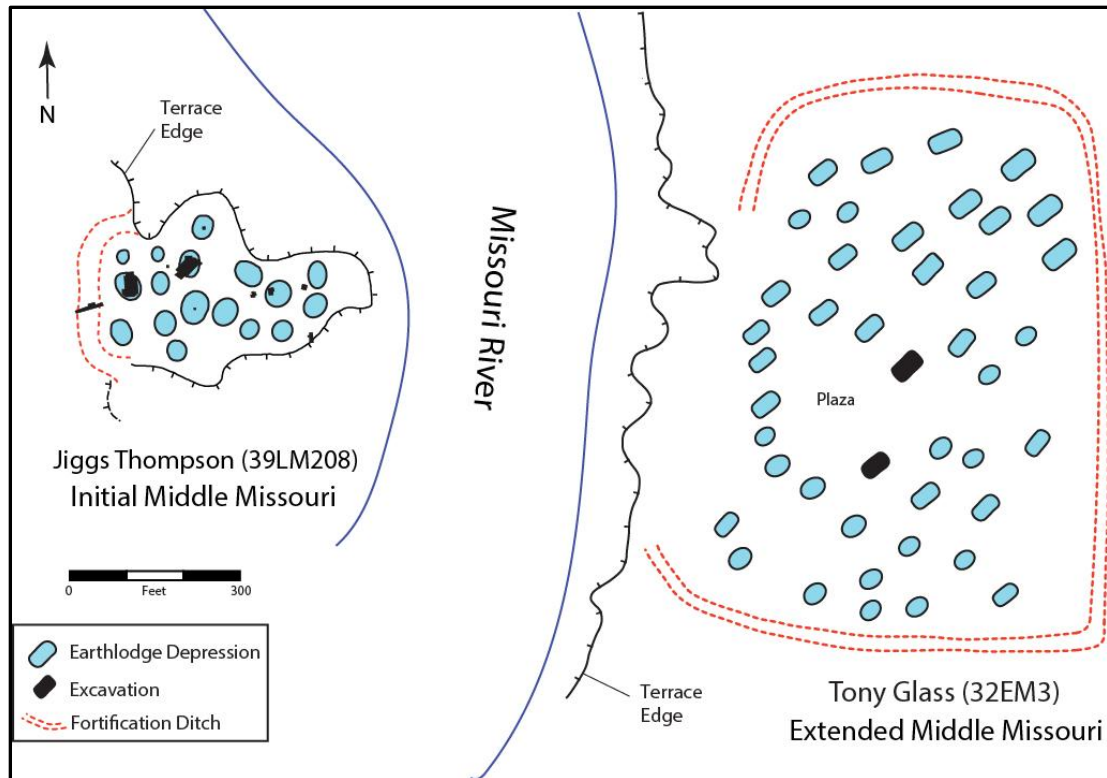


Figure 2.5: Comparison of earlier and later Middle Missouri Tradition villages (adapted from Mitchell 2013:64 [see also Mead 1999:7]; Smithsonian Institution, American Museum of Natural History [SINMNH]; Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 359, 39LM208-R113).

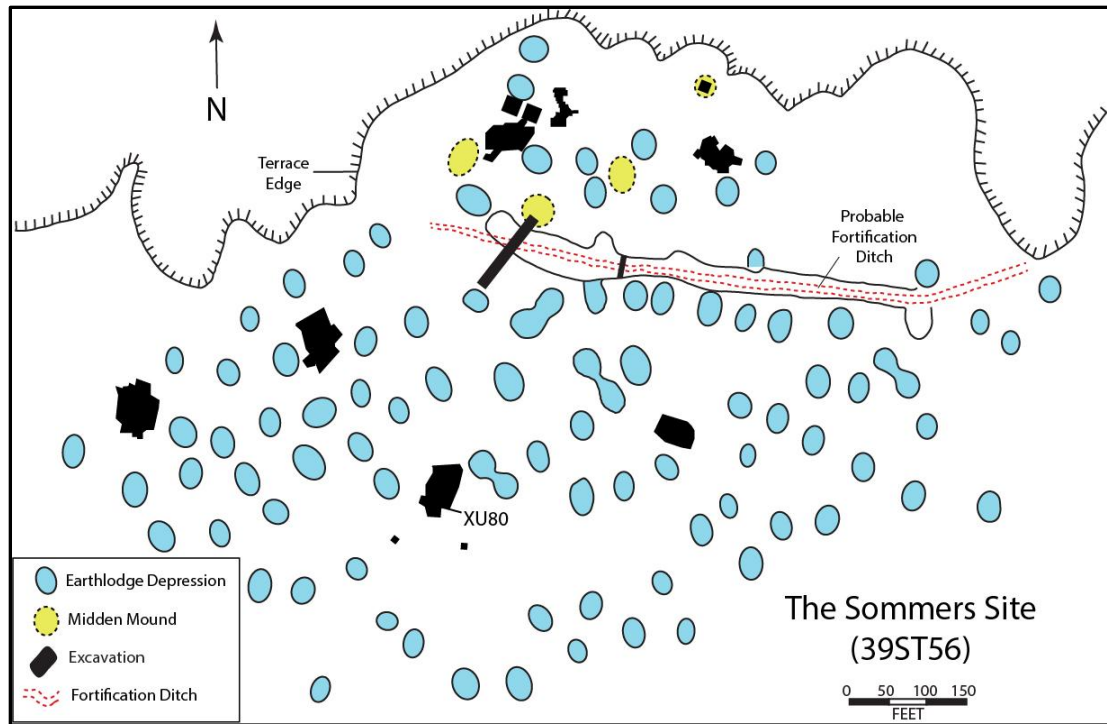


Figure 2.6: Plan view of Sommers Village. This village is exceptionally large for an Initial Middle Missouri village. Note that house XU80 was the largest house excavated at the village and is adjacent to a large cleared area that could be a plaza. (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 357, 39ST56[1]).

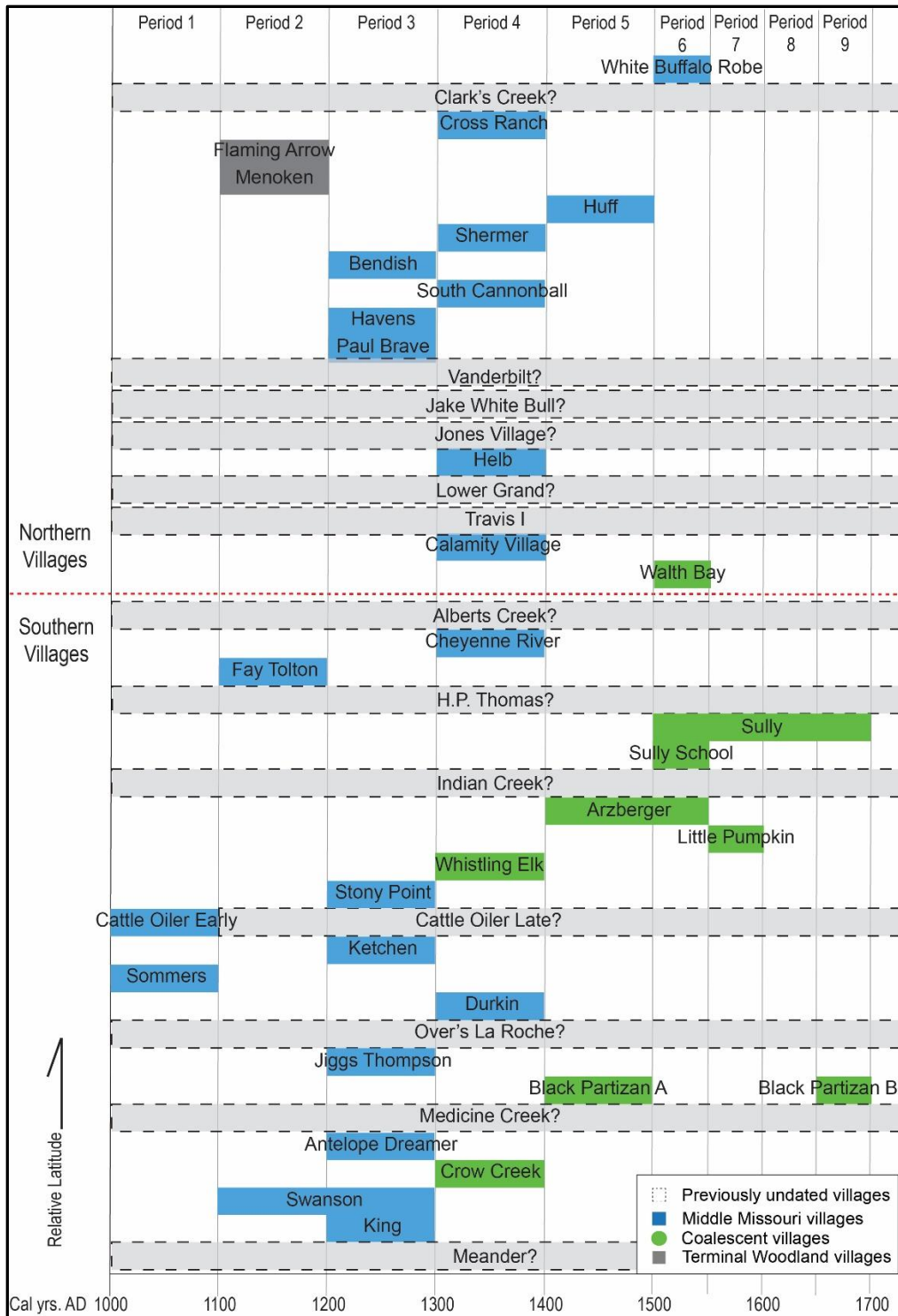


Figure 2.7: A representation of Johnson's (2007a) chronology. The chronology organizes villages into 100-year periods (Periods 1–5) and 50-year periods (Periods 6–9). Villages in a single period appear contemporaneous across the period, even though many only lasted a single generation before abandonment. Villages in two separate periods cannot overlap without crossing two entire periods (between 100 and 200 years).

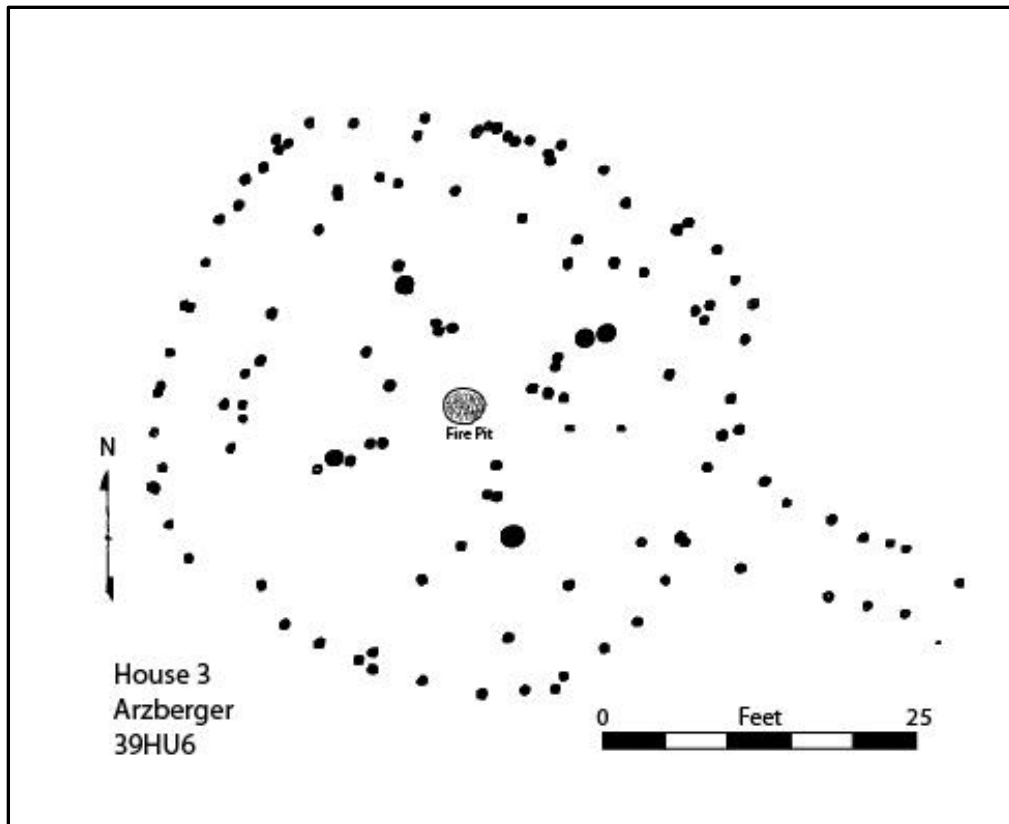


Figure 2.8: Plan view map of an excavated Initial Coalescent house (adapted from Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 309, 39HU6-R19).

CHAPTER 3

RADIOCARBON DATING AND BAYESIAN CHRONOLOGICAL MODELING

To identify events linking migration and warfare in the Missouri River Trench, a high-resolution regional chronology was constructed using 158 previously reported radiocarbon dates and 277 new Accelerator Mass Spectrometry (AMS) radiocarbon dates from 44 sites, 49 village occupations (some sites contain multiple village occupations) (Table 3.1, Appendices A and B). Advances in radiocarbon pretreatment and analysis in the last decade regularly result in uncertainties in the ± 20 –25-year range, yielding calibrated radiocarbon dates with high precision (narrower estimated date ranges; Bronk Ramsey et al. 2004). All legacy radiocarbon dates for villages in the Trench have uncertainties greater than ± 50 years, with most having uncertainties of ± 70 –80 years (Johnson 2007a). These standard errors lead to probabilistic date ranges that skew age estimates for these villages, making them appear much longer than the actual occupational events (Ahler et al. 2007:58-64). Bayesian statistical modeling was employed to further increase the precision of the 277 new radiocarbon dates for the region. Combining high-resolution AMS radiocarbon dates and Bayesian statistical methods offers interpretive utility in identifying occupational continuities and discontinuities across selected Middle Missouri Tradition and Coalescent Tradition villages.

This chapter describes the methods and justifications for creating a higher-resolution chronology of Plains Village occupations in the Missouri River Trench. The chapter begins with a discussion of the inclusion or exclusion of previously reported radiocarbon dates for the region. The methods used for sampling and dating new

supplemental samples are then described. The chapter concludes by discussing Bayesian analysis and its application in this project.

Radiocarbon Revolutions

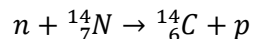
Since its inception, radiocarbon dating has undergone multiple “revolutions” in technical methods and archaeological interpretations (Bayliss 2009; Bronk Ramsey 2008). The first revolution was the development of the method itself (Arnold and Libby 1949; Libby et al. 1949). Throughout the 1950s and 1960s, the new absolute dating method provided a new understanding of time-depth in “prehistory.” The second revolution included the realization for a need to calibrate ^{14}C dates and the development of the Accelerator Mass Spectrometry (AMS) method of dating, discussed below (Bayliss 2009; Taylor 1995). Radiocarbon measurements—expressed in radiocarbon years—do not directly correspond to actual calendar years due to fluctuations in the atmospheric radiocarbon. This discrepancy between radiocarbon age and calendrical age requires a calibration curve in which radiocarbon years are cross referenced with samples of known calendrical age in order to convert a radiocarbon date to a calendrical date. The practice of calibrating dates shifted chronologies, sometimes by hundreds of years to millennia. The development of AMS dating brought an advancement in precision compared to previous counting methods, increased the relative speed a date could be produced, and allowed for dating of smaller relative sample masses required (Bronk Ramsey 2008). The most recent radiocarbon revolution was the implementation of Bayesian chronological modeling. This approach is advantageous when interpreting sets of radiocarbon dates, including the incorporation of a priori knowledge (e.g., stratigraphy) and a more formalized method for the rejection or acceptance of dates.

Radiocarbon Systematics

Advances in the technique over the last 30 years, including the introduction of AMS, and refined pretreatment methods, have enhanced accuracy and precision while reducing uncertainty in calculated likelihoods (i.e., calibrated date-ranges) (Bayliss 2009; Bronk Ramsey 2008; Bronk Ramsey et al. 2004). Radiocarbon data reported prior to and during this project include dates generated by both radiometric and AMS dating methods. Although seemingly straightforward, the production of a radiocarbon date is a complex process involving many steps, from the selection of appropriate samples to calibration. With each step a new level of uncertainty is added to the final product (the calibrated radiocarbon date).

¹⁴C Production, Distribution, and Decay

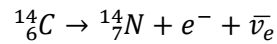
Isotopes of carbon-14 (¹⁴C) originate in earth's upper atmosphere when cosmic rays collide with nitrogen atoms in reactions called spallation (Bard 1998; Beer et al. 2002; Gosse and Phillips 2001). During this process, cosmic rays eject neutrons from the nitrogen atoms and the neutron is then captured by other nitrogen-14 (¹⁴N) atoms to form ¹⁴C and a proton.



¹⁴C atoms subsequently bond with oxygen in the atmosphere to form molecules of carbon dioxide (CO₂) gas. Plants uptake the CO₂ during photosynthesis and ¹⁴C atoms then enter food webs as animals consume plants and/or each other.

Plants and animals remain in an approximate carbon equilibrium with the atmosphere as long as they continue to uptake atmospheric carbon through photosynthesis or food consumption (Taylor and Bar-Yosef 2014:22-23). The method of

calculating a radiocarbon date is based on the fundamental assumption that ^{14}C decays to ^{14}N (Bronk Ramsey 2008):



Once an organism dies, it falls out of equilibrium as it no longer takes up carbon from the local environment. The event radiocarbon dates are typically dating is the point at which an organism or its tissues stops taking in atmospheric carbon, but there are complications that must be addressed that cause age offsets, such as differential uptake, carbon turnover rates, and isotopic fractionation, all of which are discussed in the following sections.

Material-Types

A wide variety of carbon-containing materials can be radiocarbon dated, from fruit seeds to carbon in smelted iron (Beavan-Athfield et al. 1999; Berstan et al. 2008; Bird 2013; Brock et al. 2010; L'Héritier et al. 2023). The three broad material types tested in this study are charred wood/charcoal, charred botanicals (seeds and grasses) and collagen type-I. These material types have their advantages and disadvantages when dating.

Charred Short-lived Botanicals

When available, short-lived botanicals like maize kernels and other seed types are often preferable when attempting to produce high-resolution radiocarbon chronologies. These materials typically produce high-precision dates because they only incorporate carbon from the atmosphere for short periods of time (Taylor and Bar-Yosef 2014:70). One drawback to working with some short-lived botanicals is their small size and preservation potential or recovery bias. Botanicals were not present among many of

the older, legacy collections utilized in this study. In many instances these collections derived from excavations that occurred prior to the use of standard recovery techniques like matrix screening or flotation. Other times, smaller materials like maize may have been lost or misplaced during the curation process. The pioneering of the River Basin Surveys, from which most of these collections derived, utilized a logistical system and research approach that spread collections and documentation out among multiple facilities and institutions. Over the decades this ultimately resulted in many collections and documentation being separated and sometimes lost. The smallest and most fragile of these collections were often the botanical collections. Because of these issues, many contexts in this study did not have associated short-lived botanicals.

Another issue to consider when dating short-lived botanicals is that they are more susceptible to post-depositional processes related to bioturbation and frost-action because of their size (Johnson and Hansen 1974; Rick et al. 2006). For example, there is an almost unnatural concentration of burrowing animals on the Plains and the comparatively soft matrices/fills of house pits, fire pits, and storage pits fall victim to bioturbation.

Bone: Gelatin and Type-I Collagen

Bone comprises a hierarchically structured family of materials incorporating an inorganic (mineral) fraction called hydroxyapatite and an organic fraction (collagen and other proteins specific to different taxa). The hierarchical structure begins with small plate-shaped crystals of hydroxyapatite interwoven into an organic matrix predominantly made of collagen (Calabrisotto et al. 2013; Weiner and Traub 1992). The collagen fraction comprises mostly type-I collagen triple helices formed of amino acids ingested from dietary protein (Ambrose and Norr 1993). The collagen helices form a fiber matrix of structural bone (McCullagh et al. 2010).

Although relatively stable when compared to some other datable materials, collagen can sometimes become contaminated because post-depositional soil chemistry is rarely in thermodynamic equilibrium with the bone, resulting in significant diagenetic alteration. Hydrolysis, humification, and chemical bonds causing cross-linkages between the collagen helices and infiltrating humic acids can occur during post-depositional processes (Gillespie 1989; Hedges and van Klinken 1992; van Klinken 1999). Likewise, microbial attacks can occur after the mineral fraction protecting the collagen helices degrades (Collins et al. 2002). However, these factors are typically less problematic in samples with high collagen yields. In samples with collagen yields less than 1%, degradation, exchange of carbon, and changes with respect to nitrogen (C:N ratios) are more evident.

Methods have been developed to further “clean” or “purify” collagen, including using high-performance liquid chromatography (HPCL) (Van Klinken et al. 1994), ultrafiltration (Brock et al. 2007; Brown et al. 1998; Higham et al. 2006), and XAD resin (Stafford et al. 1982, 1988). Ultrafiltration of contaminated collagen can provide more reliable age estimates in some cases, particularly for samples over 2-3 half-lives in age (Brock et al. 2013), or those with lower (<3%) collagen yields (Minami et al. 2013). However, the literature on the use of ultrafiltration highlights the risks, as well as the potential benefits, of this added step. Multiple studies have shown through controlled experiments that the use of ultrafilters introduces contaminating carbon from the filter and its humectant, despite following a rigorous cleaning protocol on the ultrafilters themselves (Brock et al. 2007; Hüls et al. 2007, 2009; Minami et al. 2013). Furthermore, ultrafilters cannot remove (and can possibly concentrate) high-molecular-weight collagen cross-linked with humic acid contaminants. Post-depositional soil chemistry and temperature are also factors that can contribute to the breakdown of both the mineral

layer protecting collagen and the collagen itself, contributing to inaccurate ages (Collins et al. 2002). However, the bone samples obtained for this study were relatively young (<1,000 years) and the local soil chemistry was dry and conducive to collagen preservation.

Although collagen can contain contaminants, another advantage of utilizing this material in radiocarbon dating is its carbon 'turnover rate,' or the rate at which new carbon atoms are incorporated into bone collagen, resulting in a time-averaging effect (Bronk Ramsey 2007). Radiocarbon assays of collagen extracted from animal bone are, like botanicals, a time-average of an individual's lifespan, weighted toward the age of death (Hedges et al. 2007). The issue with dating bone collagen as opposed to short-lived botanicals is that animals have longer lifespans, so the calculated time-average covers a longer period of time. Carbon turnover in tissue is not instantaneous and can vary both between species and between different bone elements in a single species (Tieszen et al., 1983). Bone elements containing polymers such as keratin (e.g., horn) do not uptake carbon after they are initially formed, unlike bone.

Other possible issues can arise when dating bone collagen that are not directly related to the material itself, but the behaviors of the animal from which it was taken. For example, the carbon reservoir(s) from which an animal consumes food affects dates. Carbon from the organic collagen fraction of animal bone is obtained from dietary protein (Lee-Thorp et al. 1989). As an individual consumes a species lower in the trophic hierarchy, the ingested carbon is incorporated into the consumer's tissue (e.g., bone). If an animal consumes food from multiple carbon reservoirs (e.g., terrestrial and marine), they will uptake carbon from each of those reservoirs, thus creating carbon ratios for which it can be difficult to correct. Other issues persist when dating animal bone as well. For instance, burrowing rodents are often intrusive in archaeological contexts, meaning

that a date taken from such an animal can relate not to a site's occupation, but to a post-occupational event when the animal burrowed through site contexts, particularly soft, organic-rich sediments related to midden deposits.

These sources of uncertainty can be mitigated. Selecting species with shorter average lifespans and homogenous diets (i.e., primary consumers) is beneficial as the time-average of carbon uptake is shorter and the diet is likely from a single carbon reservoir. Also, selecting animal remains known to be related to the event being dated is beneficial. For instance, bison remains in Plains Village contexts are often related to bison hunting, a practice that was as pervasive as the animals themselves (Cunfer and Waiser 2016).

Recent techniques for the pretreatment and analysis of bone collagen have increased the accuracy of bone dates (Brock et al. 2013). Furthermore, measuring the C:N ratio within a sample can help to identify possible problems with sample preservation. An acceptable ratio is typically between 2.9 and 3.5 (Brock et al. 2007; van Klinken 1999).

Charred Wood/Charcoal

Charred wood and charcoal from trees and shrubs are one of the most common sample-types for dating. They are ubiquitous in many archaeological contexts, including village assemblages on the Plains. Charred wood is found in diverse contexts (e.g., hearths, roasting ovens, and burned structures), but the interpretation of dates taken from charred wood can be complicated. One of the primary reasons for this complication is in the consideration of what specific event a charred wood date is communicating (Talyor and Bar-Yoseff 2014:67-70). As trees grow, they lay down cellulose and create rings, after which point no new cells form in that ring, meaning they cease to uptake carbon from the atmosphere. If any part other than the final growth ring is dated, the

event being dated is not the moment at which the tree was harvested or died, but the moment that particular section of the tree or shrub stopped uptaking atmospheric carbon. The date produced will inherently be older than the date the tree or shrub was deposited in the archaeological record. It is even more likely that interior rings will be dated from charred wood as the exterior of the wood is often burned off during combustion. Another confounding consideration is that the tree or shrub may have died long before its use as fuelwood or structural material.

Sample Selection

Choosing the right sample and material is an essential aspect of radiocarbon dating. The selection of a suitable sample has a direct impact on the precision and dependability of the estimated radiocarbon ages. Aside from choosing material types conducive to a dating project, other issues must also be addressed. These issues surround the question of what is actually being dated. That is, what event is actually being represented by a radiocarbon date? Every date is a probability statement that addresses the time since an organism exchanged carbon with its local environment. If dating a maize cob, the date reflects when that cob was harvested or died.

When selecting samples, a critical consideration is for the material to be as closely temporally related to the event or phase relevant to the archaeological question being asked (Dean 1978). As mentioned above, questions about what event is actually being dated can arise when dating charred wood. It may not be known how close in time the event being dated (i.e., when a new growth ring covered a previous year's ring and the old one essentially died) is to the archaeological event in question (e.g., a burning of a structure). For this study, the importance of sample selection was related to dating the phase of house occupations and, in turn, the lengths of village occupations.

Linking dateable materials to occupational histories of residential structures is a priority in this study. Contexts like storage pits, house floors, and hearths correlate to occupational activities. Similarly, house posts or roofing materials can also contribute to understanding when, and for how long, a house was occupied. The utilization of statistical manipulation like Bayesian modeling expands the potential sample universe through the incorporation of contexts that may be related to residential occupations outside of dateable materials directly from structures (Bronk Ramsey 2009a). For example, with the use of specific statistical functions, samples believed to pre- or post-date a residential occupation can be used to 'bracket' the date-range for the house. Once a specific structure's occupation or other events are adequately dated, they are combined to understand the longer phase of village occupation.

Pretreatment Processes

An equally important part of creating high-quality dates for incorporation into a chronology is sample pretreatment. The goal of pretreatment is to "purify" a sample or extract only the native carbon compounds that are of interest for dating. This process typically involves physically and chemically altering and breaking down a sample through pretreatment prior to subjecting the sample to dating. Multiple techniques exist for sample pretreatment (Bird and Gröcke 1997; Brock et al. 2010; De Vries and Barendsen 1954; Gillespie et al. 1992; Haesaerts et al. 2010; Hatté et al. 2001; Wolbach and Anders 1989). Although these techniques are similar, the protocols for pretreatment are often laboratory specific.

The pretreatment process typically begins by physically cleaning a sample to remove contaminants like rootlets that can infiltrate the pores of a sample or curation preservatives that may have been applied to the exterior of a sample in order to protect

it. This is followed by chemical pretreatment, typically involving some form of the acid-alkali-acid (AAA) method (Brown et al. 1988; Longin 1971) in which acids and bases of various temperatures are added to a sample to extract contaminants and dissolve unwanted fractions of sample that will not be dated. Likewise, multiple filtering methods and compounds can be incorporated such as in ultrafiltration or XAD (e.g., Brock et al 2007; Stafford et al. 1988).

The purpose of pretreatment is to isolate carbon that was present at the time the organism from which the sample was derived died. If these steps are not performed, the contents of a sample may contain nonnative carbon contaminants that will typically be younger than the sample (Bronk Ramsey 2008:256).

Pretreatment of Charred Botanicals and Charcoal

In this study a AAA method was used for charred botanicals to extract contaminating carbon and isolate the native carbon fraction for dating. After mechanical cleaning to remove adhering contaminants such as dirt, each sample was placed in a wash of 1N HCl and heated to 90° C for a minimum of one hour. This step is implemented to remove carbonate contaminants and low molecular weight (LMW) fulvic acid (Brock et al. 2010:104). Each sample was then placed in a room temperature 0.1N NaOH wash to remove high molecular weight (HMW) fulvic and humic acids. The reaction is considered complete and this step is finished once contaminants visually stop dissolving out of the sample. In the last AAA step, each sample was placed back into a heated (90° C) wash of 1N HCl to remove any atmospheric carbon adsorbed during the NaOH wash. Each sample was rinsed to neutral with ultrapure water between each of the AAA steps. Once rinsed to neutral after the final HCl wash, each sample was placed in a warm oven to dry.

Pretreatment of Gelatin (Type-I Collagen)

The protocol applied in this study for collagen pretreatment involves a modified Longin method, or an acid-alkali-acid (AAA) approach. This method is based on Longin's (1971) method of pretreatment, with the addition of an alkali solution, sodium hydroxide (NaOH), as suggested by Berglund and colleagues (1976), Gurfinkel (1987), and Haynes (1968). It involves the use of hydrochloric acid (HCl) to dissolve the mineral content of bone, secondary carbonates, and acid-soluble (low molecular weight) fulvic acids, as well as to break hydrogen bonds (Longin 1971). Then, 0.1N NaOH is added to dissolve humic and fulvic acids, leaving the insoluble collagen as a product (Berglund 1976). The material remaining after HCl and NaOH treatments is added to slightly acidic (HCl) water (pH = 3) and heated to 90° C for more than eight hours, producing a gelatin that consists primarily of collagen protein. The gelatin is then separated from the remaining residue through filtration. Between each step, each sample is washed to neutral with ultrapure water. Once filtered, the gelatin is heated to evaporate water added during the filtration process. After the evaporation of water, the sample is freeze-dried.

Collagen preservation, based on sample mass (starting mass vs. mass after freeze-dried) was calculated for each sample. C:N ratios were calculated to identify possible sample preservation issues. Those samples with that fell outside of the accepted C:N ratio above 2.9 or below 3.5 were discarded from the study.

Measurement by AMS

An AMS radiocarbon measurement is an isotopic ratio that measures $^{14}\text{C}/^{12}\text{C}$, $^{13}\text{C}/^{12}\text{C}$, and $^{14}\text{C}/^{13}\text{C}$ while radiometric radiocarbon measurements are performed through the process of decay counting (liquid scintillation and gas proportional counters) and

comparison to a standard (Bronk Ramsey 2008:259-260). In decay counting, the decay of ^{14}C to ^{14}N and the loss of an electron and antineutrino emits energy that is measured and counted. In AMS dating, the actual carbon atoms are ionized, accelerated through an electromagnetic field and separated by atomic mass-to-charge ratio (i.e., ^{14}C , ^{13}C , ^{12}C) using an analyzing magnet. Once separated by mass, the isotopes are then collected according to mass (Taylor and Bar-Yosef 2014:112-114). It is highly recommended that both methods also report and use the sample's $\delta^{13}\text{C}$ value to apply a correction factor for any fractionation that may have occurred (Bronk Ramsey 2008; Stuiver and Polach 1977).

Using the Libby half-life of 5,568 years for radiocarbon decay, an estimate can be calculated for how long ago an organic material fell out of equilibrium with the atmosphere (stopped taking up ^{14}C). This is represented by a number with an associated error that is presented in radiocarbon years before present (RCYBP) (before 1950).

Graphitization, AMS Dating, and IRMS In This Study

All newly-acquired samples from this study were submitted to the Center for Applied Isotope Studies (CAIS) for combustion and graphitization, followed by Accelerator Mass Spectrometry (AMS) and Isotope Ratio Mass Spectrometry (IRMS) analyses following their pretreatment. Prior to graphitization, samples were combusted in sealed ampoules containing cupric oxide (CuO) to produce carbon dioxide gas (CO_2). Collagen samples were sealed in Pyrex and combusted at 575°C , while wood/charcoal and seeds were sealed in high-purity quartz and combusted at 900°C . The CO_2 sample was then catalytically converted to graphite using the method developed by Vogel and colleagues (1984). A 0.5 MeV accelerator mass spectrometer measured the $^{14}\text{C}/^{13}\text{C}$ ratios for each graphitized sample. All samples' $^{14}\text{C}/^{13}\text{C}$ ratios were compared to the Oxalic Acid I standard (NBS SRM-4990). Each uncalibrated date was quoted in

radiocarbon years before 1950 (years BP) and percent Modern Carbon (pMC). This was calculated using the 5,568-year Libby ^{14}C half-life. The error, reported as one standard deviation, reflects both statistical and experimental errors.

AMS was employed for carbon isotope measurements, while IRMS was used for ^{13}C isotope fractionation corrections. There is a degree of primary fractionation—any process by which the ratio of isotopic species are altered during phase transition due to the specific masses of those species (Taylor and Bar-Yosef 2014:61)—that occurs among plants. During photosynthesis, lighter mass ^{12}C is preferentially taken up by the plant, resulting in an overabundance of ^{12}C in plant tissues compared to the atmosphere; consequently, the plant tissues are also depleted in ^{14}C compared to the atmosphere, causing a systematic age-offset (Bronk Ramsey 2008). The preference for ^{12}C is greater among C3 plants than C4 plants, both plants occurring in the region of interest to this study. The solution is using the ratio of ^{13}C to ^{12}C ($\delta^{13}\text{C}$) in a sample in order to measure the magnitude of fractionation and correct for it. Elemental Analyzer-IRMS was also utilized to obtain nitrogen measurements for C:N ratios in collagen samples. Information on CAIS methodologies and instrumentation can be found in Cherkinsky and colleagues' (2010) standard operating procedures.

Calibrating Dates

An underlying assumption in calculating radiocarbon dates is that ^{14}C in the atmosphere was constant over time. However, fluctuations in ^{14}C production and carbon concentration that have been observed over time violate this assumption, meaning that there is not a 1:1 correlation between the ^{14}C year reported by an uncalibrated radiocarbon date and a calendar year, necessitating calibration. Both the environmental setting in which a dated organism exchanged atmospheric carbon (e.g., marine,

terrestrial, hemisphere, etc.) and the carbon fluctuations of that environment over time are necessary for calibrations. For the plants and primary consumers used in this study, carbon uptake occurs through two simplified processes: (1) plants uptake carbon through photosynthetic pathways; and (2) primary consumers uptake carbon through eating plants.

This environmental information can then be compared to previous information on spatiotemporal variations in atmospheric carbon. The data that inform the creation of the radiocarbon calibration curve are compiled through reference measurements based on dates from known-age tree-ring samples and marine environmental data (e.g., uranium series dating of corals) (Reimer et al. 2020; Taylor and Bar-Yosef 2014:155-162). The radiocarbon date or F14C ratio can then be compared to the calibration curve to derive a calendrical date-range.

There are two methods of calibrating radiocarbon dates. This first is the intercept method, in which a researcher visually examines the calibration curve and draws a line to intersect the reference curve at one and two standard deviations (Stuiver and Reimer 1986). The other method utilizes statistical calibration software like OxCal where a likelihood, or probability density function, is calculated (Stuiver and Reimer 1993; van der Plicht 1993; Bronk Ramsey 2001). Once the probability distribution is calculated, a range of values can then be calculated using the highest probability density (HPD), typically at 95.4% probability (or two standard deviations) (Bronk Ramsey 2008:261). All dates in this project were calibrated using the OxCal 4.4 with the IntCal 20 northern hemisphere calibration curve (Bronk Ramsey 2009a, 2009b; Reimer et al. 2020).

Radiocarbon Dates in This Study

Legacy Dates

"Legacy" radiocarbon dates are defined herein as those reported prior to this research available in archaeological literature (Johnson 2007a; Theissen 1977; Toom 1992b). This project incorporates as many legacy dates as possible, but methodological refinements in acquiring, dating, and interpreting radiocarbon dates necessitates the discard of some dates. Complicating variables include incomplete or inaccurate contextual information for samples, along with outdated methods for pretreatment and dating, which must be accounted for in creating a high-resolution chronology. A radiocarbon hygiene (Graf 2009; Pettitt et al. 2003; Spriggs 1989; Spriggs and Anderson 1993) was performed to maximize the number of usable legacy radiocarbon dates, while ensuring that the included dates were of high enough quality to contribute meaningfully to a high-resolution chronology. Three criteria were developed for the inclusion or exclusion of legacy dates: archaeological context, material type, and quality of the radiocarbon date (inclusive of sample pretreatment, method of dating, and precision of date). Of the previously reported radiocarbon dates for the villages in this study, only 158 dates were of sufficient contextual and methodological quality.

Prior to the late 1970s, correction for isotope fractionation was not widespread, and $\delta^{13}\text{C}$ values were rarely measured or reported. However, dates measured on charred wood are assumed to be C3 plants in the context of this study because approximately 90–95% of arboreal taxa follow a C3 photosynthetic pathway, with few C4 plants (predominately maize) in the study area. In these cases, assumed $\delta^{13}\text{C}$ values of -25 ± 2 were used to correct the dates, and every 1‰ difference in $\delta^{13}\text{C}$ requires a correction of 16 radiocarbon years. The square root of the sum of the squares accounts

for the propagation of errors resulting from using estimated $\delta^{13}\text{C}$ values. Uncertainty was propagated using the square root of the sum of the squares as follows:

$$\sigma + \sqrt{\sigma_{\mu}^2 + \sigma_w^2}$$

- Where σ_{μ} is the standard deviation of the uncorrected ^{14}C date;
- σ_w is the uncertainty in ^{14}C yr due to stable isotope fractionation = 32 ^{14}C yr, calculated as follows: since $\delta^{13}\text{C}$ is assumed to be $\pm 2\text{‰}$, and the correction is 16 ^{14}C yr per 1‰
- $= \sqrt{\sigma_{\mu}^2 + 32^2}$

Dates not directly related (e.g., stratigraphically, architecturally, etc.) to a village's occupation were discarded. The exclusion of these samples ensured the dates included in Bayesian models were related to the specific events relevant to the occupation of each village. Also, a series of dates obtained from charred residue on ceramics was also discarded. During at least one previous study in this region, researchers attempted to date organic residue adhered to ceramic sherds (Johnson 2007a). When compared to more reliable dates from short-lived botanicals in similar contexts, the ceramic residue dates were consistently 20–30% older than dates derived from short-lived botanicals (Johnson 2007a:87). For this reason, ceramic residue dates were excluded from the study.

Legacy radiocarbon dates lacking adequate technical or contextual information with the published dates were discarded (*sensu* Bayliss 2015 and Millard 2014). This immediately excluded a number of legacy radiocarbon dates for the region. Likewise, dates reported by now-defunct laboratories without information available on pretreatment or dating methodologies were discarded. The largest number of these discarded dates were produced by the Smithsonian Institution's radiocarbon laboratory. After a concerted

effort over multiple visits, no information about this laboratory or its method of radiocarbon dating could be discerned. Smithsonian staff have been equally unsuccessful in procuring this information (James Krakker, personal communication 2016). The exclusion of these dates does not suggest that all of them are inaccurate, only that their accuracy cannot be verified.

A final set of 16 legacy radiocarbon dates from the University of Georgia (UGA) were also discarded. These dates were produced at the university between the 1970s and 1980s (Ahler 1977b; Lee 1980:134; Toom 1982b). The dates were discarded for two reasons. First, Ahler (1977:127-130) determined that at least three dates (UGa1488–1490) were unreliable because of “progressive instrumentation loss” after discussing the dates with UGA staff in the 1970s. Ahler’s explanation of “progressive instrumentation loss” was sufficiently vague that it could not be defined for the purpose of this study. Second, a number of the remaining UGa dates may not have been pretreated for humic acids (Ahler et al. 2007:69), resulting in samples that may have been dated with contaminants.

New Radiocarbon Dates

This study prioritized dating materials from the extensive archaeological collections of early-to-mid-twentieth century excavations at Missouri River Trench Plains Villages. The majority of these collections were recovered during rescue operations by the River Basin Survey (RBS) project, conducted from the 1950s through the 1970s (Lehmer 1971). During this project, collections and records were split up, sent to different facilities, culled, and/or lost. Most unmodified faunal remains were separated from their collections and sent to the Nebraska State Museum and have only recently been reintegrated at state repositories. Field journals are curated at the Midwestern

Archaeological Center in Lincoln, Nebraska, instead of with state archaeological site files and catalogs. The fractured nature of site records and collections resulted in limited access to certain sites that would otherwise be included in this dating program.

To produce the most accurate radiocarbon dates, multiple factors informed by existing literature on best practices in sample selection were considered (Bayliss 2015; Discamps et al. 2015; Millard 2014; Taché and Hart 2013; Thompson and Krus 2018). These techniques consider variables like sample context, material type, and sample mass. While these guidelines provided a framework for selection strategies, unique circumstances in the collections, like excavation techniques, material availability, and post-depositional processes, required modifications to the sampling strategy.

Based on reported archaeological evidence (architectural, spatial, and ceramic) and previous chronological studies (Johnson 2007a), villages associated with the Coalescent Tradition immigration and Middle Missouri Tradition northward emigration were identified. Villages with datable materials from secure contexts determined through examination of excavation records, site reports, and physical inspection of collections were prioritized. The chosen materials included short-lived botanicals, small diameter wood, house posts, and bone from short-lived primary consumers like members of *Bovidae* (bison), *Antilocapridae* (pronghorn), and *Cervidae* (deer).

Another consideration in the sampling strategy was the chemical treatment and stabilization of samples. A common practice of the RBS research program involved treating artifacts with glues and pesticides, which are often organic and cannot always be successfully stripped from samples during pretreatment—particularly from samples with high surface porosity like bone. Multiple sites, including Arzberger and Crow Creek, contained unmodified and modified bone with unidentifiable lacquers or glues applied to their surfaces and at fracture points during expedient repairs prior to curation. Samples

with conspicuous evidence for chemical surface treatment were removed from the sample pool.

Site Selection

The radiocarbon chronology for this study integrated site-level chronologies from 36 Middle Missouri Tradition villages and 13 Coalescent Tradition villages into a regional framework. Hundreds of Middle Missouri Tradition villages have been documented, with dozens surveyed, tested, or excavated (Lehmer 1971; Winham and Hannus 1991). Because of the high volume of Middle Missouri Tradition sites in the region, a subset of sites with occupational histories predicted to coincide with the possible Middle Missouri Tradition northward emigration was selected. Sites within this temporal range were chosen based on existing ceramic and architectural taxonomic classifications as well as previous radiocarbon estimates (Johnson 2007a; Lehmer 1971). Two Middle Missouri Tradition villages, Cattle Oiler and Sommers, interpreted to pre-date Coalescent Tradition immigration by at least 100 years, were included. These sites were considered for their potential multi-century occupations overlapping with the period of interest (Jones 1969; Steinacher 1990). Additionally, the Late Woodland of Flaming Arrow and Menoken (see Ahler 2007) were included in the study because they occupy an uncertain temporal position in the region's history relative to the expansion of Middle Missouri Tradition groups in the northern Missouri River Trench. Only six of 11 known Coalescent villages were included in the study because they were the only villages with adequate documentation and datable materials (Table 3.1). The Coalescent Tradition village of Talking Crow could not be dated due to time and funding constraints. The remaining Coalescent villages in this study were Extended Coalescent villages with reported legacy dates.

Site-level Contexts

The goal of the chronology was to date each site's occupational history. Sites like Arzberger, Huff, and Whistling Elk were identifiably single occupation villages, while others contained multiple occupations, ranging from ephemeral camp sites to intensive village settlements (e.g., Black Partizan, Cattle Oiler, Crow Creek; Table 3.1). Materials found in close association with architectural contexts were prioritized for dating because of the intensive occupational histories and rebuilding episodes at some of these sites. The distinct architectural styles of Middle Missouri Tradition and Coalescent Tradition residential structures enabled the identification and separation of the occupations in question. This approach ensured that the correct temporal occupations were dated.

The contexts selected included house floors, storage pits originating at floor level, and posts. Materials targeted from floors and storage pits included short-lived botanicals and herbivore bone. House post features were also selected on a few occasions when they provided the only datable materials, or when the stratigraphy of a house was vaguely reported. Samples from contexts pre- or post-dating houses were also acquired when possible. When used in Bayesian models, contexts that directly pre- or post-date village architecture create more accurate estimations of house and village occupations. Stratigraphic associations guided sample selection for these contexts. Storage pits and middens under house floors or dug into house fill were frequently identified. Materials from houses and palisade fortifications bisecting other houses were also sampled whenever possible.

Fortification ditches and palisades were seldom selected for dating village occupations. It is difficult to establish a direct connection between materials found within a fortification ditch and the actual construction of the ditch. Palisade posts can be dated,

however their outer rings are seldom still present, so any dates taken from palisade posts necessarily predate the palisade itself. In one instance (Calamity Village), only palisade posts could be located for dating the village. At both Calamity Village and Hickey Brothers, intensive palisade, bastion, and ditch fortification constructions were clearly visible on the ground surface and in excavations, but house floors were less discrete (Caldwell et al. 1964; Lehmer 1971).

Bayesian Modeling

Bayesian statistical modeling allows researchers to formally incorporate prior knowledge (a priori knowledge) of archaeological contexts (e.g., midden stratigraphy, superimposed houses) and radiocarbon dates into the estimation and evaluation of temporal questions (Bayliss et al. 2007; Bronk Ramsey 2008, 2009a; 2009b; 2015; Buck and Meson 2015; Buck et al. 1996). Derived from Bayes' theorem, it uses both prior and likelihood information to calculate the probability of an event (Bronk Ramsey 2015):

$$p(t|y) = \frac{p(y|t)p(t)}{p(y)}$$

- Where t is a set of parameters
- y is the measurements made
- $p(t)$ is the *prior* or information about t
- $p(y)$ is the probability of the observations made
- $p(y|t)$ is the *likelihood* for the measurements given
- $p(t|y)$ is the probability of a parameter given the measurements and prior (*posterior probability*)

This method of calculating probability based upon likelihoods and priors can be utilized to refine temporal knowledge. Using informative priors—the archaeological data

representing temporal relationships (e.g., stratigraphy)—and calculated likelihoods—the probability density contained in radiocarbon dates—researchers construct Bayesian chronological models to calculate new posterior probability distributions functions (PDF). PDFs are essentially the updated probability of the event measured by dating given the prior information. Once the model has been defined by the informative priors (archaeological data), the radiocarbon measurements made (likelihoods), and both are included into the model, Markov chain Monte Carlo (MCMC) simulations are used to calculate the posterior probability distributions.

Because of the complex nature of Bayesian chronological models that necessarily include multiple types of data including PDFs and uncertainties with a high number of possible outcomes, MCMC is used (Bronk Ramsey 2009b:353, 2015:289). Each iteration of the MCMC simulation calculates a solution to the model parameters based on the results of the last iteration, and after many thousands or millions of iterations, it eventually achieves convergence and reports a representative solution. Convergence is achieved when continuing the simulation will not significantly alter the results of the previous iteration.

The results of a completed model contain posterior PDFs. Similar to the intercept method of calibration, meaningful ranges within a PDF can be calculated. For standard calibrated radiocarbon dates, this is the 1σ and 2σ ranges. Because posterior PDFs are not normally distributed, the 68% and 95% reported for models in this study are not sigmas, but the shortest range within the PDF that includes 68% or 95% of the range, respectively (Bronk Ramsey, 2009a:344-345, 353-354). These are referred to as highest probability densities (HPD). The representativeness of model solutions to reality can be measured by using the overlap between a likelihood and marginal PDF (posterior PDF for a single date within a model) to create an agreement index (Bronk Ramsey 1995,

2009a). This is not a formal statistical approach, but a comparison made between a marginal PDF and the null prior, or likelihood. Under this approach, a value of 60% is the reasonable acceptable value (Bronk Ramsey 1995). If an individual agreement index within a model is below 60%, then there may be an inconsistency between the specific likelihood and related data entered into the model. Such inconsistencies can be addressed through manual removal of a date or formal outlier analysis (Christen 1994, 2003; Bronk Ramsey 2009a). The agreement indices for overall agreement for an entire model can also be approached in the same way, where a value below 60% agreement for a model is evidence that the priors and likelihoods entered into the model have significant inconsistencies. In OxCal, the program used in this study, the Amodel indices can be used to evaluate model acceptance (Bronk Ramsey 2009a, 2009b).

The Bayesian method of analyzing radiocarbon dates is now convention in much of Europe (Banks 2015; Bayliss et al. 2007; Hamilton et al. 2015; Krus and Peteranna 2016; Whittle et al. 2011; Wood 2015). The technique is also becoming common practice in North America and has helped resolve issues with site-level occupational histories, regional settlement distributions, and the temporality of warfare and population movement (Abel et al. 2019; Birch et al. 2021; Hamilton and Krus 2018; Kennett et al. 2014; Krus 2016; Manning et al. 2018; Thompson and Krus 2018). The following CQL (Chronological Query Language) commands were used in this study. They are taken from Bronk Ramsey (2009b, 2015, 2024). All OxCal commands in this study are capitalized (e.g., Phase as opposed to phase).

R_Date

The *R_Date* command calculates the probability density function of the likelihood of an event represented by radiocarbon sample dating to a certain period along the

radiocarbon calibration curve. This command was used to calculate posterior PDFs for every radiocarbon date used in this study.

Sequence and Phase

Sequence and Phase are commands that provide model structure as opposed to queries or functions. The major differences between the commands are that Sequence treats model information placed within it as a temporally ordered list, where Phase assumes that all information placed within it is unordered. The posterior PDF of each event is calculated based on these assumptions. As such, it is an ordered function.

Boundary

Boundaries are placed in Sequences or other ordered functions to estimate PDFs for the beginning and end posterior PDFs of Phases and Sequences. In this study they typically identify the beginning and end of village occupations.

Interval

The Interval command is used here as a command to estimate a parameter. Here, the command is used to estimate the temporal range (posterior PDF) that a village was occupied. The command reports the timespan between events or groups of events in a Sequence. It is most commonly used to identify the number of calendar years between Boundaries in a Sequence.

One approach for using the Interval function was to include a log-normal expression $[\text{LnN}(\ln(50), \ln(2))]$ to constrain the posterior Interval PDF returned by the model to 50-years ± 50 years (100 years or fewer). This approach was adopted here because many villages lacked evidence for long-term occupations (described below).

The other way Interval was applied was as a query without an accompanying expression. In this approach the Interval function returns a posterior PDF that is unconstrained and representative of the Phase of dates between two Boundaries. This was applied to models for long-lived villages.

Here, 'short-lived villages' are those occupied for 0-to-50 years as studies of Plains Villages suggest the typical village was occupied between one-to-two generations. Both archaeological (Ahler et al. 2007:66; Alex 1981; Baerries and Alex 1974; Bamforth 2006:77-82; Dallman 1983:30; Henning and Henning 1982; Johnson 2007a; Lensink 2005; Lensink and Alex 2001; Mitchell 2010; Peterson 1965, Tiffany 1991; Toom 1992a, 1992b) and ethnohistoric (Will 1930; Wilson 1934; Weitzner, 1979) resources discuss village longevity in the region. Lensink (2005) and Johnson (2007a:57-67) present overviews of these studies and use that information to estimate village occupation. A similar justification from a broader continental perspective for village occupational longevity is used by Birch and colleagues (2021) and Manning and colleagues (2020). A reexamination of these methods is not within the scope of this project; rather, the objective herein is to reaffirm that many of these studies independently identified that the typical Missouri River Trench village was occupied between 20 to 50 years, on average.

Mitchell (2010:392-393), drawing from Ahler and colleagues (2007:66) and Toom (1992a:84-94), uses house rebuilding, house superposition, and midden accumulation to conclude village occupations were typically fewer than 50 years. Lensink (2005:156), using radiocarbon dispersion, house longevity, midden accumulation, and ceramic discard/consumption rates (*sensu* Drenan 1984; Shiffer 1975), produces a range of 0.8 to 69 years for typical village duration. Lensink's (2005) range is conservative.

The consensus among Plains archaeologists, based on the evidence provided, is that most villages in the Missouri River Trench were short lived (one-to-two generations). Because of the ubiquity of short-lived villages, this study argues the burden of proof is in demonstrating a village was long-lived rather than short-lived (to be conservative, here a short-lived village is <100 years). Atypical long-lived villages in the Missouri River Trench have been identified at sites like Crow Creek (Bamforth and Nepstad-Thornberry 2007a; Kivett and Jensen 1974) and Buffalo Pasture (Lehmer and Jones 1968). Thick sheet midden predominated throughout the site locality at Crow Creek, structures like houses and a fortification ditch were filled with midden deposits, and houses were built and rebuilt on preexisting middens. The criteria used herein to identify which villages were long-lived are similar to Johnson's (2007a:66) PELTO criteria (primary evidence for long term occupation). Here, a village is considered long-lived if it contains: (1) evidence of superimposed house floors and/or extensive rebuilding episodes; and/or (3) deep middens of 40 cm or more in depth and many square meters in extent (i.e., sheet midden).

These criteria are adopted here because house rebuilding and midden accumulation suggest long-term occupations. Because Middle Missouri Tradition and Coalescent Tradition houses were pre-planned structures with regularized, similar architecture (Johnson 1998:315; Krause 2012; Lehmer 1971; Winham and Calabrese 1998:285-290), it is often easy to identify rebuilding episodes in a site layout or plan view of a village or house (Figure 3.1). Furthermore, studies on well-dated historic Mandan, Hidatsa, and Arikara midden accumulations demonstrate that "...an occupation of less than 50 years would yield a midden less than about 40 cm in maximum thickness in outside house locations" (Johnson 2007a:65-66).

Outliers

An Outlier model measures the probability that a specified date or date-range (R_Date, Sequence, Phase, etc.) falls outside of an assigned distribution with a specified magnitude. This study utilized two types of outlier analysis. The first is identified by *Bronk Ramsey* (2009b:1028) as the General Outlier model. This model uses a Student's t-distribution [T(5)] and scaling distribution between 1 and 10,000 years [U(0,4)]. This long-tailed distribution down-weights outliers based on their distance from the accepted date-range. As a result, extreme outliers will affect the model the least. This command was used for every non-charcoal date included within a village's occupation, defined by a Sequence or Phase.

Dates identified as statistical outliers were removed from a model and the model was re-run. Highly probable outliers were dates that fell well below the 60% acceptance threshold or upon review of the archaeological context it was revealed that the date likely pertained to an event not related to a village's occupation (e.g., a rodent burrow). In other instances (e.g., Medicine Creek and Menoken), outliers were retained. In these situations, it was identified that the full statistical universe of a specified event (a village occupation) had likely not been evenly sampled and the date identified as an outlier could be a date representing an earlier or later section of a village's occupation.

The second type of outlier analysis used pertains to the inclusion of dates on charcoal (*Bronk Ramsey* 2009b:1028). The Charcoal Outlier Model [Exp(1,-10,0),U(0,3)] assumes that any radiocarbon date identified as an outlier will necessarily pre-date the event in question. Instead of assuming that the charcoal date pre-dates the event by any number of years, it assumes the likelihood is higher that the sample is closer in time to the specified event, with a long-tail, exponential distribution of older dates (tree rings) as a less likely occurrence and a scaling of 0 to 10,000 years. The Charcoal Outlier Model

was applied to dates from wood and charcoal samples identified as large-diameter wood (e.g., house posts).

Date

The Date command, as it is used here, estimates the date of an undated event within the expression it is placed. If placed in a Phase with multiple other dates, the Date command determines a hypothetical event describing the temporal extent of the Phase between its start and end Boundaries. It should be noted that the results of the Date command should never be taken as a substitute for Boundaries but can be utilized like 'shorthand' that summarizes the Phase. The use of the Date command to summarize a Phase has been implemented recently in multiple studies (e.g., Birch et al. 2021, 2024; Conger 2022; Manning and Birch 2022; Manning et al. 2019, 2020). The Date command was utilized in two ways.

First, the Date was used to summarize Phase durations, which then became a proxy for discussing village occupational duration. In some instances, the Date command may be underestimating village occupations when an insufficient number of radiocarbon dates are present to adequately represent the full range of human occupation. For some village models, the Date command returned posterior PDFs longer than those of the Interval command.

The Date command was also used to compare the occupations of two villages and quantify their likelihood of overlap. In these situations, the posterior PDF returned by the Date function for a specific village occupation was compared to the Date posterior PDF returned by that of another village using the Difference and Interval commands.

Before and After

Before and After commands define the terminus ante quem (TAQ) and terminus post quem (TPQ) constraints for the model. When identifying dates as TAQs or TPQs, the model is instructed to place all posterior PDFs in the constraints of each of these commands either before or after other posterior PDFs believed to pre- or post-date them. In this study, TAQs and TPQs were used for samples from secure stratigraphic contexts to temporally come before or after a targeted event, such as a house occupation.

Difference

As used in this study, the Difference command quantifies the possibility of temporal overlap between two specified elements in a model. Instead of returning a calendrical date range, this function returns a negative-to-positive probability that two elements overlap in time. The Difference command was used to identify the possibility that two villages overlapped in time.

Order

The Order command was used to query the relative order of events within a group, based on probability. This command can be applied to a specific group of elements or the model as a whole. This command was used to establish the probability that one village occurred before another in time.

Conclusion

In conclusion, the integration of AMS radiocarbon dating and Bayesian chronological modeling has the ability to fundamentally transform approaches to

establishing more precise and reliable chronologies. This chapter demonstrates that methodological refinements over time and appropriate radiocarbon hygiene protocols can help to create more accurate and reliable chronologies. Furthermore, incorporating prior archaeological knowledge with Bayesian chronological modeling can further improve precision in dating occupational phases and distinguish between continuous and discontinuous settlement patterns.

These approaches to dating are utilized to create an new regional chronology of village occupations in the Missouri River Trench between the eleventh and sixteenth centuries AD. The next chapter will describe the rationale for model construction and results of each village occupation. That is followed by a discussion of regional and subregional trends that address the research questions posed in the introductory chapter.

Chapter 3 Tables

Table 3.1: List of sites included in this project.

Site Number	Site Name	Occupations
39AR8	Alberts Creek	Extended Middle Missouri
39LM146	Antelope Dreamer	Initial Middle Missouri
39HU6	Arzberger	Initial Coalescent
32MO2	Bendish	Extended Middle Missouri
39LM218	Black Partizan Early	Initial Coalescent
39LM218	Black Partizan Late	Extended Coalescent
39DW231	Calamity Village	Extended Middle Missouri
39ST224	Cattle Oiler Early	Initial Middle Missouri
39ST224	Cattle Oiler Late	Extended Middle Missouri
39ST1	Cheyenne River	Extended Middle Missouri
32ME1	Clark's Creek	Extended Middle Missouri
32OL14	Cross Ranch	Extended Middle Missouri
39BF11	Crow Creek Early	Initial Middle Missouri
39BF11	Crow Creek Late	Initial Coalescent
39ST238	Durkin	Extended Middle Missouri
39ST1	Fay Tolton	Initial Middle Missouri
32ML4	Flaming Arrow	Late/Terminal Woodland
39ST12	H.P. Thomas	Initial Middle Missouri

Site Number	Site Name	Occupations
32EM1	Havens	Extended Middle Missouri
39CA208	Helb	Extended Middle Missouri
32MO11	Huff	Extended Middle Missouri
39ST15	Indian Creek Early	Extended Middle Missouri
39ST15	Indian Creek Late	Extended Coalescent
39CO6	Jake White Bull	Extended Middle Missouri
39LM208	Jiggs Thompson	Initial Middle Missouri
39CA3	Jones	Initial Middle Missouri
39ST223	Ketchen	Extended Middle Missouri
39LM55	King	Initial Middle Missouri
39HU97	Little Pumpkin	Extended Coalescent
39CO14	Lower Grand	Extended Coalescent
39LM201	Meander	Extended Coalescent
39LM218	Medicine Creek Early	Initial Middle Missouri Initial Coalescent
39LM218	Medicine Creek Late	Extended Coalescent
32BL2	Menoken	Late/Terminal Woodland
32MO291	N/A	Extended Middle Missouri
39ST9	Over's La Roche	Extended Coalescent
32SI4	Paul Brave	Extended Middle Missouri

Site Number	Site Name	Occupations
32EM10	Shermer	Extended Middle Missouri
39ST56	Sommers	Initial Middle Missouri
32SI19	South Cannonball	Extended Middle Missouri
39ST235	Stony Point	Initial Middle Missouri
39SL4	Sully	Extended Coalescent
39SL7	Sully School	Initial Middle Missouri Initial Coalescent
39BR16	Swanson	Initial Middle Missouri
39CO213	Travis I	Extended Middle Missouri
39CA1	Vanderbilt	Extended Middle Missouri
39WW203	Walth Bay	Extended Coalescent
39HU242	Whistling Elk	Initial Coalescent
32ME7	White Buffalo Robe	Extended Middle Missouri

Chapter 3 Figures

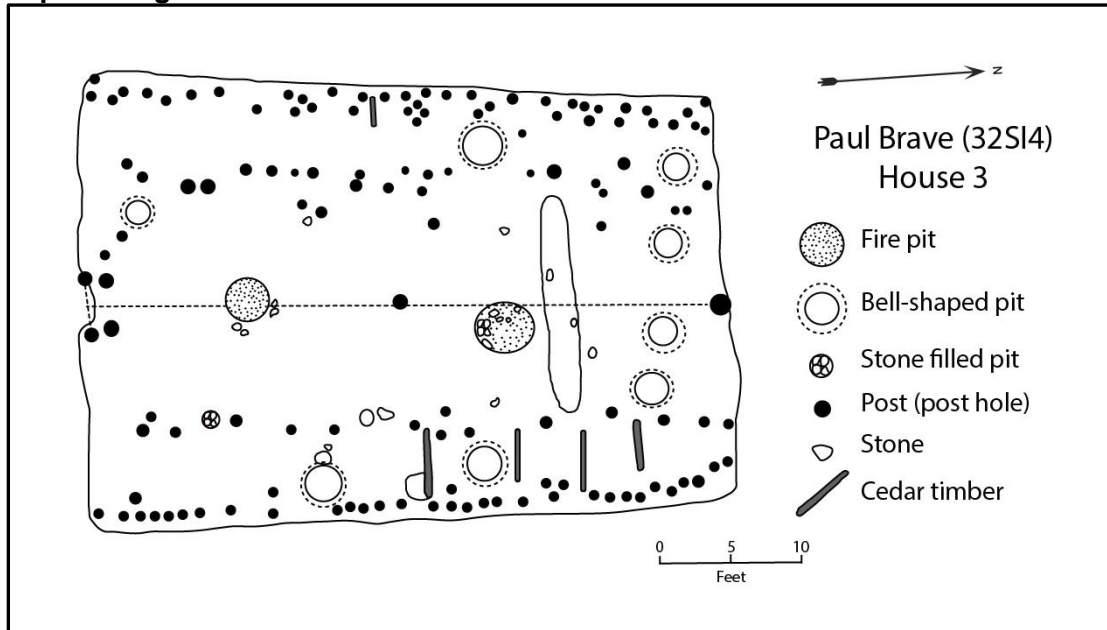


Figure 3.1: House with evidence of rebuilding. Structural rebuilding is assumed due to the presence of inner and outer parallel rows (figure adapted from Wood and Woolworth 1964:6).

CHAPTER 4
SITE-LEVEL MODELS, RESULTS, AND MULTISCALAR SETTLEMENT
PATTERNING

This chapter describes the results of the radiocarbon dating program and introduces an updated regional chronology of Middle Missouri and Coalescent Tradition village occupations. In the subsequent chapter, the chronology is used in conjunction with archaeological information to examine the dynamics of migration and conflict in the Missouri River Trench from the thirteenth to sixteenth centuries AD.

The results of the dating and Bayesian modeling are reported below according to archaeological tradition in order to address the questions posed in the introductory chapter:

- 1) *Does Middle Missouri migration into the northern areas of the Trench coincide with evidence of violence?*
- 2) *Does the adoption of inclusive institutions (that would facilitate inclusive ideologies and shared identities) cooccur with the migration north?*
- 3) *Does Coalescent migration occur while some Middle Missouri groups still occupy the southern extent of the study region?*
- 4) *Do Coalescent groups abandon the practice of building fortifications after Middle Missouri groups leave the area?*
- 5) *Does evidence for intervillage warfare and/or migration among either Middle Missouri or Coalescent groups coincide with evidence for climatic shifts like drought cycles?*

The first section describes the rationale and results for every model built for each village. The second section discusses general trends in the chronology and addresses the questions above. The Middle Missouri subsection addresses questions one and two by discussing the timeline of migration north and shows that the migration does not coincide with violence in the area. It is not until later that evidence of violence among these villages occurs. Plazas and adjacent ceremonial lodges also become more common as groups migrate north.

The Coalescent subsection addresses questions three and four. The timing of Coalescent migration into the southern portion of the Trench is identified, and the occurrence of coincident Middle Missouri villages suggests that the migrants entered an area already experiencing warfare. This section also identifies the time range for the Coalescent transition from fortified to unfortified settlements. It is shown that Coalescent groups only stopped fortifying their villages after the last Middle Missouri village dated in this study was abandoned.

Question five is addressed in the Climate, Migration, and Conflict section. The chronology shows some overlap between evidence for climatic instability and conflict. However, more data are needed to address the nature of warfare and its association with climatic trends.

It is acknowledged that the number of villages dated in this project and the chronological models discussed below are tentative attempts at constructing a comprehensive occupational history of the Missouri River Trench between the thirteenth and sixteenth centuries AD. Within the Smithsonian River Basin records, hundreds of possible village sites were identified during preliminary aerial and pedestrian surveys (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection). However, most of these

identifications have never been confirmed as actual village sites (as opposed to campsites or other types of artifact scatters) through further survey or excavation. Multiple comprehensive regional studies also mention a number of sites within the Trench related to Middle Missouri or Coalescent occupations (Ahler and Haas 1993; Alex 1981; Butler 2014; Fox 1980; Johnson 2007a; Lehmer 1971; Steinacher 1984; Winham and Hannus 1991)(Appendix E). Cross-referencing the sites documented in these studies, at least 325 precontact sites (444 occupations due to multiple occupations at some sites) are confirmed to exist. Of these 444 occupations, 204 are Middle Missouri and 240 are Coalescent. At present, it is unknown how many of these sites represent actual village occupations (i.e., the presence of architecture). In the north, 23 Late Woodland and Middle Missouri villages may have been occupied between the thirteenth and sixteenth centuries (Ahler and Haas 1993; Johnson 2007a). A similar number of southern Middle Missouri villages (26 villages) may have also been occupied during the same period (Johnson 2007a). Approximately 58 Coalescent villages may have been occupied between the thirteenth and sixteenth centuries (Johnson 2007a). However, it must be noted that the numbers of villages cited above are likely inaccurate. As mentioned, many of the sites documented as villages and possible villages identified initially during the preliminary River Basin Surveys have never been confirmed (with many sites now inundated due to hydroelectric dams), so more villages may have occupied the terraces of the Missouri Trench between the thirteenth and sixteenth centuries. Alternatively, fewer villages may have been occupied during this period, as the chronologies referencing them lack temporal resolution below the centennial level.

Another important point is that Bayesian chronological models should be considered living models, meant to be continually reevaluated and refined as new data becomes available. This is especially true for sites in this study with few radiocarbon

dates. All legacy dates used in this study can be found in Johnson (2007a:Table 7). The original publications reporting these dates will also be cited. Provenience and AMS results of each date produced for this study can be found in Appendices A and B. Model structures and results of each village model are contained in Appendices C and D.

Site Level Models

All ranges are reported in this section at 68% probability. In the subsequent sections involving general trends in regional settlement, 68% and 95% probabilities are reported. A village's occupational date-range is defined here as the results returned by the Date command in the Phase or Sequence in which a village's radiocarbon dates are placed in a model. A village's occupational duration refers to the results returned by the Interval command in a model. All modeled date ranges are noted in italics to indicate they were derived from Bayesian models to differentiate modeled from unmodeled date ranges.

Multi-occupation Sites

Black Partizan

Black Partizan is a multi-occupation, Coalescent Tradition village site (Caldwell 1966a:77). The majority of the house depressions at Black Partizan are in a bastioned palisade and ditch. At least five additional house depressions occur outside the fortification system. Based on a ceramic analysis of the site, Caldwell (1966a:74) interprets the site as having two separate occupational components with no temporal overlap. Multiple lines of evidence suggest that the earlier occupation was long-term: the floor of House 11 was dug into an existing midden, and multiple houses in the

fortification presented complicated and irregular post patterns, suggesting rebuilding episodes.

No legacy radiocarbon dates for Black Partizan are reported. I produced a total of 14 new radiocarbon dates for this site. One date (UGAMS-43145) was removed from consideration because it is modern. Two other dates were also rejected (UGAMS-43139 and 43140). These dates were initially meant to be used with the Before command to better date House 11 as they came from near-surface pits that stratigraphically postdate the house. However, UGAMS-43139 and 43140 are over 100 years older than the dates drawn from House 11 contexts. These may have been older pieces of bone redeposited over House 11 after it was abandoned.

In the first Black Partizan model, I placed the remaining 11 dates into two Phases. I placed dates from contexts in the fortification system into a Phase and dates from contexts outside the fortification system into a second Phase. I constrained the Interval command to 100 years for this model because there is evidence of long-term occupation. I also placed an unconstrained Interval command between the two occupations.

The results of the Black Partizan model produced an acceptable agreement index ($A_{\text{model}} = 100.7\%$). The occupational date-range (Date command) for the early occupation of Black Partizan is ca. *cal yrs AD 1375–1430* with an occupational duration (Interval command) of 50–105 years. The results of the latter occupation produced a date range of *cal yrs AD 1515–1565* with an occupational duration of 10–55 years. The unconstrained Interval command placed between the early and late occupations of the site returned a date range of 50–105 years, suggesting the two occupations at Black Partizan did not overlap.

Cattle Oiler

Cattle Oiler is a multicomponent, unfortified village consisting of Initial and Extended Middle Missouri occupations. This village was chosen for inclusion in this study because it is considered one of the last Middle Missouri villages to be occupied in the southern section of the Trench (Johnson 2007a:101). Although the site contains multiple components, in a partial report written between the 1965 and 1966 field seasons, Moerman and Jones (n.d.) suggest the village consisted of only a single, short-term occupation (but see Johnson 1977:213). For this reason, I dated both components.

Seven legacy radiocarbon dates are reported for this site (Long and Mielke 1967:370; Stuckenrath and Mielke 1970:195). Six of the seven dates were run at the Smithsonian radiocarbon laboratory and could not be confidently included in the study (see Chapter 3). The remaining date (ETH-11040) was not discarded. I produced a total of 26 new radiocarbon dates. On my first modeling attempt, I placed all dates into a single Phase. I also constrained the Interval command to 50 years as no evidence exists for long-term occupation.

The first model returned an Amodel index of 65.1%. The agreement index reported for the Interval command was in low agreement with the model (A=7.2%). The Begin and End Boundaries of the model returned a date range *between cal yrs AD 1145–1345* and the Interval command returned an occupational duration of 150–190 years. Even when constraining the Interval command to 50 years, this model produced an occupational date-range and interval inconsistent with the archaeological evidence above. No evidence exists for a long-term occupation. The two components found at the site are more likely to represent two occupational periods.

In the second model, I divided the dates based on the components with which they are associated. The sample associated with the earlier occupation was placed first

in a Sequence, while the later occupation was placed in a later Sequence. I still constrained the Interval command to 50 years for each component. The results of the second model were more consistent with the archaeology. The second model produced an Amodel index of 132.4%. The beginning and end Boundaries returned a date range of *cal yrs AD 1180–1200* for the early (Initial Middle Missouri) occupation and *cal yrs AD 1305–1360* for the later (Extended Middle Missouri) occupation. The occupational duration for the early occupation was 5–25 years and 5–25 years for the later occupation. The Interval command placed between the early and late occupations returned a range of 85–130 years. This suggests that the two occupations at Cattle Oiler were generations apart and did not overlap temporally. These results align with the archaeological evidence, suggesting two short-lived occupations.

Crow Creek

Crow Creek is a large, multicomponent village site with a long and complex occupational history and equally complex history of excavation by numerous individuals over multiple decades (Bamforth and Nepstad-Thornberry 2007a; Haug 1986; Kivett and Jensen 1974; Willey and Emerson 1993; Zimmerman and Bradley 1993). The site consists of an Initial Middle Missouri occupation overlaid by an Initial Coalescent occupation. Both occupations are believed to represent multigenerational occupations (Bamforth and Nepstad-Thornberry 2007; but see Ahler et al. 2007:81). Although there is no evidence of fortifications associated with the Middle Missouri occupation, at least two sets of fortifications are associated with the Coalescent occupation (bastioned palisades and ditches) (Kivett and Jensen 1974:16-22).

Five legacy radiocarbon dates reported for Crow Creek were included in this study (M-836, I-577, I-578, M-1079a, and WIS-1074) (Bender et al. 1980:116; Crane and Griffin 1959:179, 1962:194; Haug 1986;). Three dates (M-836, I-577, I-578) were drawn

from the Initial Middle Missouri occupation. One date (M-1079a) was drawn from the Initial Coalescent occupation. The last date (WIS-1074) was also included within the Initial Coalescent occupation since it is a sample recovered from the bone bed and could be associated with the later village occupation (Willey and Emerson 1993:241).

Due to the complex and long history of occupation at Crow Creek and the site's importance for understanding conflict and migration, 81 samples were identified for dating. Unfortunately, during pretreatment, I found that much of the animal bone from the collection had been treated with an unidentified substance, likely for stabilization. Due to time constraints, I was unable to identify the substance or a solvent that could be used during pretreatment. From the original 81 samples, I was able to produce 52 new dates. However, after dating, discrepancies between field notes and the field catalog brought into question the provenience of four samples (UGAMS-46658, 46659, 46661, 46665) that were subsequently removed from consideration. Another date (UGAMS-46721) was also discarded because, based on a reexamination of field notes and the field catalog, it was likely to postdate the Coalescent occupation. The date for UGAMS-46721 is hundreds of years older than any dates associated with the Coalescent occupation.

With the remaining five legacy dates and 47 new dates, I constructed a Bayesian model accounting for the Initial Middle Missouri and Initial Coalescent assemblages from the site. First, samples were divided based on provenience into two Phases representing the Middle Missouri and Coalescent occupations. The two Phases were then placed in a single Sequence, with the Phase representing the Initial Middle Missouri occupation positioned before the Initial Coalescent Phase. An unconstrained Interval command was placed between each Phase. An unconstrained Interval command was also placed in each Phase, as there is ample evidence for long-term occupation. Both the General and Charcoal Outlier Models were applied to the model. Based on stratigraphic evidence,

five dates were utilized as terminus post and terminus anti quems. Using the Before command, two dates (UGAMS-46726 and 46727) were used as terminus ante quems to constrain the end of the Initial Middle Missouri occupation. Using the After command, two dates (UGAMS-46733 and 46736) were used as terminus post quems to constrain the beginning of the Initial Coalescent occupation. Finally, I applied the Before command to one date to constrain the end of the Initial Coalescent occupation. The results of the first model produced an acceptable agreement ($A_{model} = 94.1\%$). The Initial Middle Missouri occupation of Crow Creek likely lasted 20–70 years, ca. *cal yrs AD 1160–1195*. The later, Initial Coalescent occupation of the village likely lasted 85–140 years, ca. *cal yrs AD 1345–1420*.

It should be noted that the timing of the attack at Crow Creek is still not clear. One date (WIS-1074), taken from the bone bed, is often associated with the massacre. However, this date was most likely taken from charred material that postdated the bone bed (Bamforth 2018:22-23). With the number of dead, it might be supposed that the massacre marks the end of the village's occupation, but there is evidence that people reinhabited the village post-massacre (Bamforth and Nepstad-Thornberry 2007a). Without more evidence to link datable materials to the attack, it is difficult to identify when it occurred. Evidence suggests that the massacre was later in the occupation.

Indian Creek

Indian Creek is a multicomponent site consisting of a fortified Extended Middle Missouri village and an unfortified Post-Contact Coalescent village (Winham 1995). Ceramic evidence also suggests an Extended Coalescent occupation. The village lacks substantial evidence of long-term occupation during the Extended Middle Missouri occupation. Evidence of rebuilding at one house exists (Winham 1995:178). The later Post-Contact Coalescent village partially destroyed the earlier Extended Middle Missouri

occupation (Lehmer and Jones 1968:64-66). I chose Indian Creek not only because it contains an Extended Middle Missouri component in the southern area of the Trench but also because of the surprisingly young suite of legacy radiocarbon dates associated with what was believed by the excavators to be an Extended Middle Missouri component.

Four legacy radiocarbon dates on charcoal exist for Indian Creek (Winham 1995). These dates, ranging from 450 ± 80 to 300 ± 80 RCYBP, are considered late for any Middle Missouri village. Both Winham (1995) and Ahler and colleagues (2007:85) note that due to possible mixing, these dates may derive from intrusive materials from the later Post-Contact Coalescent occupation. I drew 10 samples from the Indian Creek assemblage to test this assumption. One date (UGAMS-46708) was burned bone and did not survive pretreatment. Another date (UGAMS-46699) was post-European contact (120 ± 20 RCYBP). UGAMS-46699 was rejected. The remaining new dates are hundreds of years earlier than the legacy dates, suggesting that the legacy dates were drawn from intrusive contexts.

To formally test the possibility that the legacy dates were from intrusive contexts, I placed the 12 legacy and new dates into a single Phase. The Charcoal Outlier was applied to the four legacy dates. The Indian Creek model returned an unacceptable agreement index ($A_{\text{model}} = 18.2\%$). This result is not unexpected. The legacy dates were likely drawn from intrusive contexts.

In the second Indian Creek model, I divided the legacy and new dates into two Phases in the overall Sequence. I placed the Phase containing the new dates before the Phase containing the legacy dates in the Sequence. The rest of the model remained the same. The second Indian Creek model returned an acceptable agreement index ($A_{\text{model}} = 68.1\%$). The early occupation of Indian Creek likely occurred ca. *cal yrs AD* 1345–1405, for 5–60 years. The later occupation of Indian Creek likely occurred ca. *cal*

yrs AD 1450–1580, for 5–35 years. The unconstrained interval placed between the early and late occupations suggests the gap in occupation occurred for 40–175 years.

Medicine Creek

Medicine Creek is a multicomponent site consisting of Initial Middle Missouri, Initial Coalescent, and Extended Coalescent occupations (Lehmer 1971:195). There is no formal report for this site, and all data were taken from field records (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 313, 39LM2, 1-3). Although the site has an Initial Coalescent occupation, it lacks evidence of fortifications typically associated with Initial Coalescent villages. Interestingly, House D (XU-31), identified in the excavation records as an Initial Coalescent house, is located directly between two Initial Middle Missouri houses (Houses C and E).

No legacy radiocarbon dates exist for Medicine Creek. I produced 20 new dates associated with each occupation. One sample (UGAMS-43115) returned a modern date range and was removed from further consideration. The remaining 19 radiocarbon dates were organized in a Bayesian model based on their association with the three occupations. The Interval command for each occupation was constrained to 50 years, as the site has no evidence for possible long-term occupation. Huscher and McNutt (1958:56) mention the existence of mounds in the site boundaries and suggest they may be midden mounds. These small mounds were unexcavated and may have also been a natural part of the landscape. Their association with any of the site occupations could not be verified. I also applied the Before command for all three occupations as house excavation blocks from each occupation contained intrusive features likely to postdate these house occupations. Because the features could not be attributed to one of the occupations, they could only be used as terminus anti quems. A Charcoal Outlier was

also applied to dates derived from house posts (UGAMS-46667, 46668, 46669). Last, the Difference command was used to estimate the probability of temporal overlap between the Initial Middle Missouri and Initial Coalescent houses, as these houses were found very close together and in a linear configuration, typical of Initial Middle Missouri house organization.

The results of the first model produced an unacceptable agreement index ($A_{\text{model}} = 48.2\%$). The Outlier Model also identified one date (UGAMS-43127) from House D as having a poor agreement with the overall model ($A_{\text{model}}=5.2\%$) and being an outlier. UGAMS-43172 is hundreds of years earlier than the other dates and likely does not date the village occupation. The date was removed and a new model was run.

The second model produced an acceptable agreement index ($A_{\text{model}} = 102.9\%$). The General Outlier model identified two dates (UGAMS-43119 and 43120) from House I as outliers. Both outliers are within ten radiocarbon years of other dates in the model. Upon review of the samples that produced UGAMS-43119 and 43120, I found that both samples, each formal bison bone tools, were drawn from the house floor. Both dates only slightly fail the arbitrary cutoff for the Outlier Model and are clearly from human occupation. I interpret these outliers as evidence that not enough radiocarbon dates were run to fully represent the entire early occupation of the village. In this instance, I chose the conservative option of leaving the dates in the model so as not to shorten the occupational duration of the village artificially.

Another important element of the second model's results was that the Interval command placed between the Initial Coalescent and Initial Middle Missouri occupations returned a range of 0–17 years. Likewise, the Difference command, measuring the likelihood of overlap between the occupations, returned a range of -2–17. Both of these

measures of overlap suggest there is a likelihood that these two occupations overlapped temporally.

The third Medicine Creek model was the same as the previous model except for one amendment. Because of the high likelihood of temporal overlap between the Initial Middle Missouri and Initial Coalescent houses and their linear placement, I arranged the dates from Initial Middle Missouri and Initial Coalescent contexts into a single Phase. The third model produced an acceptable agreement index ($A_{\text{model}} = 79.9\%$). Interestingly, combining Initial Middle Missouri and Initial Coalescent dates into the same Phase corrected the outlier issues with UGAMS-43119 and 43120, further suggesting that the Initial Middle Missouri and Initial Coalescent occupations were the same. The unconstrained Interval command placed between the early (Initial Middle Missouri and Initial Coalescent) and late (Extended Coalescent) occupations of the site returned a range of 338–450 years. Likewise, the Difference command measuring the temporal overlap between the early and late occupations returned a range (-475 – -363), suggesting the occupations occurred centuries apart.

Medicine Creek likely contained two separate occupations. The earliest occupation was a mixture of Initial Middle Missouri houses and possibly one Initial Coalescent house, ca. *cal yrs AD 1155–1180* and spanning approximately 5–40 years. The second occupation of Medicine Creek came hundreds of years later and consisted of Extended Coalescent houses, ca. *cal yrs AD 1540–1645*, and spanning approximately 5–35 years.

It should be noted that the structure (House D), identified as an Initial Coalescent house, occurring so early in time presents three competing possibilities. First, the Initial Middle Missouri and Initial Coalescent groups lived together in the same village in at least one instance. However, if House D is evidence of a Coalescent occupation, it

would be the earliest Coalescent house documented by almost 100 years. Such an early date range suggests the presence of a Coalescent occupation during a period when Central Plains groups—ancestors of Coalescent groups—were just beginning to appear in the archaeological record (Ropper 2014). The classification of House D as an Initial Coalescent house is debatable at this point.

The second possibility is that House D is not evidence of an Initial Coalescent occupation. The archaeological evidence for House D being an Initial Coalescent occupation is scant. The plan view of House D is not clearly representative of the typical four-post square-to-round structure of an Initial Coalescent house. The designation of a round house relies solely on the circular shape of what was identified as a circular floor during excavation. Furthermore, there is no evidence of the typical Initial Coalescent fortification system at the site, other Initial Coalescent houses, or Coalescent ceramics. Although Maleen (1948:27) suggests the existence of Central Plains ceramics, Berg (2002:6-7) found no evidence of this.

The third possibility is that the dated materials that were believed to have been from House D contexts originated from the earlier Middle Missouri occupation. Two bell-shaped pits were found under the house floor (Features 45 and 46) which predate the House D occupation. However, according to the field records, the dated materials came from bell-shaped pits (Features 39 and 47) believed to date to the house occupation (i.e., the opening of each of the pits originates at the house floor level suggesting they are contemporaneous). Interestingly, the one date taken out of the model (UGAMS-43127), because it was identified as a strong outlier, originated from bison bone taken from Feature 40. This radiocarbon date could be either a one-in-twenty statistically “bad” date (*sensu* Bronk Ramsey 2009b: 1025), or there was some mixing within the House D contexts.

Sully School

Sully School is the most confusing site in this study. No report exists for the site. Sully School is a multicomponent site, including Extended Middle Missouri and an undefined Coalescent occupation (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 337, 39SL7, 1-3). Based on pottery types/percentages present, Johnson (2007a:118) identifies the Middle Missouri component as a “transitional Initial Middle Missouri-to-Extended Middle Missouri occupation,” suggesting the occupation would occur early among Extended Middle Missouri villages.

Two legacy radiocarbon dates are reported for Sully School (ETH-11051 and 11052; Johnson 2007a:Table 7). I rejected both dates because they were the product of a study testing pretreatment methods on ceramic residue dates. The study found that the method produced dates consistently 20–30% older than dates derived from short-lived botanicals (Johnson 2007a:87).

A total of 10 new dates were produced for Sully School. I created a Bayesian model where dates from each occupation were placed in separate Phases. Because Johnson (2007a:172, 186) suggests that the Middle Missouri occupation occurred prior to the Coalescent, I then added each Phase into a single Sequence with the Middle Missouri occupation first and the Coalescent last. Although the site contains no evidence of long-term occupation, due to the existence of materials related to both Middle Missouri and Coalescent cooccur, the occupation was constrained to 100 years. The General Outlier Model was applied to the entire model. OxCal could not resolve the order, causing the model to fail. This suggests that the site's Middle Missouri and Coalescent assemblages indicate a simultaneous occupation.

A second Bayesian model was created, placing all dates in a single Phase. The model reported an acceptable agreement index ($A_{\text{model}} = 76.9\%$). The occupational duration of Sully School was 40–85 years (ca. *cal yrs* 1275–1325). People participating in practices (including house construction) related to both Middle Missouri and Coalescent practices may have cohabitated at Sully School, pushing the initial migration of Coalescent groups back at least 50 years.

Middle Missouri Villages

Alberts Creek

Alberts Creek is a fortified, single-occupation Extended Middle Missouri village. The site has no report, but site records do not suggest a long-term occupation (Smithsonian Institution, American Museum of Natural History [SINMNH] 1954-1957: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 279, 39AR8). However, it should be noted that only limited excavation was done at this site. This site was chosen for inclusion in this study as it had not been dated previously and is among the few Extended Middle Missouri villages in the southern Missouri River Trench. This presents an opportunity to contribute to understanding the relative age of younger Middle Missouri villages in the south to those in the north.

No legacy dates are reported for Alberts Creek. Because Alberts Creek saw limited excavation and was inundated before further excavation was possible, only a small number of secure contexts will ever exist for this site. Only three new radiocarbon dates could be acquired (UGAMS-46696, 46697, 46698).

A Bayesian model was constructed with the three radiocarbon dates in a single Phase. No outliers were used as only three radiocarbon dates likely do not fully

represent a random sample of the site's entire occupation. The Interval command was constrained to 50 years as there is no evidence of long-term occupation at the site.

The Alberts Creek model produced an acceptable agreement index ($A_{\text{model}} = 94.9\%$). As discussed above, with models containing a limited number of dates, these model results should be treated as preliminary. However, due to the limited number of excavations and the small number of datable artifacts and contexts for this site, it is an important site that will likely never see further excavation. The Alberts Creek occupation was ca. *cal yrs AD 1315–1360* and lasted for approximately 5–35 years.

Antelope Dreamer

Antelope Dreamer is a single component Initial Middle Missouri village with 10–15 identifiable house depressions and no evidence of long-term or multiple occupations (Toom 1990). The village was selected for inclusion in the chronology as it has been identified as a later southern village dating to ca. *cal yr AD 1270* (Ahler et al. 2007:83). Evidence of burning also suggests that this may have been a conflict site, although there is no evidence for fortification systems.

Six legacy dates exist for Antelope Dreamer village, consisting of three dates on maize from House 11 and three on charcoal from House 15 (Toom, 1990:92-93). Due to time and funding constraints, no additional dates were obtained for this site.

The village was modeled as a single Phase. The Charcoal Outlier was applied to the three charcoal dates (UCR-2311, 2312, and 2313). Since no evidence of long-term occupation was found at this site, I applied the Interval function, constrained to 50 years. The results of the Bayesian model reported an acceptable agreement index ($A_{\text{model}} = 148\%$). The analysis suggests the Antelope Dreamer was occupied for 5–30 years, ca. *cal yrs AD 1265–1290*.

Bendish

Bendish is a single component, unfortified Extended Middle Missouri village located in the northern Missouri River Trench (Thiessen 1995). The site contains no evidence of long-term occupation. The village was chosen for redating because it is a northern Extended Middle Missouri village, and understanding its occupational history can help identify when Middle Missouri groups began migrating north of the Moreau River.

Four legacy radiocarbon dates exist for Bendish (Thiessen 1976). All legacy dates were retained for the study. I produced 10 new radiocarbon dates for the site. A Bayesian model was constructed with the four legacy and 10 new radiocarbon dates. The After command was applied to a single date (UGAMS-32654) from a context believed to predate the occupation. All remaining dates were placed into a single Phase in the model. The Interval command was constrained to 50 years as the site appears to have been briefly occupied. The Charcoal Outlier model was applied to four legacy dates from charred wood (NWU-17, 18, 47, and 48). The General Outlier model was then applied to all remaining dates.

The first model failed the acceptable agreement index threshold ($A_{\text{model}} = 42.2\%$). UGAMS-32644 was reported as an outlier by the model and had poor agreement with the rest of the overall model ($A_{\text{model}}=5.8\%$). This date is over 100 years younger than the next earliest date from this site (NWU-17). This site has no evidence of long-term occupation (i.e., over 50 years), so the outlier date was removed from the model and the model was re-run.

The second model produced an acceptable agreement index ($A_{\text{model}} = 80.1\%$). The General Outlier model did not identify any outliers and no individual dates reported a

low agreement with the overall model. Bendish was likely a short-lived village (5–20 years) occupied ca. *cal yrs AD 1290–1380*.

Calamity Village

Calamity Village is a fortified Extended Middle Missouri village located north of the Moreau River, in the northern area of the Trench (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 296, 39DW231, 1–2). Like Bendish and other northern Extended Middle Missouri villages, Calamity was included in the chronology for this project as it was one of the Middle Missouri villages established after migrating north. Understanding the temporality of this site will contribute to our understanding of the Middle Missouri migration north. Calamity is a unique village. It is a heavily fortified Extended Middle Missouri village, which is rare in itself. Also, the site's excavators found that house floors within the fortification system were likely at ground surface during their occupation instead of dug into the ground like most Middle Missouri earth lodges. It has been posited that Calamity was a short-lived village that existed long enough for the inhabitants to build its fortification system before it was abandoned or that it may have been a type of waystation for Middle Missouri groups migrating north (Lehmer 1971:126-127).

Three legacy radiocarbon dates exist for Calamity Village (Johnson 2007a:Table 7; Long and Mielke 1969:179). Two dates were discarded. The first discarded date (SI-375) was not included because it was produced at the now-defunct Smithsonian radiocarbon laboratory. The second date (ETH-10110) was on charred sherd residue and was discarded as per hygiene protocol. The third date (ETH-10111), taken from a piece of unprovenienced charred maize, was not rejected. This decision was made on

the basis that the date for ETH-10111 fell within the same date range as the new dates produced for this study.

I produced eight new radiocarbon dates for Calamity. Because limited excavations were conducted at the site, most of which were focused on the massive, double ditch-lined fortification system, all but two dates for this site came from posts forming the palisade lines. It is acknowledged here that dating palisade posts may not fully encompass the occupational period of most villages. The only non-post dates (ETH-10111 and UGAMS-46677) were taken from an unprovenience piece of charred maize (see Johnson 2007a:C.2) and a piece of bison bone found in a cache pit southwest of House 1.

In the first Bayesian model, all dates were placed in a single Phase. Although charcoal dates were used in this model, the Charcoal Outlier was not used because the dates were taken from the outer rings of the posts and I would have to apply the Charcoal Outlier to every date but one. This would place an unreasonable amount of statistical weight on the single bone sample not tested by the Charcoal Outlier model. The General Outlier model was applied to all dates. The Interval command was not constrained because these dates were taken from house posts.

The agreement index of the first model was acceptable ($A_{model}=92.5\%$). However, the Outlier Model identified UGAMS-46677 as an outlier. This date came from a bison bone sample recovered from a cache pit (F38), just southwest of House 1. The sample was chosen because it was the only datable material found in approximate association with House 1. Since the sample could not be directly related to the house occupation, and thus, the village occupation, it was removed from the model and the model was re-run.

The results of the second model did not identify any possible outliers. The model was in agreement ($A_{\text{model}}=103.7\%$). Because the only secure contexts for Calamity that could be dated were from the palisade posts, we cannot know the true occupational duration. All that can be said about Calamity is that the fortifications were likely built *ca. cal yrs AD 1390–1415*.

More dating of Calamity would be beneficial. However, only one house was excavated, and the site was inundated during reservoir-building along the Missouri River from the 1950s to 1970s. The site's excavation records list a limited number of modified and unmodified animal bones from secure contexts inside House 1. After a concerted effort, I failed to locate any of these bones within either the Smithsonian's or the South Dakota Historical Society's collections. If these artifacts can be found, dating them would help to describe the village's occupation better, but they would be of limited use as they would only describe the occupation of one house in the village.

Cheyenne River

No report exists for Cheyenne River. Excavation records suggest that it is a multicomponent site consisting of Extended Middle Missouri, Extended Coalescent, and Post-Contact Coalescent occupations (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Boxes 340-342, 39ST1). Only the Extended Middle Missouri occupation was dated for this project.

The Extended Middle Missouri occupation was fortified. I included this site in the chronology because it is an Extended Middle Missouri site. Thus, it was likely one of the last Middle Missouri villages in the southern area and most likely to overlap with Coalescent Migration.

A total of 11 legacy radiocarbon dates exist for Cheyenne River (Crane and Griffin 1960:40; Ives et al. 1964:184-185; Johnson 2007a:Table 7; Long 1965:247; Trautman 1963:71). Seven dates (SI-12, 15, 17, 116, 117, 118, 119) were discarded because they were produced at the Smithsonian Institution laboratory and no information on this laboratory's methods could be found (see Chapter 3). An eighth date (I-582) was also discarded. This date is reported by Johnson (2007a:286), however the reference attached was inaccurate and the original record of this date could not be found.

Due to a lack of datable material from secure contexts, I was only able to produce four new radiocarbon dates from Cheyenne River. One of the new dates (UGAMS-46678) had to be discarded as it returned a modern date, bringing the total number of acceptable dates from the site to six. Also, due to limited excavations at the site, only the Extended Middle Missouri occupation could be sampled.

I created a Bayesian model that contained all six radiocarbon dates in a single Phase. I applied the Charcoal Outlier to three dates (UGAMS-46670, M-840, and I-581). I applied the General Outlier model to the remaining dates. Because the Extended Middle Missouri occupation lacked evidence for long-term occupation (Johnson 2007a:76), I constrained the Interval command to 50 years.

The Cheyenne River model produced an acceptable agreement index ($A_{\text{model}} = 93.1\%$). The Extended Middle Missouri occupation of Cheyenne River likely occurred ca. *cal yrs AD 1295–1365*. The Interval command reported a village occupational duration of 5–40 years. Although these estimates are accurate, a more robust and precise model could be built with more radiocarbon dates.

Clark's Creek

Clark's Creek is an unfortified Extended Middle Missouri village in the far northern Missouri River Trench (Calabrese 1972). The site exhibits no evidence of long-term occupation.

Three legacy radiocarbon dates exist for Clark's Creek (Ahler and Haas 1993; Crane and Griffin 1972:179-180). All three dates were placed in a single Phase. The Interval command was constrained to 50 years as no evidence of long-term occupation exists. The General Outlier model was applied to all dates. The Clark's Creek model results reported an acceptable agreement index ($A_{model} = 128.6\%$), and the range of occupation reported by the model was ca. *cal yrs AD 1235–1300*, with an occupational duration of 5–35 years. The results of this model are strictly preliminary, as three dates are too few to adequately represent this site's occupation.

Cross Ranch

Cross Ranch is a single component Extended Middle Missouri site (Calabrese 1972). The village lacks evidence of long-term occupation or fortification. This site was chosen for inclusion in the current chronology because it is a northern Extended Middle Missouri village.

A total of six legacy dates are reported (Ahler and Haas 1993:119-120; Calabrese 1972:13; Johnson 2007a:284; Crane and Griffin 1972:180-181). Due to time and budgeting constraints, new radiocarbon dates were not obtained for this site. However, I did model the six legacy dates for this site (M-2368, M-2369, SMU-1059, SMU-1202, GX-19395, Beta-66015).

I placed all six dates for Cross Ranch into a single Phase. The Interval command was constrained to 50 years since no evidence of long-term occupation exists. I also applied the General Outlier model to all dates.

The agreement index for the Cross Ranch model was acceptable ($A_{model} = 68.4\%$). The model reported no outliers; however, one date (M-2368) was in poor agreement with the model ($A_{model}=46.4\%$). There are likely not enough dates in this model to fully represent the occupational duration of the village. The date range of occupation reported by the model was ca. *cal yrs AD 1315–1410*, with an occupational duration of 5–35 years.

Durkin

Durkin is a single component, unfortified Extended Middle Missouri village in the southern portion of the Trench. The village was likely occupied for a brief time (Toom et al. 1979). I chose to include Durkin in the current chronology because it is a southern Extended Middle Missouri village that can help to inform the timing of Middle Missouri migration out of the south and the coexistence of Middle Missouri and Coalescent groups during Coalescent migration.

Two legacy radiocarbon dates exist for Durkin (Margaret et al. 1976:131). Both dates were drawn from secure contexts. I produce an additional 11 new dates for the site. One date (UGAMS-46681) was discarded because it returned a modern date. Six of the new dates I produced were from house posts. It was believed that these dates were taken from the outermost, charred rings of each post. However, because these samples returned dates much earlier than the relatively more secure dates taken from house floors, I assume here that these samples were derived from inner growth rings.

Six dates (UGAMS-41523, UGAMS-41524, UGAMS-41525, UGAMS-41527, WIS-743, and WIS-746) were placed in a single Phase as they are believed to be contemporaneous house contexts. Because of the large discrepancy in post and house floor dates, I used the After command to place the post dates before the house occupation as terminus post quem. I applied the Charcoal Outlier to the legacy dates

(WIS-743 and 746) derived from charred wood. The General Outlier command was applied to all other dates within the occupational Phase. I constrained the Interval command to 50 years as Durkin does not have evidence of long-term occupation.

The Durkin model produced an acceptable agreement index ($A_{model} = 125.6\%$). No dates were identified as outliers by the Outlier Model. The occupational date-range reported by the model is ca. *cal yrs AD 1360–1390* with an occupational duration of 5–25 years.

Fay Tolton

Fay Tolton is a fortified, Initial Middle Missouri site. The village does not contain any evidence of a long-term occupation (Wood 1976). The village also has substantial evidence of a raid at the terminal occupation of the village with an apparent burning event and the bodies of at least five slain individuals.

Five legacy dates exist for Fay Tolton (Crane and Griffin 1962:195; Johnson 2007a: Table 7; Long and Mielke 1967:131-132; Wood 1976:42). All five dates were placed in a single Phase. The Interval command was constrained to 50 years as there is no evidence of long-term occupation at the site. The General Outlier model was applied to all dates. The results of the Fay Tolton model produced an acceptable agreement index ($A_{model} = 148.9\%$). No outliers were identified. The model returned an occupational date-range of ca. *cal yrs AD 1060–1220* with an occupational duration of 5–35 years.

H. P. Thomas

H. P. Thomas is a multicomponent site (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 349, 39ST12, 1-3). No formal report exists for the site, but excavation records suggest the site contains Initial Middle Missouri, Extended

Coalescent, and Post-Contact Coalescent components. Only the Middle Missouri contexts were dated. I included this site in the chronology because it is considered a later Initial Middle Missouri site, and its exact temporal location is poorly understood (Johnson 2007a:xvi).

No legacy dates are reported for H. P. Thomas. I produced six new radiocarbon dates for this site specifically to date the Initial Middle Missouri contexts. Three samples (UGAMS-43088, 43089, and 43180) date Initial Middle Missouri contexts, and three (UGAMS-43179, 43181, and 43182) postdate these contexts.

UGAMS-43088, 43089, and 43180 were placed into a single Phase, while UGAMS-43179, 43181, and 43182 were placed in the Before function. Although no evidence for long-term occupation of the sites was reported, the excavation records are vague, so I decided to constrain the Interval function to a more conservative 100 years instead of 50 years.

The model results produced an acceptable agreement index ($A_{\text{model}} = 114.2\%$). The General Outlier Model did not identify any outliers. The Initial Middle Missouri occupation of H. P. Thomas occurred ca. *cal yrs AD 1170–1210* with an occupational duration of 10–50 years.

Havens

Havens is a large (approximately 56 houses), unfortified Extended Middle Missouri village on the northern Missouri Trench (Sperry 1982, 1995). Evidence, including house-rebuilding episodes and numerous clusters of overlapping pits intruding into one another, suggests the village was occupied longer than is typical for Middle Missouri villages. I included this village in the current chronology because it is an Extended Middle Missouri village in the northern part of the Missouri Trench.

Four legacy dates (M-2362, M-2363, ETH-11047, ETH-11048) are reported for Havens (Crane and Griffin 1972:179-180; Johnson 2007a:Table 7). Two dates (ETH-11047 and 11048) were rejected as their provenience could not be directly traced to secure contexts. I produced an additional 15 new radiocarbon dates for the village.

All remaining dates were placed into a single Phase as there is no direct evidence of breaks in the site's occupation. The Charcoal Outlier was applied to two dates (M-2362 and 2363). The General Outlier model was applied to the remaining dates. I did not constrain the Interval command because there is evidence of long-term occupation (Sperry 1982:74). The results of the Havens model produced an acceptable agreement index ($A_{\text{model}} = 130.9\%$). The date range reported by the model is ca. *cal yrs AD 1280–1310* with an occupational duration of 0–55 years.

Helb

Helb is a single-occupation, fortified site with an Extended Middle Missouri component (Ahler et al. 2007:67-68). Although multiple researchers consider Helb a multi-century occupation village, this is because they accept the existing range of radiocarbon dates from the site (Falk and Calabrese 1973; Kay 1994; Thiessen and Nickel 1975). However, as pointed out by Ahler and colleagues (2007:67-68), the site lacks any evidence for long-term occupation. I chose to include this village in the current chronology because it may be the region's earliest Extended Middle Missouri village (Falk and Calabrese 1973).

A total of 13 legacy dates are reported for Helb (Johnson 2007a:Table 7; Tucek 1977:252; Thiessen and Nickel 1975:Table 1). Five dates (RL-298, NWU-38, NWU-39, NWU-45, and NWU-46) were discarded because their relationship to the village occupation could not be confirmed. A last date, NWU-54, was also discarded because it was taken from a sample recovered from the hearth in House 8 and it could not be

determined if intrusive burrowing was a possibility. I produced another nine radiocarbon dates for Helb. The 15 accepted dates were placed into a single Phase. I applied the Charcoal Outlier model to eight charcoal samples (RL-299, NWU-40, NWU-52, NWU-53, NWU-55, UGAMS-45212, UGAMS-45213, and UGAMS-45837). The remainder of the samples were subject to the General Outlier model.

In the first model, Date NWU-40 was reported as an outlier. NWU-40 was discarded, and the model was re-run. The results of the second Helb model produced an acceptable agreement index ($A_{\text{model}} = 98.9\%$). The model returned an occupation of *ca. cal yrs AD 1335–1360*. The constrained Interval command returned an occupational duration of 5–30 years.

Huff

Huff is a heavily fortified, single-occupation village with a Terminal Middle Missouri component (Wood 1967). Huff has been the subject of multiple dating projects (Ahler and Kvamme 2000; Wood 1967). Although the site is considered a short-lived village, a wide array of date ranges are reported, from 770 RCYPB to modern. This village is considered one of the latest Extended Middle Missouri villages, but the incongruity between legacy radiocarbon dates and archaeological evidence, I chose to include this village in the current chronology.

A total of 20 legacy radiocarbon dates exist for Huff village (Ahler and Kvamme 2000; Long and Mielke 1966:416, 1967:371, 1969:167; Thiessen 1977:68). Of the legacy dates, nine were rejected because they were run at the Smithsonian radiocarbon laboratory (see Chapter 3). Because this site is well excavated and curated, I produced 18 new radiocarbon dates. All 28 dates were placed in a single Phase. I used the Charcoal Outlier with all charred wood and charcoal samples and the General Outlier for all others.

The results of the first Huff model produced an acceptable agreement index ($A_{\text{model}} = 82\%$). Two dates were identified as outliers (UGAMS-34753 and 32663). These two dates were also in poor agreement with the model ($A_{\text{model}} = 26.4\%$ and 16.6% respectively). UGAMS-21584 also had poor agreement with the model ($A_{\text{model}} = 39.4\%$). It was not identified as an outlier. UGAMS-34753 and 32663 were removed from the model and the model was re-run.

The results of the second Huff model produced an acceptable agreement index ($A_{\text{model}} = 107.1\%$). No outliers were identified. The model returned an occupational date-range of ca. *cal yrs AD 1440–1455* with an occupational duration of 0–20 years.

Jake White Bull

Jake White Bull is a fortified Extended Middle Missouri village with no evidence of long-term occupation (Ahler 1977b). 11 legacy radiocarbon dates were reported for the site prior to this study (Ahler 1977b; Johnson 2007a:Table 7). Eight of the 11 dates had to be rejected because seven were legacy UGa dates subjected to questionable pretreatment methods, and one was taken from charred sherd residue (see Ahler et al. 2007:68-70, 87). Due to funding and time constraints, I could not redate this village, so only three dates can be modeled for Jake White Bull.

All three dates were placed in a single Phase. The Charcoal Outlier was applied to two charcoal samples. The Interval command was constrained to 25 years as the archaeological evidence contains no evidence of long-term occupation.

The Jake White Bull model returned an acceptable agreement index ($A_{\text{model}} = 138.1\%$). The village occupation occurs ca. *cal yrs AD 1250–1300* with an occupational duration of 5–35 years. As mentioned, this village requires more dates to test this tentative model, as only three dates were used.

Jiggs Thompson

Jiggs Thompson is a late occupation Initial Middle Missouri village (Johnson 2007a:105). Although unreported, excavation records suggest the village lacks any evidence of long-term occupation (Johnson 2007a:205; Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 317, 39LM208, 1-2).

Three legacy radiocarbon dates exist for Jiggs Thompson (Johnson 2007a:Table 7). Both dates were placed into a single Phase. The General Outlier command was applied to all dates. The results of the Jiggs Thompson model reported an acceptable agreement index ($A_{model} = 111.9\%$). Based upon the limited number of dates, Jiggs Thompson was occupied for 5–35 years, ca. *cal yrs AD 1230–1300*. Like many other sites in this project, this village requires more dates to test this tentative model.

Jones Village

Jones is a multicomponent site with Initial Middle Missouri and Extended Middle Missouri components (Ahler et al. 2007:73; Johnson 1997, 2007b). Only the Initial component has dated contexts. I included Jones village because this is considered one of the earliest Middle Missouri villages in the northern portion of the Trench.

A total of 10 legacy radiocarbon dates exist for Jones Village (Falk and Pepperl 1986; Johnson 2007a:Table 7). Four of the 10 dates (UGa-3357, 3358, 3359, 3360) had to be rejected because they were legacy UGa dates that were subjected to questionable pretreatment methods, and one date (ETH-16076) was taken from charred sherd residue (see Ahler et al. 2007:68-70, 87). Due to funding and time constraints, I was not able to redate this village. Five dates from Jones Village are included in this study.

All five dates were placed in a single Phase. The Interval command was constrained to 100 years because the dates included in the model related directly to a

single short-lived occupation. The General Outlier model was applied to all dates. The results of the Jones Village model returned an acceptable agreement index ($A_{\text{model}} = 127.2\%$). The General Outlier Model did not identify any outliers among the dates. The model returned a date range of ca. *cal yrs AD 1055–1210*. The unconstrained Interval command returned an occupational duration of 10–55 years.

John Ketchen

The John Ketchen site is a multicomponent site containing Middle Missouri, Coalescent, and Historic components (Johnson 1977:68). The Middle Missouri component has been identified variously as Initial, Extended, and Modified Initial (Johnson 1977; Lehmer 1971; Toom and Steinacher 1979). Here, only the Middle Missouri occupation is considered as it was the only occupation with excavation. This occupation contained no evidence of long-term occupation (Johnson 1977:20-69).

Four legacy radiocarbon dates exist for Ketchen (Long and Mielke 1969:168-169, 1970:196, 1976:132). Two dates (SI-378 and SI-477) were discarded because they were produced from the defunct Smithsonian radiocarbon laboratory, which lacks any information on methodology. Due to a lack of datable material, only two new radiocarbon dates could be produced for the John Ketchen site (UGAMS-46684 and 46685).

All dates were placed in a single Phase. The General Outlier model was applied to all dates. The Interval command was constrained to 50 years as there is no evidence of long-term occupation at the site. The model results returned an acceptable agreement index ($A_{\text{model}} = 100.3\%$). The model identified no outliers. The Ketchen model returned an occupational duration of 5–40 years, between ca. *cal yrs AD 1255–1285*.

King

King is a single component, unfortified Initial Middle Missouri village with no evidence of long-term occupation (Smithsonian Institution, American Museum of Natural

History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 316, 39LM201, 1-3). The site has been identified variously as Modified Initial and Initial Middle Missouri (Lehmer 1971:195; Winham and Calabrese 1998:275). I included the King site in this chronology because of its assumed late occupation by Initial Middle Missouri groups.

Two legacy dates (WIS-744 and 748) were reported prior to this study (Bender et al. 1976:131). Due to a lack of datable materials within the site's curated collections, I was only able to add three dates (UGAMS-43090, 43091, 43092) for a total of five radiocarbon dates for this site.

All five dates were placed into a single Phase. I applied the Charcoal Outlier to two dates (WIS-744 and 748) taken from charred wood. The General Outlier model was applied to the remaining three dates. I constrained the Interval command to 50 years as there is no evidence of long-term occupation at King. The model results returned an acceptable agreement index ($A_{model} = 106\%$). The model identified no outliers. The King model returned an occupational duration of 5–35 years, between ca. *cal yrs AD 1190–1230*.

Paul Brave

Paul Brave is an Extended Middle Missouri village in the northern Missouri Trench. This unfortified, single component site has evidence for long-term occupation in the form of house rebuilding episodes at multiple houses (Lehmer 1971:39-40; Wood and Woolworth 1964:51). I chose to include this site in the current chronology because it is an Extended Middle Missouri village in the northern portion of the Trench.

Understanding this and other northern Extended Middle Missouri villages' temporal relationship with southern villages can aid in understanding the temporality and timing of the general shift north by Middle Missouri groups.

Five legacy dates are reported for Paul Brave prior to this study (Crane and Griffin 1972:179-180; Johnson 2007a:Table 7). All legacy dates were included. I produced 10 new radiocarbon dates for this study. I placed all 15 dates in a single Phase. Because limited evidence for long-term occupation exists at Paul Brave, I constrained the Interval command to a more conservative 100 years instead of 50 years. The Charcoal Outlier was applied to the five legacy dates. The General Outlier model was applied to all UGAMS dates. The Paul Brave model returned an acceptable agreement index ($A_{model} = 99.2\%$). Paul Brave was likely occupied ca. *cal yrs AD 1285–1315* for approximately 25–55 years.

Shermer

Shermer is a fortified, Extended/Terminal Middle Missouri village in the northern Trench (Sperry and Bass 1968). The site has limited evidence of long-term occupation in the possible rebuilding episode of a single house (Sperry and Bass 1968:23). I chose to include this site in the chronology because it is a mid-to-late occupation Middle Missouri village in the north.

Shermer has five legacy dates (ETH-11045, 11046, 16394, 17511, and DRI-3205) reported (Johnson 2007a:Table 7). I removed ETH-16394 because it was determined by Ahler and colleagues to be a spurious result, as the maize sample was dated twice (see Ahler et al. 2007:77-78). ETH-11046 was also removed as the date came from a piece of maize within House 6 contexts, which contained multiple internal features that likely predated it (Sperry and Bass 1968:21-24). The provenience information attached to the date refers to the feature numbers used during excavation. Unfortunately, these feature numbers were changed to pit numbers for publication. I could not locate the original excavation records that listed the feature numbers. Without

the original house features, it cannot be determined if this sample came from a context that predated the house.

I placed the remaining accepted dates into a single Phase. I constrained the Interval command to 50 years as the site lacks evidence of long-term occupation. The Shermer model returned an acceptable agreement index ($A_{\text{model}} = 76.7\%$). Based upon this preliminary model, the Shermer occupation occurred ca. *cal yrs AD 1330–1395* with an occupational duration of 5–40 years.

Sommers

Sommers is a large, partially fortified Initial Middle Missouri village (Steinacher 1990). The site is a large village (100+ house depressions) with signs of long-term occupation, including houses superimposed upon one another, midden mounds, and house-rebuilding episodes. There is also a fortification ditch that only encircles a portion of the site. Steinacher (1990:235-236) suggests that this site may have expanded into a large village and later contracted into a small fortified settlement. This village was included in the current chronology because evidence of a long-term occupation presented the possibility that the site was occupied during the Initial Coalescent migration. Likewise, the village is abnormally large and possibly long-lived for an Initial village. It also contains evidence of plazas, an aspect typically attributed to later Extended variant villages.

A total of 13 legacy dates existed for Sommers prior to this study (Johnson 2007a:Table 7; Long and Mielke 1967:370; Steinacher 1990:82). Only two dates (SI-314 and 315) were discarded as they were produced by the Smithsonian radiocarbon lab and lacked adequate pretreatment and analysis data (see Chapter 3). I produced an additional nine dates for the site. The goal of this model was not only to develop an

occupational date-range and duration of the village but also to measure the likelihood that houses inside the fortification ditch overlapped temporally with houses outside.

The Sommers model may be the most complex model produced for this dissertation. All dates were divided into Phases based on their occurrence inside or outside the fortification ditch. Dates were further divided into Phases based on their relationship to individual houses. This further division was created because the legacy dates (from wooden posts) were likely taken from inner post rings; however, this could not be verified. Because of this discrepancy, I used the After command to include the house post dates in the model. Because of the evidence for long-term occupation and the size of the village, I did not constrain the Interval function. Because the fortification ditch encompasses only a portion of the site, I also produced two dates apiece for each stratigraphic unit excavated. This was an attempt to understand how quickly the ditch had been filled. These dates were placed in a Sequence and then in the encompassing village Phase. I also used the Difference command to measure the likelihood that the houses in the fortification ditch were occupied at the same time as those outside of the ditch.

The Sommers model returned an acceptable agreement index ($A_{\text{model}} = 85.2\%$). The Outlier function did not identify any outliers. According to this model, the village was likely occupied ca. *cal yrs AD 1165–1205* for as long as 30 years. An occupational duration of only 30 years is surprising considering the evidence for possible long-term occupation at the site. A short occupation is also supported by the results of the Difference function (-10–10) measuring the likelihood that houses inside the fortification overlapped temporally with those outside the fortification.

South Cannonball

South Cannonball is an unfortified, Extended Middle Missouri village in the northern Missouri River Trench. Griffin (1984:108-111) suggests the site was occupied for an extended period due to the temporal spread of radiocarbon dates associated with the site, leading to his assumption of house-rebuilding episodes. Ahler and colleagues (2007:85) suggest that long-term occupation evidence is lacking.

A total of 14 legacy radiocarbon dates exist for South Cannonball (Stuckenrath and Mielke 1970:117-118, 1981:146-147). I rejected four dates because a ^{13}C correction could not be applied to them (I-4202, 4203, 4204, and 4205). The remaining dates were all produced from uncharred house posts. Due to time limitations, additional dates were not produced for this village. The General Outlier command was applied to all dates.

The 10 remaining dates were placed into a single Phase. The Interval command was constrained to 100 years. The 100-year constraint was chosen because, although there is little evidence for long-term occupation, the dates were drawn from sections of the posts that most closely represented the occupation of each house (Griffin 1984:90).

The South Cannonball model returned an acceptable agreement index (Amodel =73.1%). According to the house post dates, South Cannonball was occupied ca. *cal yrs AD 1285–1390* with an occupational duration of 15–70 years. Although the reported date range and duration likely approximate the village's occupation to a reasonable degree, more dates should be run from house contexts other than posts to verify this estimate.

Stony Point

Stony Point is an unreported, multicomponent Initial Middle Missouri and protohistoric site. Only the Initial Middle Missouri occupation is discussed here. The site lacks evidence for long term occupation (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys

[RBS] Collection, Box 362, 39ST235). The site also contains multiple fortification rings (Clark 2018:317).

Only three legacy dates exist for this site (Johnson 2007a:284, 289; Toom 1990). Two dates (UCR-2314 and 2315) were drawn from the Middle Missouri contexts, and one (GX-13406) postdates the Middle Missouri occupation. The UCR dates were placed in a single Phase and the Before command was applied to the GX date. Because there is no evidence of long-term occupation, a conservative 100-year constraint was placed upon the Interval command.

The Stony Point model returned an acceptable agreement index (Amodel =75.4%). The date range returned by the model spanned *cal yrs AD 1220–1290*. The Interval function returned 15–80 years.

Swanson

Swanson village is a fortified, Initial Middle Missouri site. The site has some evidence of long-term occupation in the form of house rebuilding (Hurt 1951:3). I chose to include Swanson in the current chronology because this site was a fortified Middle Missouri village that may have overlapped with the Initial Coalescent migration.

A total of 13 legacy radiocarbon dates are reported for Swanson (Bender et al. 1973:236-237, 618-619, 1975:127; Crane and Griffin 1960:40). Like South Cannonball, all dates for this site are taken from house posts. Five dates (M-839, 551, 552, 650, and 657) were rejected because it could not be determined if they were taken from inner or outer rings. WIS-529 was removed because it was taken explicitly from inner rings. Three dates (WIS-523, 524, and 526) were also rejected because they are believed to have been contaminated by preservatives during curation (Bender et al. 1973:236, 1975:127). The remaining four dates were placed in a single Phase. Because there is

limited evidence for long-term occupation at the site, I constrained the Interval to a more conservative 100 years instead of 50 years. I also applied the Charcoal Outlier.

The Swanson model returned an acceptable agreement index ($A_{\text{model}} = 73.4\%$). The date range returned by the model spanned *cal yrs AD 1155–1260*. The Interval function returned 10–70 years.

Travis I

Travis I is an unfortified, multicomponent site containing an Extended Middle Missouri and an Extended Coalescent village in the northern Missouri Trench. Only the Extended Middle Missouri occupation was dated. The village lacks any evidence of long-term occupation (Haberman 1982).

Only two legacy dates exist for Travis I (Steventon and Kutzbach 1986:1207-1208). Both dates are associated with the Extended Middle Missouri occupation. Limitations due to time and funding prevented further dating of this village. Both dates were placed in a single Phase. I constrained the Interval command to 50 years due to a lack of evidence for a long-term occupation. Because the model only contained two dates, no Outlier commands were applied.

The Travis I model returned an acceptable agreement index ($A_{\text{model}} = 136.6\%$). Based upon this preliminary model the Extended Middle Missouri occupation occurred *ca. cal yrs AD 1215–1280* with an occupational duration of 5–35 years. Two dates are insufficient to date any occupation adequately, and more radiocarbon dates need to be assayed to create a more accurate estimate of this site's occupation.

Vanderbilt

Vanderbilt is an unfortified Extended Middle Missouri village located in the northern Missouri Trench (Lehmer 1971:67). The site does not contain evidence of long-

term occupation. The site was included in the current chronology because it is an Extended Middle Missouri village in the northern Missouri River Trench.

Five legacy dates exist for the site (Falk and Pepperl 1986; Johnson 2007a:Table 7). The model excluded two dates (UGa-3355 and 3356) because they may not have been pretreated for humics (see Ahler 2007:68-70). Due to time and funding constraints, additional dates were not run for this site. The remaining three radiocarbon dates were placed into a single Phase. The Charcoal Outlier was applied to the two dates taken from charred wood (DRI-3113 and ETH-16070). The Interval command was constrained to 50 years.

The Vanderbilt model returned an acceptable agreement index (Amodel =114.8%). The village was likely occupied ca. *cal yrs AD 1265–1315* with an occupational duration of 5–35 years. Like the Travis I site, three dates are insufficient to date any occupation adequately. More dates need to be assayed for this site to estimate the complete occupation accurately.

White Buffalo Robe

White Buffalo Rode is a multicomponent site containing Extended Middle Missouri and protohistoric Coalescent assemblages (Lee 1980). Only the Extended variant assemblage is discussed here. There is no evidence of a fortification or long-term habitation at the site.

Twenty-four legacy radiocarbon dates (SMU-724, 729, 731, 732, 769, 793, 794, 795, 796 and Uga-2993, 2994, 2995, 2996, 2997, 2998, 2999, 3000, 30001, 30002, 30003, 3004, 3005, 3006, 3007) exist for the site (Lee and Ahler 1980:140-142). Only five of these radiocarbon dates were included in the study. As previously discussed, the early Uga dates were systematically discarded. The SMU dates (731, 793, and 795) were also discarded as they did not represent contexts associated with the village

occupation. The remaining five dates were placed in a single Phase. The General Outlier model was applied to all dates. The Interval command was constrained to 50 years because no evidence of long-term occupation exists at the site.

The White Buffalo Robe model results produced an acceptable agreement index ($A_{\text{model}} = 86.5\%$). The date range reported by the model is *ca. cal yrs AD 1285–1385* with an occupational duration of 5–35 years.

32MO291

32MO291 is an Extended/Terminal Middle Missouri occupation site (Ahler et al. 2000:256). No evidence of fortifications was found during excavations. Due to the limited excavation at the site, it cannot be determined if 32MO291 was a long-term or multi-occupation site.

32MO291 has 20 legacy radiocarbon dates reported (Ahler and Metcalf 2000:85). One date, ETH-18103, was removed because the feature from which it was taken had evidence of burrowing (Ahler et al. 2000:42). I placed the remaining 19 samples into a single Phase. Because of the possibility of long-term occupation, I constrained the Interval function to a more conservative 100 years. I applied the Charcoal Outlier to seven charcoal dates (DRI-3375, 3376, 3377, 3378, 3379, 3380, and 3381). The General Outlier model was applied to all other dates. The 32MO291 model returned an acceptable agreement index ($A_{\text{model}} = 151.9\%$). 32MO291 was occupied for 0–55 years, sometime between *ca. cal yrs AD 1430–1460*.

Woodland Villages

Flaming Arrow

Flaming Arrow is a short-lived, single-component, fortified village with no evidence of long-term occupation (Ahler 2007; Ahler et al. 1991; Kvamme 1998). The

occupation is classified as a Terminal Woodland occupation with strong resemblances to later Middle Missouri Tradition villages. I chose to include Flaming Arrow because of its resemblance to both later Middle Missouri villages and Menoken (another Terminal Woodland village). Ahler (2007) suggests that these villages, not Initial Middle Missouri villages, are the origin of Extended Middle Missouri “peoples,” arguing that they are of the same cultural “stock.” This argument has some issues, especially with regard to ideas of “peoples” and “stock” (see Chapter 2). The temporal association between Terminal Woodland and Extended Middle Missouri villages must be established before the theoretical discussion of such terms is addressed.

Three legacy radiocarbon dates are reported for this site prior to this study (Ahler et al. 1991:29-30). None of these dates were rejected. I created an additional seven dates for the site. Two dates (UGAMS-43093 and 43097) were rejected because they did not fall within the accepted C:N ratio between 2.9 and 3.5 (van Kilinken 1999). These samples also dated 2,000 years older than the other samples from the site. I placed the remaining eight dates into a single Phase. Because the three legacy dates were from charcoal, I applied the Charcoal Outlier Model to them. I also constrained the Interval command to 50 years as there is no evidence for long-term occupation at the site (Ahler et al. 1997).

The model results produced an acceptable agreement index ($A_{model} = 78.6\%$). The village was likely occupied ca. *cal yrs AD 1185–1220*, with an occupational duration of 5–35 years.

Menoken

Ahler (2003) identifies Menoken as a fortified, single-component (Terminal Woodland) village with a short-lived occupation. He also identifies two clusters of significantly different house architecture. Like Flaming Arrow, I chose to include this

village because of its close material culture affinity to Middle Missouri villages. Ahler (2007) suggests that this village is evidence of an evolutionary trend in Woodland groups “mixing” with Initial Middle Missouri groups to produce the Extended Middle Missouri. Interestingly, two distinct types of house architecture are found at the site.

The five legacy radiocarbon dates reported by Ahler (2003:222) were initially included in the analysis. I produced an additional 15 radiocarbon dates for Menoken. One sample (UGAMS-31418) returned a modern date and was discarded from further consideration. Two bison bone samples (catalog numbers 2335 and 2761) were analyzed twice, producing UGAMS-31414, 31414-2, 31415, and 31415-2. I used the R_Combine function to combine each of these samples. The remaining 19 dates were placed into a single Phase. I constrained the Interval command to 25 years as there is little evidence of long-term occupation at the site. I applied the Charcoal Outlier on the charcoal dates (ETH-19573 and 19574) and the General Outlier Model to the remaining dates.

The first model returned an agreement index lower than the acceptable 60.0% threshold (Amodel =23.2%). The Outlier Model identified multiple outliers and dates below the acceptable agreement threshold. One sample, UGAMS-32339, was a strong outlier as it is hundreds of years younger than any other dates related to Menoken. I manually removed this date. UGAMS-32339 was taken from an uncharred seed just below the central hearth in House 17. This may have been a rodent burrow that was not identified during excavation.

Because of the low agreement for the first Menoken model, I reexamined each date and its context. Two dates (ETH-19577 and UGAMS-32341) from the fortification ditch were discarded because their association with the village occupation could not be confirmed. One date from the House 17 excavations (UGAMS-32336) was taken from a

bison scapula fragment found in the only storage pit associated with the floor of House 17 (Feature 135). However, after further review, it appears that the pit was excavated hastily by a student at the end of the field season and was poorly recorded (Ahler 2003:166). Furthermore, the bone excavated from within the pit had a calcium carbonate crust, suggesting that the bone could be much older than the house occupation. Because of the uncertainty associated with F135, I chose to remove it from the model. I then ran the new model.

The second Menoken model returned an acceptable agreement index ($A_{model} = 120.0\%$). The occupation of the village likely occurred ca. *cal yrs AD 1200–1230* with an occupational duration of 5–35 years. A third model was run on Menoken. In this model, I divided the dates based on their relationships with the two types of architecture on the site. This was done to test whether or not the site represents two separate occupations. The third Menoken model returned an acceptable agreement index ($A_{model} = 144.9\%$). The earlier occupation likely occurred ca. *cal yrs AD 1150–1210* with an occupational duration of 5–25 years. The later occupation likely occurred ca. *cal yrs AD 1200–1240* with an occupational duration of 5–35 years. The Interval command placed between the earlier and later occupations at the site returned a duration of 0–35 years, while the Difference command returned -2–34 years. These results suggest that both occupations may have overlapped.

Given the results of the second and third models, the second model is the most representative of the site occupation. That is, I interpret the site to be a single occupation with mixed architecture occurring ca. *cal yrs AD 1200–1230* with an occupational duration of 10–45 years. However, because only 16 dates were included in the model, the occupation of this site may be more complex than either the original excavators or I have interpreted. More dates need to be run from more contexts at Menoken to better

understand this site's occupational history and the relation between the two types of architecture that found at the site.

Coalescent Villages

Arzberger

Arzberger is a single component, Initial Coalescent village (Spaulding 1956). No evidence for multiple or long-term occupations is reported for the site. The village is heavily fortified with a palisade and bastions. Arzberger is considered one of the latest fortified Coalescent villages in the Trench. Johnson (2007a:185) places the site at ca. cal yr AD 1500–1550.

Four legacy dates exist for Arzberger (M-1126a, M-1126, ETH-10114, ETH-11042)(Crane and Griffin 1962:193-194). One of the dates (ETH-10114) came from charred ceramic residue. This sample was part of a previous study that found the pretreatment method used to treat this sample produced dates consistently 20–30% older than dates derived from short-lived botanicals (Johnson 2007a:87).

I identified thirteen additional bison bone samples for Arzberger. Unfortunately, a number of the samples were treated with an unidentified preservative or pesticide. Ultimately, five of the fourteen samples attained for dating failed during pretreatment. The remaining eight samples were dated and added to the remaining three legacy dates for modeling.

To model the Arzberger occupation, I placed the remaining dates into a single Phase as no evidence for multiple or long-term occupations was reported. I used an Interval command constrained to a 50-year range. I also applied the Charcoal Outlier to two dates (M-1126 and 1126a) and the General Outlier to the remaining dates.

The first Arzberger model produced an acceptable agreement index ($A_{\text{model}} = 63.5\%$). However, the General Outlier function identified the single legacy date (ETH-11042) as an outlier. The date also had a poor agreement with the model ($A_{\text{model}}=6.0\%$). I removed ETH-11042 and ran a second model. This date was likely from an intrusive context. The material dated was uncharred sunflower seeds. During this study, numerous dates from uncharred seeds were found to be centuries younger than other dates from the same site/occupation. This is likely due to unrecorded intrusive burrowing.

The second Arzberger model produced an acceptable agreement index ($A_{\text{model}} = 166.5\%$). No outliers were identified. The results of the final model suggest Arzberger was occupied for no more than 20 years, ca. *cal yrs AD 1405–1415*. This occupation is earlier than reported by Johnson (2007a:78).

Little Pumpkin

Little Pumpkin is a multicomponent site including an Extended Coalescent village and a historic component (Toom 1992d). Only the Extended Coalescent occupation is dated in this study. The site does not contain significant evidence of long-term occupation. However, it should be noted that only limited investigation has occurred at the site.

Three legacy dates exist for Little Pumpkin (Toom 1992d). The dates were taken from charcoal within a single cache pit and a hearth (Toom 1992d). Due to time and funding constraints, no new dates were acquired for Little Pumpkin.

A Bayesian model was constructed using the three legacy dates for the site. The samples were placed in a single Phase. No outliers were used, as only three radiocarbon dates would likely not fully represent a random sample of the site's entire occupation. The Interval command was used to constrain the village occupation as no

evidence for long-term occupation exists. Instead of constraining the model's Interval to 50 years, the constraint was placed at a broader 100 years because of the limited information on the site.

The model results produced an acceptable agreement index ($A_{\text{model}} = 127.8\%$). The occupation of Little Pumpkin was likely 10–65 years, *ca. cal yrs AD 1500–1620*. It is reiterated here that a limited subsurface investigation of this site was conducted, and the use of only three radiocarbon dates has limited interpretive value. The results of this model should be taken as preliminary at best.

Lower Grand

Lower Grand is a single occupation Extended Coalescent village that is somewhat unique (Ahler et al. 2007:7). Lower Grand has evidence of multiple fortifications, interpreted to have been expanded through time to accommodate a growing settlement. Second, there is evidence of multiple houses being rebuilt. Both of these lines of evidence suggest a long-term occupation. However, this site has been extensively studied, and no other traces of long-term occupation have been identified (e.g., deep middens). The third unique aspect of Lower Grand is that this village is one of the most northern Extended Coalescent villages recorded. A fortified, long-occupied village as far north as the Grand River is unique among Extended Coalescent villages.

A total of 10 legacy radiocarbon dates are reported for Lower Grand (Johnson 2007a:Table 7; Minze and Pollach 1977:252-253; Winham 1995). All ten legacy dates were used. Like other Extended Coalescent villages in this study, no new radiocarbon dates were acquired due to time and budgetary constraints.

A Bayesian model was constructed using ten radiocarbon dates in a single Phase, as there is no evidence for multiple occupations. The Charcoal Outlier was applied to all charcoal samples (seven out of the ten samples), and the General Outlier

was applied to a sample of small wood (I-17,912) and one of maize (ETH-10412). Although there is some evidence of longer-term occupation, there are no deep middens and overlaid construction typical of long-term villages such as Crow Creek (Kivett and Jensen 1974; Bamforth and Nepstad-Thornberry 2007a). For this reason, the Interval command was restrained to 100-years.

The model results returned an acceptable agreement index ($A_{\text{model}} = 101.8\%$). This model suggests that Lower Grand was occupied ca. *cal yrs AD1455–1540*, for 5–80 years.

Meander

Meander is a single-occupation Extended Coalescent village (Husted 1965). Like most Extended Coalescent villages, Meander has no indication of being fortified. Excavation records and the site's short report indicate no evidence of long-term occupation (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 317, 39LM201).

Three legacy radiocarbon dates are reported for Meander (Johnson 2007a:Table 7). All three dates (ETH-10116, 10117, and 10118) are included in this study. Due to constraints, no new dates were acquired. The Bayesian model developed for Meander consists of all three in a single Phase. No outliers were used as only three radiocarbon dates likely do not fully represent a random sample of the site's entire occupation. However, the Interval command was used to restrain the occupation to 50 years, as all evidence suggests that Meander was a short-term occupation.

The model results returned an acceptable agreement index ($A_{\text{model}} = 89.9\%$). This model suggests that Lower Grand was occupied ca. *cal yrs AD 1490–1630*, for 5–35 years. Like other models using a low number of dates (e.g., Little Pumpkin, Lower

Grand, and Sully), further dating is necessary to confirm this village's temporal placement and occupational duration.

Over's La Roche

Over's La Roche is an unfortified, Extended Coalescent site. Although the site contains evidence of two occupations, both are considered Extended Coalescent, and neither contains evidence for long-term occupations (Hoffman 1968). These may be the same occupation (Ahler et al. 2007:80).

Three legacy radiocarbon dates exist for Over's La Roche (Johnson 2007a:Table 7; Long 1965:248; Long and Mielke 1967:370, 1969:168). All three dates were placed in a single Phase. The Interval command was constrained to 100 years as there is some evidence for multiple occupations, but neither were long-term. The General Outlier model was applied to all dates. The Over's La Roche model results returned an acceptable agreement index ($A_{\text{model}} = 72.4\%$). This model suggests that Lower Grand was occupied ca. *cal yrs AD 1505–1625*, for 15–70 years. This site's long date span and occupational duration are likely due to a wiggle in the calibration curve between 1500 and 1600 and the low number of dates representing both occupations.

Sully

Sully is an unreported Extended Coalescent village with some evidence of long-term occupation (Johnson 2007a:79–80; Lippincott 2000). Three legacy radiocarbon dates are reported for Sully (Johnson 2007a:Table 7). All three dates (ETH-10416, 10417, and SMU-2726) are included in this study. Due to constraints, no new dates were able to be acquired.

I placed all three dates in a single Phase with a Bayesian model. No outliers were used, as only three radiocarbon dates likely do not fully represent a random sample of the site's entire occupation. However, the Interval command was used to

restrain the occupation to 100 years. Although evidence for long-term occupation exists, the 100-year constraint was placed upon the model because there is not enough evidence to suggest an occupation greater than 100 years (as opposed to sites like Crow Creek).

The model results returned an acceptable agreement index ($A_{\text{model}} = 91.6\%$). This model suggests that Sully was occupied ca. *cal yrs AD 1495–1620*, for 10–70 years. Like other models using a low number of dates, this model is strictly preliminary, and more dating is required for this site.

Walth Bay

Walth Bay is a single-occupation Extended Coalescent village with little evidence of long-term occupation (Falk and Ahler 1988). Eight legacy radiocarbon dates are reported for Walth Bay (Johnson 2007a:Table 7; Minze and Pollach 1977:253-254). All legacy dates are included in the model for this site. No new radiocarbon dates were acquired for the study.

A Bayesian model was constructed placing all radiocarbon dates in a single Phase. The Charcoal Outlier was applied to all dates taken from charred wood and charcoal samples. The General Outlier model was applied to all other dates. The Interval command was used to constrain the occupational duration to within 50 years as there is no evidence for long-term occupation.

The model results produced an acceptable agreement index ($A_{\text{model}} = 115.9\%$). This model suggests that Sully was occupied ca. *cal yrs AD 1510–1640*, for 5–35 years.

Whistling Elk

Whistling Elk is a single component Initial Coalescent village (Steinacher 1984; Toom and Kvamme 2002). The village displays the typical architectural traits of an Initial Coalescent village, with a fortification ditch, bastioned palisade, and round four-post

houses. Burned houses with ceramics full of lithics and maize left in situ suggest a village quickly abandoned due to conflict. Whistling Elk lacks evidence for long-term occupation.

A total of ten legacy radiocarbon dates exist for Whistling Elk (Toom 1983b). Of the ten legacy dates, only three were accepted for further consideration. Seven dates were rejected because they were previously run by the University of Georgia when the Center for Applied Isotope Studies may not have reliably pretreated all samples for humic and fulvic acids (see Ahler et al. 2007:68-70). I produced nine new radiocarbon dates for this study on charred maize (n=6) and bison bone collagen (n=3).

The 12 radiocarbon dates for Whistling Elk were placed into a single Phase. The Interval command was constrained to 50 years because there is no evidence of long-term occupation at the site. The General Outlier model was applied to all dates in the model.

The results of the Bayesian model produced an acceptable agreement index ($A_{\text{model}} = 121.2\%$). The model identified no outliers and all dates reported an agreement over 60%. The model was not modified after this point. Whistling Elk appears to have been a short-lived Initial Coalescent village. The occupation occurred ca. *cal yrs AD 1310–1365* and lasted for approximately 5–25 years.

Regional and Subregional Patterns

Below are the general trends taken from the site-level models. All date ranges in this section are reported at 95% and 68% probability highest posterior densities (HPD) (Table 4.1). It should be noted that a more conservative 95% HPD is statistically more accurate; however, its high level of accuracy sacrifices a great deal of precision, creating long “tails” of diminishing probability at either end of the distribution (Bayliss et al. 2007;

Hamilton and Krus 2018). This lack of precision can become a problem when attempting to interpret the duration of short-term events like short-term village occupations or their temporal overlap at a 95% HPD, making these events appear longer than they actually were. Therefore, in-text discussions concentrate primarily on 68% HPD. A 68% HPD is often used to interpret past events requiring higher levels of precision (e.g., Birch et al. 2021:72; Hamiton et al. 2015; Thompson et al. 2019:189-190).

A certain amount of “ambiguity and smearing of dating probability” is present in some models because of the position many villages occupy on the radiocarbon calibration curve (Manning and Hart 2019:7). This ambiguity limits the ability to identify precisely when some villages were established and abandoned. These villages occupy an area of the calibration curve with a significant reversal between cal yrs AD 1300 and 1400 (Figure 4.1). Modeled date ranges for some villages' beginning and end boundaries appear to represent long-term habitation inconsistent with excavation data (midden size/depth, stratigraphy, etc.) because of this reversal in the calibration curve. This is why the *occupational date-ranges* at sites like Cattle Oiler Late are longer than their *occupational durations*.

Middle Missouri Migration and Initial Peace

This section addresses Question 1: *Does Middle Missouri migration into the northern areas of the Trench coincide with evidence for violence?* The timing of Middle Missouri arrival in the north is discussed relative to evidence for warfare. Although evidence of warfare existed in the north prior to migration at the Late/Terminal Woodland villages of Menoken and Flaming Arrow, the first Middle Missouri villages founded in the north show little evidence of conflict. Only generations after the first migrants arrive does

evidence of warfare reoccur in the region. This suggests a hiatus in intervillage warfare during early settlement and integration and a reestablishment of intervillage conflict later.

The new chronology shows the temporal span of Middle Missouri Tradition villages in the north begin in the mid-thirteenth century (Figure 4.2). The earliest villages in the northern Missouri Trench include the Initial variant village of Jones (occupied 10–55 years, *ca. cal yrs AD 1055–1210*) and the Terminal Woodland villages of Menoken (occupied 10–45 years, *ca. cal yrs AD 1200–1230*) and Flaming Arrow (occupied 5–35 years, *ca. cal yrs AD 1185–1220*).

Menoken and Flaming Arrow were fortified Woodland tradition villages, suggesting that these communities were concerned about the possibility of warfare in the later 1100s or early 1200s. Jones, a village at the northern border of the earliest Middle Missouri settlement distribution, may have been positioned to facilitate procurement of Knife River Flint from Woodland groups (Ahler 2007; Johnson 1997, 2007b). In any case, the new chronology indicates that these villages were abandoned prior to the foundation of later Middle Missouri villages in the north.

The first villages that likely represent the migration north are unfortified, Extended variant villages founded in the early-to-mid-thirteenth century. Among these, Travis I is statistically the earliest Extended Middle Missouri village in the dataset (*ca. cal yrs AD 1215–1280*) (Table 4.2). Travis I is followed by three clusters of villages in the north. The first cluster of villages occurs in the Knife subregion and includes Clark's Creek, Cross Ranch, and White Buffalo Robe (Figures 2.1, 2.2, and 2.3). This cluster is located over 100 miles north of the nearest contemporaneous villages. The occupational ranges for these villages vary from early in the northern occupational sequence (Clark's Creek, 5–35 years, *ca. cal yrs AD 1235–1300*) to relatively late (Cross Ranch, 5–35 years, *ca. cal yrs AD 1315–1410*; Figure 4.2). The chronology shows a continuous occupation in the

Knife subregion with the possibility of only one village occupation at a time, as there is little temporal overlap among these villages. Importantly, none of these villages have evidence of warfare in the form of fortifications or raiding (burning, perimortem trauma, etc.).

The north's second and third village clusters occur in the Cannonball subregion. The first cluster comprises five villages between the Grand and Cannonball Rivers (Jake Whitebull, Vanderbilt, Paul Brave, Havens, and Helb). The second cluster comprises five villages between Cannonball and Heart Rivers (South Cannonball, Bendish, Shermer, Huff, and 32MO291). These villages were occupied from as early as *cal yr AD 1235* (Jake White Bull) to as late as *cal yr AD 1480* (32MO291). The *occupational durations* of these villages vary from approximately a single generation at Bendish (5–20 years) to possibly multiple generations at South Cannonball (15–70 years).

Similar temporal trends can be observed in the absence and presence of fortifications among both Cannonball village clusters. Excluding the early village of Jake White Bull (*cal yrs AD 1250–1300*), no villages in the Cannonball subregion are fortified from the beginning of migration with the establishment of Travis I (*cal yrs AD 1215–1280*) until the establishment of Shermer (*cal yrs AD 1330–1395*) and Helb (*cal yrs AD 1335–1360*). Once the first fortified villages are established in the Cannonball, all later villages in the subregion are also fortified.

The two Cannonball clusters also show a general trend of northward movement over time, followed by an abrupt distancing between the villages of the two clusters. Both clusters show a trend in northward movement until the mid-fourteenth century, however the cluster between the Grand and Cannonball rivers abruptly shifts farther south with the establishment of Helb (*cal yrs AD 1335–1360*) and Calamity (*cal yrs AD 1390–1415*)

(Figure 4.3). This abrupt shift also coincides with the return to fortification-building among these villagers.

The new chronology demonstrates that Middle Missouri groups in the north did not initially feel the need to fortify their villages during the early decades of migration in the thirteenth century. Little evidence of warfare exists in the far north (Knife subregion). In the Cannonball subregion, conflict shifts only after Middle Missouri groups lived there for multiple generations. The early-thirteenth and early-fourteenth centuries lack significant evidence for warfare in the Cannonball subregion. However, conflict (or the threat thereof) became more common in the subregion as the two clusters moved apart and fortified by the mid-fourteenth century.

Village Aggregations and the Emergence of Plazas and Ceremonial Lodges

This section addresses Question 2: *Does the adoption of integrative practices (that would help to create inclusive ideologies) cooccur with the migration north?* The emergence of plazas and ceremonial lodges is discussed in relation to village aggregations. The new chronology suggests that plazas and ceremonial lodges cooccurred with village aggregations. However, the initial use of these practices occurred prior to the Middle Missouri migration north.

The earliest dated village with evidence of aggregation and implementation of plazas and ceremonial lodges occurred at the Initial variant village of Sommers (*cal yrs AD 1165–1205*) (Figure 4.2). This demonstrates that the use of plazas and ceremonial lodges occurred prior to the Middle Missouri migration north, with the establishment of the first northern Middle Missouri villages, Travis I (*cal yrs AD 1215–1280*) and Clark's Creek (*cal yrs AD 1235–1300*). This also demonstrates that the use of plazas and

ceremonial lodges predates the first Extended variant villages (sometimes associated with plazas and ceremonial lodges).

The new chronology also places Sommers much later than previous estimates, making it more likely that villagers in the north knew of and utilized the practices developed at Sommers. Johnson's chronology places Sommers approximately 100 to 200 years earlier, within his Period 1 (AD 1000– 1100) (2007a:169). Sommers was occupied much closer in time to the first northern villages with evidence of plazas and ceremonial lodges (Clark's Creek, *cal yr AD 1235–1300* and Paul Brave, *cal yr AD 1285–1315*).

Later, among the two village clusters in the Cannonball subregion, there is a significant overlap in aggregated villages, including plazas and ceremonial lodges. As mentioned in Chapter 2, villages in the Cannonball subregion typically had larger populations. The new chronology shows that most of these villages are also occupied for longer and overlap temporally. This indicates that members of the two Cannonball village clusters are not simply two populations abandoning one village for another as they move north over time. Instead, these villages were places where larger populations were aggregating. The earliest aggregated village in the Cannonball subregion (Vanderbilt, *cal yr AD 1265–1315*) also contains evidence of plazas. After Vanderbilt, the use of plazas and ceremonial lodges become common among many villages in the Cannonball, including later possible aggregation villages like Havens (*cal yr AD 1280–1310*), South Cannonball (*cal yr AD 1285–1390*), and Bendish (*cal yr AD 1290–1380*).

The new chronology demonstrates that village aggregations among Middle Missouri groups coincide with the implementation of plazas and ceremonial lodges. However, the use of plazas and ceremonial lodges dates to at least a generation before the initial migration north, at the southern aggregation village of Sommers.

War in the South

This section addresses Question 3: *Does Coalescent migration occur while some Middle Missouri groups still occupy the southern extent of the study region?* The section begins by discussing the timing of Middle Missouri abandonment of the south. This is followed by a consideration of when Coalescent migration into the south occurred. Models calculating the probability of temporal overlap between Middle Missouri and Coalescent villages identified by the new chronology are presented. Although the Middle Missouri migration out of the south occurred before Coalescent migration, multiple southern Middle Missouri villages (fortified and unfortified) were still occupied during Coalescent migration into the area.

Middle Missouri Migration from the South

In the southern Missouri River Trench, 18 Middle Missouri villages (17 sites; one with two occupations) were modeled with *occupational date-ranges* spanning the mid-eleventh to the early fifteenth centuries (Table 4.1 and Figure 4.2). The last Middle Missouri villages occupied in the southern area were abandoned between the mid-fourteenth and early-fifteenth centuries. These villages were fortified and occupied the Bad-Cheyenne locality (Alberts Creek, Cheyenne River, and Indian Creek) (Figures 2.1 and 2.2). Of these later southern Middle Missouri villages, the last abandoned is Indian Creek Early (End Boundary ca. *cal yrs AD 1365–1415*).

Durkin, located south of Albert's Creek and Cheyenne River villages (Figure 2.2), could have been abandoned during the same period. The exact establishment and abandonment of Durkin are less precise because of the date-smearing that occurs at the fourteenth century reversal in the calibration curve (Figure 4.1). Even though Durkin occupies the same area of the calibration curve as villages like Alberts Creek and

Cheyenne River, the latter two villages produced at least one radiocarbon date younger than Durkin (560 ± 20 and 590 ± 25 RCYBP, respectively). The later radiocarbon dates from Alberts Creek and Cheyenne River occur within the trough presented by the calibration curve at the fourteenth century reversal (Figure 4.4). This increases the probability that the event being dated by the Alberts Creek and Cheyenne River models (village occupation) occurs later, shortening the overall *occupational date-range* for each village.

The models also demonstrate a gradual northward movement of Middle Missouri villages over 200 years. (Figure 4.5). Beginning with the southernmost Middle Missouri Tradition villages, King was occupied for 5–35 years, with an *occupational date-range* of *ca. cal yrs AD 1190–1230* (Figure 4.2). Later, and approximately 20–30 miles upstream of King, is Antelope Dreamer (occupied 5–30 years, *ca. cal yrs AD 1265–1290*). After the abandonment of Antelope Dreamer, Durkin (occupied 5–25 years, *ca. cal yrs AD 1360–1390*) is the southernmost occupied village, 20–30 miles upstream. This pattern extends north to Indian Creek Early (occupied 5–60 years, *ca. cal yrs AD 1345–1405*). Approximately every 10–30 years, the southernmost extent of Middle Missouri occupation moves 20–30 miles northward and upstream.

Coalescent Migration into the South

The migration of groups associated with the Coalescent may have begun slowly, within individual households or household groups, as early as the mid-thirteenth century at Sully School. Sully School (*cal yrs AD 1275–1325*), which contains evidence for both Middle Missouri and Coalescent “occupations” (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 337, 39SL7, 1-3). Johnson (2007a:118) describes Sully School as a “transitional Initial Middle Missouri-to-Extended Middle Missouri occupation”

with a Coalescent component. The Bayesian model for this site does not separate the occupations temporally, suggesting that either the occupations were simultaneous or that they were so close in time that the model cannot differentiate between the two. There is currently no evidence suggesting that the Middle Missouri and Coalescent occupations were separate. The distinction between occupations was an assumption made by archaeologists predicated on the cooccurrence of taxonomically different ceramics and architecture (Smithsonian Institution, American Museum of Natural History [SINMNH]: Museum of Natural History Archives, River Basin Surveys [RBS] Collection, Box 337, 39SL7, 1-3). If Sully School represents a simultaneous occupation by Middle Missouri and Coalescent groups, then the migration of Coalescent groups north of the Niobrara River in northern Nebraska occurred as early as the mid-thirteenth century. A co-residential, ethnically mixed community would also shift the narrative of Coalescent migration from one of incursion by an invading population intent on taking and settling new territory to a more complex history of household-level interactions between newcomers and locals.

Although the Coalescent migration into the southern portion of the Trench may have begun with the relocations of household groups as early as the mid-thirteenth century, the establishment of Initial Coalescent villages occurred over approximately a century. This larger migration begins with Crow Creek Late (Start Boundary *cal yrs AD 1345–1420*) and Whistling Elk (Start Boundary *cal yrs AD 1310–1365*) (Table 4.2). The next established village among those dated was Black Partizan Early (Start Boundary *cal yrs AD 1375–1430*), followed by Arzberger (Start Boundary *cal yrs AD 1405–1415*).

Because the date ranges reported for the establishment of Crow Creek Late and Whistling Elk overlap, it is unclear which village was established first. To attempt to disambiguate these occupations, the Order command was used to estimate the

probability that either village preceded the other. While too ambiguous to be statistically significant, the results of this model suggest that Crow Creek may have been established prior to Whistling Elk (62.29% probability) (Table 4.3). Despite the lack of clarity as to which village came first, what is clear is that Crow Creek and Whistling Elk were established before Black Partizan Early, while Arzberger, the northernmost Coalescent village, was established last (Table 4.1 and Figure 4.2).

The range of *occupational durations* (reported by the Interval command) for each of the four Initial Coalescent villages decreases with increasing latitude. The models for the two northernmost Initial Coalescent villages of Whistling Elk and Arzberger returned short *occupational durations* that suggest single-generation occupations (1–21 and 6–20 years, respectively). Crow Creek Late and Black Partizan Early, the two southernmost Initial Coalescent villages in the Trench, returned longer, multi-generational occupational durations (86–140 and 53–101 years, respectively). The archaeological data from each village supports the *occupational durations* reported for each village.

The abandonment of Initial Coalescent villages occurs more quickly than their establishment. With the exception of Whistling Elk, which was destroyed by a raid earlier in the period (Steinacher 1984), the pattern of Initial Coalescent village abandonment (and transition back to dispersed, unfortified villages) occurs relatively rapidly, in a north-to-south direction. Arzberger, the northernmost and latest established village, is abandoned first (End Boundary *cal yrs AD 1410–1425*). Crow Creek Late follows the abandonment of Arzberger (End Boundary *cal yrs AD 1420–1435*) and Black Partizan Early (End Boundary *cal yrs AD 1425–1450*). These models suggest that the transition away from fortified villages occurred within a generation.

Contemporaneity of Middle Missouri and Coalescent Villages

One of the basic questions this dissertation attempts to answer is whether Middle Missouri and Coalescent Tradition villages with and without evidence for conflict overlapped in time. The evidence above suggests that Middle Missouri villages may have been occupied when the first distinct Coalescent villages—Crow Creek Late and Whistling Elk—were established in the late thirteenth and early fourteenth centuries. If there is significant temporal overlap, it is possible that interactions between these migrants and locals were at least one of the sources of warfare observed in the archaeological record. If the two do not overlap, then the possibility of conflict originating from the proximity of these two groups is less likely.

The earliest and latest dates for a village's temporal placement can be hundreds of years apart for villages that were occupied for less than 50 years because of their location on the radiocarbon calibration curve. As discussed above, this was an issue for a number of sites in this study. Because of this "date smearing" (*sensu* Manning and Hart 2019:7), I decided that a more quantitative approach to defining the probability of overlap between some of the villages was necessary, specifically for the later Middle Missouri villages in the south and their possible overlap with Initial Coalescent villages. Temporal overlaps were modeled between all Initial Coalescent villages in this study and those 10 southern Middle Missouri villages with possibilities of both spatial and temporal overlap with Initial Coalescent villages (Alberts Creek, Antelope Dreamer, Cattle Oiler Late, Cheyenne River, Durkin, Indian Creek Early, Jiggs Thompson, Ketchen, Stony Point, and Sully School) (Table 4.4).

In order to present a more formalized, probability-based approach to identifying overlap between Middle Missouri and Coalescent villages, the Difference command was utilized. Two village models were placed into a single Phase and the Difference

command was applied to measure the likelihood of temporal overlap between each village's beginning Boundary, end Boundary, and Date results. The difference between these was measured because only one of these three metrics cannot fully represent the probable occupation of each site. If the numerical range returned by each of these measures crosses zero, there is a likelihood that the modeled PDFs, or date ranges from each village, overlap. The cells highlighted in green indicate those date ranges with a likelihood of overlap (Table 4.4).

According to the results of the Difference models, all Initial Coalescent villages have some probability of overlapping with at least one Middle Missouri village. Only the Begin Boundary at Crow Creek has any possibility of overlapping with the three Initial Middle Missouri villages evaluated (Antelope Dreamer, Jiggs Thompson, and Stony Point). Only two Middle Missouri villages (Antelope Dreamer and Ketchen) do not have any probability of temporal overlap with a Coalescent village. Although Arzberger has a probability of overlap with one village (Indian Creek Early), it is low, suggesting that this Initial Coalescent village is unlikely to overlap temporally with any southern Middle Missouri Tradition village.

Among the other Initial Coalescent villages, Whistling Elk has the highest number of likely overlaps with Middle Missouri villages. Alberts Creek, Cattle Oiler Late, Cheyenne River, Durkin, Indian Creek Early, Jiggs Thompson, and Sully School all have some probability of temporal overlap with Whistling Elk. Of these overlapping Middle Missouri villages, Alberts Creek, Cattle Oiler Late, Cheyenne River, and Durkin have a high likelihood of overlap in almost all categories. The villages overlapping with Whistling Elk are fortified (Alberts Creek, Cheyenne River, Indian Creek Early, Jiggs Thompson, and Sully School) and unfortified (Cattle Oiler Late and Durkin). Of the overlapping villages, the two in closest proximity to Whistling Elk are unfortified villages directly

across the river to the west: Cattle Oiler Late and Durkin. The closest fortified villages, Alberts Creek and Cheyenne River villages are over 60 miles north of Whistling Elk (Figure 2.2).

The remaining two Initial Coalescent villages, Black Partizan Early and Crow Creek Late, also have multiple points of overlap with Middle Missouri villages. As with Whistling Elk, both of these Initial Coalescent villages have possible overlaps with Alberts Creek, Cattle Oiler Late, Cheyenne River, Durkin, Indian Creek Early, Jiggs Thompson, and Sully School. With the exceptions of Jiggs Thompson and Sully School, the general trend in overlap between Crow Creek Late and the remaining Middle Missouri villages (Alberts Creek, Cattle Oiler Late, Cheyenne River, Durkin, and Indian Creek Early) is that the establishment and main *occupational date-range* of Crow Creek Late overlaps temporally with the establishment, main *occupational date-range*, and abandonment of each of these villages. The trend in the overlap between southern Middle Missouri villages and Black Partizan Early is similar to Crow Creek Late but with fewer overlaps.

From the Difference models, it is clear that three out of the four Initial Coalescent villages included in this chronology were likely established during a period when Middle Missouri Tradition villages (fortified and unfortified) still occupied the southern Missouri River Trench. Crow Creek Late even predates some southern Middle Missouri villages (Alberts Creek and Indian Creek Early) (Table 4.2). With the exception of Whistling Elk, the other Initial Coalescent villages were not abandoned until after the abandonment of the later Middle Missouri villages in the south.

The Transition from Fortified to Unfortified Villages

This section discusses Question 4: *Do Coalescent groups abandon the practice of building fortifications after Middle Missouri groups leave the area?* I discuss the

instances of fortified Coalescent villages in relation to Middle Missouri villages. The enhanced chronology shows that Coalescent groups only built fortifications while Middle Missouri groups also occupied the south.

The chronology presented here provides estimates for when Coalescent groups abandoned the practice of building large, fortified villages (Initial Coalescent villages) and returned to unfortified, dispersed villages or farmsteads characterized by Extended Coalescent villages and reminiscent of earlier Central Plains Tradition villages. The models for the Extended Coalescent villages presented here do not have enough data (dates) for each village to make concrete assertions about their occupational ranges and should be considered preliminary. Despite the relatively sparse dataset, the results of the models do provide information relevant to the broader themes of this study.

According to the preliminary Extended Coalescent models, there is a temporal gap between the abandonment of fortified, Initial Coalescent villages (Black Partizan Early End Boundary *ca. cal yrs AD 1425–1450*) and the establishment of unfortified, Extended Coalescent villages (Indian Creek Late, Begin Boundary *ca. cal yrs AD 1440–1565*). There is a low probability of overlap between Black Partizan Early (Initial Coalescent) and Indian Creek Late (Extended Coalescent). This temporal gap between fortified and unfortified villages is likely due to a lack of Coalescent villages sampled or the limited number of dates for each village not fully representing the earliest and latest occupational components. It appears that the final abandonment of fortified Initial Coalescent villages occurs as early as *ca. cal yrs AD 1425* at Black Partizan Early, while the establishment of unfortified Extended Coalescent villages occurs as late as *cal yr AD 1440* at Indian Creek Late. Of note is one Extended Coalescent village (with fortifications) located in the north, Lower Grand (Figures 2.2 and 4.2). This village bridges the temporal gap between fortified Initial Coalescent and unfortified Extended

Coalescent villages. Lower Grand's *occupational date-range* is *cal yrs AD 1455–1540*, with an *occupational duration* of 5–80 years.

The new chronology demonstrates that the Coalescent practice of constructing fortification systems only occurred when Middle Missouri groups also resided in the south. According to the models presented here, the practice of constructing fortified villages has a relatively short timeframe when compared to the dispersed, unfortified villages of the early-fourteenth and mid-fifteenth centuries that bookend this variant. After the abandonment of the last Initial Coalescent village, the adoption of dispersed, unfortified village layouts in the Missouri River Trench appears to occur over a shorter period.

Climate, Migration, and Conflict

This final section addresses Question 5: *Does evidence for intervillage warfare and/or migration among either Middle Missouri or Coalescent groups coincide with evidence for climatic shifts like drought cycles?* Recent studies focusing on localized patterns of drought in the Northern Plains establish that cycles of prolonged and intense drought occurred during the thirteenth, latter half of the fourteenth, and beginning of the fifteenth centuries (Cook et al. 2016; Trabert and Hollenback 2021:91,118). The new chronology demonstrates that droughts throughout the thirteenth century coincide with the Middle Missouri migration north (Figure 4.2). Multiple Middle Missouri villages were abandoned in the south during the thirteenth century, while the first Middle Missouri villages were founded in the north during the same period.

The Coalescent migration into the south also coincides with a major drought period in the Missouri River Trench (Cook et al. 2016; Trabert and Hollenback 2021:118). The initial migration occurs during a period of severe drought in the Central Plains,

where these groups likely originated. The establishment of Crow Creek Late (established ca. *cal yrs AD 1290–1345*) and Whistling Elk (established ca. *cal yrs AD 1300–1355*) occurs during a drought cycle in the Central Plains that takes place between the early-to-mid-thirteenth century.

The relationship between drought and warfare is less clear. Although the droughts of the thirteenth century align with the Middle Missouri migration north, they do not correlate to evidence of wide-spread conflict in the north. When warfare becomes more common in the north, this does not occur during times of significant drought. In fact, of all the Middle Missouri villages occupied during the thirteenth century, the majority were unfortified and none have evidence of village attacks.

In the south, severe drought does not always correlate with warfare. According to the new chronology, the attack at the Coalescent village of Whistling Elk would have occurred in the early-to-mid-fourteenth century, a time when drought was not nearly as significant in the region (Cook et al. 2016; Trabert and Hollenback 2021:118). The relationship between drought and the attack at Crow Creek Late is less clear. Although the attack likely occurred in the latter half of the village's occupation, there is substantial evidence of a reoccupation after the massacre (Bamforth and Nepstad-Thornberry 2007a). Unlike many other villages, the final abandonment of Crow Creek Late cannot be used as a proxy for the timing of the attack. Ultimately, we may not be able to identify the timing of the attack on the village without dating human remains, which is neither desirable nor possible. A single radiocarbon date on charred wood (WIS-1047) exists from a clay surface capping the mass grave (Bamforth 2018:23; Willey and Emerson 1993:241). The date (610 ± 55 RCYBP) calibrates to ca. *cal yrs AD 1304–1398* (68% probability) and *1285–1418* (95% probability). This is a single date from a context that does not directly relate to the massacre itself. However, if this date is accurate and

relates to just after the attack, then a mid-to-late fourteenth century date for the massacre is likely. If the attack occurred in the mid-fourteenth century, it does not overlap with severe drought. If the attack occurred in the late fourteenth century, a period of severe drought does overlap with the attack. This would also overlap with the final abandonment of the south by Middle Missouri groups at Indian Creek Early (Figure 4.2). Without a clear understanding of when the attack occurred, it is difficult to identify any apparent connection between drought and the attack on Crow Creek (see section on Crow Creek above).

Summary

The goal of producing a new chronology was to answer questions regarding the nature of warfare as it relates to the migration of Middle Missouri groups north and Coalescent groups into the south. The chronology presented here accomplishes each of these tasks to varying degrees.

In answer to questions one and two, the new chronology suggests that the migration north was relatively peaceful as practices associated with village integration (plazas and ceremonial lodges) align with a lack of warfare and population aggregations. The chronology also demonstrates that these integrative practices began in the south, prior to the beginning of the migration north. Interestingly, not all sites with evidence of plazas and ceremonial lodges were large, aggregated villages. The late occurrence of Sommers and the correlation between unfortified villages, aggregation, and integrative practices suggest that the already existing practices related to plazas and ceremonial lodges may have aided in peaceful integration.

In answer to questions three and four, the new chronology demonstrates that both Middle Missouri and Coalescent groups occupied the south simultaneously. It also

demonstrates that Coalescent villagers abandoned the practice of fortifying villages just after the last Middle Missouri villagers migrated out of the south. This supports the idea that conflict at sites like Crow Creek Late and Whistling Elk may have resulted from migrant-local animosity. However, two pieces of evidence uncovered by the chronology suggest that not all Middle Missouri locals were antagonistic to Coalescent migrants. First, the earliest Coalescent migrants appear to have lived alongside some Middle Missouri locals at Sully School. Second, not all southern Middle Missouri villages that occur with Coalescent villages were fortified.

The answer to the fifth question is perhaps the least obvious. The chronology demonstrates that both Middle Missouri and Coalescent migrations begin during periods of relatively extreme drought. For Middle Missouri groups, this was a period of drought in the Northern Plains that occurred during the thirteenth century. For Coalescent migration, drought was occurring in both the region these groups were migrating into and the region they were abandoning in the early-to-mid-fourteenth century. The association between drought and conflict is less clear as both droughts overlap with some evidence of warfare; however, there are instances of conflict outside of the drought periods.

The next chapter discusses the implications of this new chronology in further detail; within the context of a new narrative, it explains the historical processes of warfare and migration in the Missouri River Trench between the thirteenth and sixteenth centuries. The five questions answered above remain relevant to the discussion in the next chapter. However, what is most relevant is what these answers tell us about the intersectionality of warfare and migration in the region and how individuals and groups approached Clark and colleagues' (2018) "migrant paradox" through competition or cooperation.

Chapter 4 Tables

Table 4.1: Modeled date ranges for each village discussed in this study.

	Begin Boundary	Date	End Boundary	Interval	Agreement (Model)
Alberts Creek	1305-1350 (68.3%)	1315-1360 (68.3%)	1325-1370 (68.3%)	5-35 (68.3%)	94.9%
	1290-1400 (95.4%)	1315-1360 (95.4%)	1320-1420 (95.4%)	0-65 (95.4%)	
Antelope Dreamer	1255-1275 (68.3%)	1265-1290 (68.3%)	1275-1300 (68.3%)	5-30 (68.3%)	148%
	1230-1280 (95.4%)	1245-1305 (95.4%)	1265-1320 (95.4%)	0-65 (95.4%)	
Arzberger	1395-1410 (68.3%)	1405-1415 (68.3%)	1410-1425 (68.3%)	5-20 (68.3%)	166.5%
	1390-1415 (95.4%)	1395-1425 (95.4%)	1405-1415 (95.4%)	0-35 (95.4%)	
Bendish	1280-1370 (68.3%)	1290-1380 (68.3%)	1295-1390 (68.3%)	5-20 (68.3%)	80.1%
	1275-1380 (95.4%)	1280-1390 (95.4%)	1290-1395 (95.4%)	0-35 (95.4%)	
Black Partizan Early	1345-1380 (68.3%)	1375-1430 (68.3%)	1425-1450 (68.3%)	50-105 (68.3%)	100.7%
	1305-1390 (95.4%)	1340-1455 (95.4%)	1410-1470 (95.4%)	35-150 (95.4%)	
Interval between	50-105 (68.3%) 10-200 (95.4%)				
Black Partizan Late	1500-1545 (68.3%)	1515-1565 (68.3%)	1535-1575 (68.3%)	10-55 (68.3%)	
	1460-1640 (95.4%)	1490-1650 (95.4%)	1525-1670 (95.4%)	5-100 (95.4%)	
Calamity	1375-1405 (68.3%)	1390-1415 (68.3%)	1405-1430 (68.3%)	5-55 (68.3%)	103.7%
	1305-1410 (95.4%)	1335-1435 (95.4%)	1400-1455 (95.4%)	0-135 (95.4%)	
Cattle Oiler Early	1170-1200 (68.3%)	1180-1210 (68.3%)	1195-1220 (68.3%)	5-25 (68.3%)	132.4%
	1165-1210 (95.4%)	1170-1220 (95.4%)	1180-1225 (95.4%)	0-45 (95.4%)	
Interval between	85-130 (68.3%) 75-175 (95.4%)				
Cattle Oiler Late	1295-1355 (68.3%)	1305-1360 (68.3%)	1310-1370 (68.3%)	5-25 (68.3%)	
	1285-1390 (95.4%)	1295-1395 (95.4%)	1310-1400 (95.4%)	0-55 (95.4%)	
Cheyenne River	1285-1355 (68.3%)	1295-1365 (68.3%)	1310-1375 (68.3%)	5-40 (68.3%)	93.1%
	1265-1390 (95.4%)	1285-1400 (95.4%)	1305-1405 (95.4%)	0-85 (95.4%)	
Clark's Creek	1220-1285 (68.3%)	1235-1300 (68.3%)	1250-1310 (68.3%)	5-35 (68.3%)	128.6%
	1185-1380 (95.4%)	1205-1395 (95.4%)	1220-1405 (95.4%)	0-80 (95.4%)	
Cross Ranch	1305-1395 (68.3%)	1315-1410 (68.3%)	1330-1425 (68.3%)	5-35 (68.3%)	68.4%
	1290-1405 (95.4%)	1300-1425 (95.4%)	1315-1440 (95.4%)	0-80 (95.4%)	

Table 4.1 (Cont.): Occupational data for each village dated in this study.

	Begin Boundary	Date	End Boundary	Interval	Agreement (Model)	
Crow Creek Early	1145-1165 (68.3%)	1160-1195 (68.3%)	1180-1220 (68.3%)	20-70 (68.3%)	94.10%	
	1125-1200 (95.4%)	1145-1215 (95.4%)	1170-1230 (95.4%)	0-85 (95.4%)		
Interval between	85-145 (68.3%) 65-175 (95.4%)					
Crow Creek Late	1290-1345 (68.3%)	1345-1420 (68.3%)	1420-1435 (68.3%)	85-140 (68.3%)		
	1275-1360 (95.4%)	1305-1435 (95.4%)	1410-1450 (95.4%)	60-160 (95.4%)		
Durkin	1295-1380 (68.3%)	1360-1390 (68.3%)	1305-1395 (68.3%)	5-25 (68.3%)		125.60%
	1280-1385 (95.4%)	1285-1395 (95.4%)	1300-1405 (95.4%)	0-45 (95.4%)		
Fay Tolton	1045-1210 (68.3%)	1060-1220 (68.3%)	1070-1235 (68.3%)	5-35 (68.3%)		148.90%
	1030-1220 (95.4%)	1040-1235 (95.4%)	1055-1255 (95.4%)	0-75 (95.4%)		
Flaming Arrow	1175-1210 (68.3%)	1185-1220 (68.3%)	1205-1235 (68.3%)	5-35 (68.3%)		78.60%
	1160-1215 (95.4%)	1165-1230 (95.4%)	1175-1245 (95.4%)	0-60 (95.4%)		
H.P. Thomas	1155-1190 (68.3%)	1170-1210 (68.3%)	1190-1225 (68.3%)	10-50 (68.3%)	114.20%	
	1190-1225 (95.4%)	1050-1230 (95.4%)	1170-1250 (95.4%)	5-100 (95.4%)		
Havens	1265-1300 (68.3%)	1280-1310 (68.3%)	1290-1325 (68.3%)	0-55 (68.3%)	130.90%	
	1260-1290 (95.4%)	1265-1330 (95.4%)	1310-1395 (95.4%)	15-130 (95.4%)		
Helb	1325-1355 (68.3%)	1335-1360 (68.3%)	1350-1370 (68.3%)	5-30 (68.3%)	98.90%	
	1305-1360 (95.4%)	1310-1370 (95.4%)	1330-1380 (95.4%)	0-55 (95.4%)		
Huff	1435-1445 (68.3%)	1440-1455 (68.3%)	1450-1460 (68.3%)	0-20 (68.3%)	107.10%	
	1425-1450 (95.4%)	1430-1460 (95.4%)	1440-1465 (95.4%)	0-35 (95.4%)		
Indian Creek Early	1325-1385 (68.3%)	1345-1405 (68.3%)	1365-1415 (68.3%)	5-60 (68.3%)	68.10%	
	1280-1390 (95.4%)	1300-1410 (95.4%)	1325-1425 (95.4%)	0-90 (95.4%)		
Interval between	40-175 (68.3%) 20-260 (95.4%)					
Indian Creek Late	1440-1565 (68.3%)	1450-1580 (68.3%)	1465-1585 (68.3%)	5-35 (68.3%)		
	1430-1635 (95.4%)	1440-1650 (95.4%)	1455-1660 (95.4%)	0-70 (95.4%)		
Jake White Bull	1235-1285 (68.3%)	1250-1300 (68.3%)	1265-1310 (68.3%)	5-35 (68.3%)		138.10%
	1205-1310 (95.4%)	1220-1325 (95.4%)	1230-1340 (95.4%)	0-70 (95.4%)		

Table 4.1 (Cont.): Occupational data for each village dated in this study.

	Begin Boundary	Date	End Boundary	Interval	Agreement (Model)
Jiggs Thompson	1220-1285 (68.3%) 1175-1380 (95.4%)	1230-1300 (68.3%) 1200-1395 (95.4%)	1240-1315 (68.3%) 1220-1405 (95.4%)	5-35 (68.3%) 0-80 (95.4%)	111.90%
Jones Village	1040-1190 (68.3%) 1025-1200 (95.4%)	1055-1210 (68.3%) 1040-1225 (95.4%)	1075-1225 (68.3%) 1055-1245 (95.4%)	10-55 (68.3%) 5-115 (95.4%)	127.20%
John Ketchen	1240-1270 (68.3%) 1215-1275 (95.4%)	1255-1285 (68.3%) 1230-1295 (95.4%)	1270-1295 (68.3%) 1240-1315 (95.4%)	5-40 (68.3%) 0-75 (95.4%)	100.30%
King	1175-1215 (68.3%) 1160-1220 (95.4%)	1190-1230 (68.3%) 1165-1240 (95.4%)	1210-1240 (68.3%) 1180-1260 (95.4%)	5-35 (68.3%) 0-75 (95.4%)	106.00%
Little Pumpkin	1470-1585 (68.3%) 1440-1630 (95.4%)	1500-1620 (68.3%) 1460-1655 (95.4%)	1535-1650 (68.3%) 1485-1680 (95.4%)	10-65 (68.3%) 5-135 (95.4%)	127.80%
Lower Grand	1425-1515 (68.3%) 1360-1595 (95.4%)	1455-1540 (68.3%) 1405-1615 (95.4%)	1485-1560 (68.3%) 1460-1640 (95.4%)	5-80 (68.3%) 5-170 (95.4%)	101.80%
Meander	1475-1615 (68.3%) 1455-1630 (95.4%)	1490-1630 (68.3%) 1465-1645 (95.4%)	1505-1645 (68.3%) 1480-1660 (95.4%)	5-35 (68.3%) 0-75 (95.4%)	89.90%
Medicine Creek Early	1145-1165 (68.3%) 1125-1180 (95.4%)	1155-1180 (68.3%) 1145-1205 (95.4%)	1165-1190 (68.3%) 1160-1215 (95.4%)	5-40 (68.3%) 0-70 (95.4%)	79.90%
Interval between	340-450 (68.3%) 320-460 (95.4%)				
Medicine Creek Late	1530-1635 (68.3%) 1510-1635 (95.4%)	1540-1645 (68.3%) 1515-1650 (95.4%)	1550-1655 (68.3%) 1525-1670 (95.4%)	5-35 (68.3%) 0-65 (95.4%)	
Menoken	1185-1215 (68.3%) 1165-1220 (95.4%)	1200-1230 (68.3%) 1180-1245 (95.4%)	1220-1240 (68.3%) 12220-1260 (95.4%)	10-45 (68.3%) 0-80 (95.4%)	120.60%
Over's La Roche	1475-1600 (68.3%) 1435-1630 (95.4%)	1505-1625 (68.3%) 1460-1660 (95.4%)	1530-1655 (68.3%) 1490-1685 (95.4%)	15-70 (68.3%) 5-145 (95.4%)	72.40%
Paul Brave	1270-1290 (68.3%) 1260-1295 (95.4%)	1285-1315 (68.3%) 1270-1335 (95.4%)	1310-1330 (68.3%) 1300-1350 (95.4%)	25-55 (68.3%) 5-85 (95.4%)	99.20%

Table 4.1 (Cont.): Occupational data for each village dated in this study.

	Begin Boundary	Date	End Boundary	Interval	Agreement (Model)
Shermer	1320-1380 (68.3%) 1285-1400 (95.4%)	1330-1395 (68.3%) 1300-1415 (95.4%)	1345-1410 (68.3%) 1315-1435 (95.4%)	5-40 (68.3%) 0-80 (95.4%)	76.70%
Sommers	1155-1200 (68.3%) 1150-1200 (95.4%)	1165-1205 (68.3%) 1160-1210 (95.4%)	1175-1210 (68.3%) 1170-1220 (95.4%)	0-30 (68.3%) 0-60 (95.4%)	85.20%
South Cannonball	1260-1370 (68.3%) 1245-1380 (95.4%)	1285-1390 (68.3%) 1270-1400 (95.4%)	1310-1405 (68.3%) 1300-1420 (95.4%)	15-70 (68.3%) 5-135 (95.4%)	73.10%
Stony Point	1200-1265 (68.3%) 1145-1280 (95.4%)	1220-1290 (68.3%) 1170-1330 (95.4%)	1245-1315 (68.3%) 1215-1380 (95.4%)	15-80 (68.3%) 5-170 (95.4%)	75.40%
Sully	1465-1595 (68.3%) 1435-1630 (95.4%)	1495-1620 (68.3%) 1455-1650 (95.4%)	1525-1650 (68.3%) 1480-1675 (95.4%)	10-70 (68.3%) 5-140 (95.4%)	91.60%
Sully School	1260-1280 (68.3%) 1290-1405 (95.4%)	1275-1325 (68.3%) 1260-1365 (95.4%)	1310-1350 (68.3%) 1305-1405 (95.4%)	40-85 (68.3%) 25-145 (95.4%)	76.90%
Swanson	1125-1230 (68.3%) 1035-1290 (95.4%)	1155-1260 (68.3%) 1055-1315 (95.4%)	1185-1280 (68.3%) 1070-1355 (95.4%)	10-70 (68.3%) 5-150 (95.4%)	73.40%
Travis I	1205-1270 (68.3%) 1150-1290 (95.4%)	1215-1280 (68.3%) 1160-1310 (95.4%)	1230-1290 (68.3%) 1175-1325 (95.4%)	5-35 (68.3%) 0-75 (95.4%)	136.6%
Vanderbilt	1250-1300 (68.3%) 1220-1385 (95.4%)	1265-1315 (68.3%) 1245-1400 (95.4%)	1280-1325 (68.3%) 1270-1410 (95.4%)	5-35 (68.3%) 0-75 (95.4%)	114.80%
Walth Bay	1500-1630 (68.3%) 1470-1640 (95.4%)	1510-1640 (68.3%) 1490-1655 (95.4%)	1525-1650 (68.3%) 1500-1665 (95.4%)	5-35 (68.3%) 0-75 (95.4%)	115.90%
Whistling Elk	1300-1355 (68.3%) 1295-1395 (95.4%)	1310-1365 (68.3%) 1305-1400 (95.4%)	1320-1370 (68.3%) 1315-1405 (95.4%)	5-25 (68.3%) 0-50 (95.4%)	121.20%
White Buffalo Robe	1270-1375 (68.3%) 1260-1385 (95.4%)	1285-1385 (68.3%) 1270-1400 (95.4%)	1295-1400 (68.3%) 1285-1410 (95.4%)	5-35 (68.3%) 0-70 (95.4%)	86.50%
32MO291	1415-1440 (68.3%) 1400-1450 (95.4%)	1430-1460 (68.3%) 1415-1480 (95.4%)	1450-1480 (68.3%) 1440-1495 (95.4%)	0-55 (68.3%) 0-85 (95.4%)	151.90%

Table 4.2: Probabilities for each of the three earliest Extended Middle Missouri villages predating one another. This model used the Order command to calculate probabilities.

Probability (t ₁) predates (t ₂)		t ₂		
		Travis I begin Boundary	Ketchen begin Boundary	Clark's Creek Begin Boundary
t ₁	Travis I Begin Boundary	0.00%	72.49%	72.91%
	Ketchen Begin Boundary	27.51%	0.00%	57.71%
	Clark's Creek Begin Boundary	27.10%	42.29%	0.00%

Table 4.3: Probabilities of the establishment of Crow Creek predates the establishment of Whistling Elk. This model used the Order command to calculate probabilities.

Probability (t ₁) predates (t ₂)		t ₂	
		Crow Creek Late begin Boundary	Whistling Elk begin Boundary
t ₁	Crow Creek Late Begin Boundary	0.00%	62.29%
	Whistling Elk Begin Boundary	37.71%	0.00%

Table 4.4: Difference in overlap between southern Middle Missouri and Coalescent villages. The number ranges show the establishment (Begin Boundary), abandonment (End Boundary), and main occupation (results of the Date command) between southern Middle Missouri (rows) and Coalescent (columns) villages. The numerical ranges were calculated using the Difference command. If a numerical range crosses zero, then there is a likelihood that the two elements overlapped in time (green highlighted cells). In the first column, “begin” represents the Begin Boundary, or establishment of a village; “end” represents the End Boundary, or abandonment of a village; and “date” represents the main occupation of a village as reported by the Date command. All ranges are reported at 68% probability.

	Alberts Creek	Antelope Dreamer	Cattle Oiler Late	Cheyenne River	Durkin	Indian Creek Early	Jiggs Thompson	Ketchen	Stony Point	Sully School
Arzberger (begin-begin)	(-98) – (-53)	(-150) – (-125)	(-109) – (-48)	(-131) – (-51)	(-111) – (-25)	(-75) – (-20)	(-184) – (-116)	(-161) – (-133)	(-202) – (-140)	(-142) – (-124)
Arzberger (end-begin)	(-75) – (-32)	(-129) – (-105)	(-91) – (-32)	(-94) – (-34)	(-95) – (-6)	(-34) – (15)	(-159) – (-88)	(-134) – (-110)	(-156) – (-86)	(-90) – (-51)
Arzberger (begin-end)	(-114) – (-68)	(-166) – (-140)	(-125) – (-64)	(-149) – (-67)	(-125) – (-39)	(-90) – (-35)	(-199) – (-132)	(-177) – (-148)	(-216) – (-155)	(-157) – (-138)
Arzberger (end-end)	(-91) – (-46)	(-145) – (-120)	(-107) – (-47)	(-110) – (-51)	(-111) – (-21)	(-47) – (-1)	(-174) – (-104)	(-149) – (-124)	(-170) – (-100)	(-105) – (-67)
Arzberger (date-date)	(-95) – (-48)	(-149) – (-122)	(-110) – (-47)	(-119) – (-65)	(-111) – (-21)	(-63) – (-7)	(-179) – (-109)	(-157) – (-127)	(-189) – (-120)	(-135) – (-86)
Arzberger (date-begin)	(-88) – (-40)	(-140) – (-115)	(-101) – (-40)	(-110) – (-47)	(-104) – (-14)	(-55) – (0)	(-172) – (-102)	(-149) – (-120)	(-180) – (-114)	(-128) – (-78)
Arzberger (date-end)	(-105) – (-55)	(-156) – (-130)	(-117) – (-55)	(-127) – (-62)	(-118) – (-29)	(-70) – (-15)	(-187) – (-117)	(-165) – (-135)	(-195) – (-129)	(-143) – (-94)
Arzberger (begin-date)	(-107) – (-60)	(-158) – (-133)	(-118) – (-57)	(-140) – (-83)	(-120) – (-31)	(-84) – (-26)	(-190) – (-125)	(-171) – (-140)	(-210) – (-147)	(-151) – (-130)
Arzberger (end-date)	(-84) – (-37)	(-137) – (-112)	(-100) – (-39)	(-102) – (-45)	(-101) – (-13)	(-38) – (7)	(-168) – (-95)	(-141) – (-117)	(-162) – (-94)	(-97) – (-59)

Table 4.4 (Cont.): Difference in overlap between the establishment (Begin Boundary), abandonment (End Boundary), and main occupation (results of the Date command) between Middle Missouri (rows) and Initial Coalescent (columns) villages. The numerical ranges were calculated using the Difference command. If a numerical range crosses zero, then there is a likelihood that the two elements overlapped in time (green highlighted cells). In the first column, “begin” represents the Begin Boundary, or establishment of a village; “end” represents the End Boundary, or abandonment of a village; and “date” represents the main occupation of a village as reported by the Date command. All ranges are reported at 68% probability.

	Alberts Creek	Antelope Dreamer	Cattle Oiler Late	Cheyenne River	Durkin	Indian Creek Early	Jiggs Thompson	Ketchen	Stony Point	Sully School
Black Partizan (begin-begin)	(-62) – (11)	(-117) – (-74)	(-74) – (-13)	(-80) – (-4)	(-76) – (33)	(-45) – (29)	(-145) – (-65)	(-131) – (-82)	(-166) – (-90)	(-112) – (-73)
Black Partizan (end-begin)	(-35) – (35)	(-95) – (-51)	(-56) – (7)	(-52) – (21)	(-55) – (53)	(4) – (65)	(-118) – (-33)	(-100) – (-57)	(-114) – (-30)	(-53) – (5)
Black Partizan (begin-end)	(-141) – (-86)	(-190) – (-159)	(-153) – (-88)	(-159) – (-85)	(-148) – (-55)	(-117) – (-54)	(-223) – (-151)	(-205) – (-168)	(-234) – (-175)	(-185) – (-155)
Black Partizan (end-end)	(-117) – (-62)	(-169) – (-135)	(-133) – (-67)	(-130) – (-65)	(-129) – (-36)	(-71) – (-20)	(-198) – (-124)	(-175) – (-141)	(-195) – (-121)	(-129) – (-84)
Black Partizan (date-date)	(-95) – (-17)	(-155) – (-95)	(-113) – (-36)	(-113) – (-28)	(-70) – (10)	(-70) – (12)	(-178) – (-82)	(-166) – (-101)	(-188) – (-98)	(-135) – (-60)
Black Partizan (date-begin)	(-48) – (22)	(-106) – (-63)	(-65) – (-2)	(-66) – (6)	(-66) – (44)	(-23) – (49)	(-131) – (-49)	(-115) – (-69)	(-141) – (-61)	(-90) – (-25)
Black Partizan (date-end)	(-130) – (-73)	(-180) – (-147)	(-143) – (-79)	(-144) – (-76)	(-140) – (-45)	(-98) – (-35)	(-210) – (-138)	(-190) – (-154)	(-220) – (-149)	(-166) – (-113)
Black Partizan (begin-date)	(-109) – (-29)	(-169) – (-105)	(-123) – (-48)	(-128) – (-42)	(-80) – (1)	(-94) – (-9)	(-192) – (-98)	(-181) – (-116)	(-214) – (-128)	(-162) – (-103)
Black Partizan (end-date)	(-83) – (-3)	(-144) – (-82)	(-104) – (-25)	(-98) – (-13)	(-61) – (20)	(-44) – (31)	(-164) – (-68)	(-150) – (-88)	(-159) – (-69)	(-100) – (-29)

Table 4.4 (Cont.): Difference in overlap between the establishment (Begin Boundary), abandonment (End Boundary), and main occupation (results of the Date command) between Middle Missouri (rows) and Initial Coalescent (columns) villages. The numerical ranges were calculated using the Difference command. If a numerical range crosses zero, then there is a likelihood that the two elements overlapped in time (green highlighted cells). In the first column, “begin” represents the Begin Boundary, or establishment of a village; “end” represents the End Boundary, or abandonment of a village; and “date” represents the main occupation of a village as reported by the Date command. All ranges are reported at 68% probability.

	Alberts Creek	Antelope Dreamer	Cattle Oiler Late	Cheyenne River	Durkin	Indian Creek Early	Jiggs Thompson	Ketchen	Stony Point	Sully School
Crow Creek (begin-begin)	(-24) – (45)	(-85) – (-30)	(-39) – (26)	(-66) – (2)	(-17) – (78)	(-4) – (71)	(-106) – (-20)	(-91) – (-37)	(-127) – (-49)	(-72) – (-24)
Crow Creek (end-begin)	(1) – (71)	(-60) – (-6)	(-20) – (51)	(-24) – (39)	(2) – (97)	(46) – (111)	(-80) – (10)	(-61) – (-10)	(-75) – (8)	(-15) – (49)
Crow Creek (begin-end)	(-125) – (-76)	(-179) – (-149)	(-137) – (-75)	(-167) – (-112)	(-137) – (-47)	(-100) – (-44)	(-210) – (-140)	(-190) – (-156)	(-227) – (-164)	(-170) – (-145)
Crow Creek (end-end)	(-101) – (-54)	(-155) – (-129)	(-119) – (-55)	(-120) – (-84)	(-120) – (-29)	(-56) – (-11)	(-186) – (-111)	(-160) – (-133)	(-181) – (-110)	(-115) – (-75)
Crow Creek (date-date)	(-77) – (12)	(-145) – (-70)	(-95) – (-6)	(-111) – (-28)	(-59) – (41)	(-50) – (40)	(-158) – (-50)	(-152) – (-73)	(-169) – (-69)	(-117) – (-29)
Crow Creek (date-begin)	(-12) – (58)	(-71) – (-18)	(-30) – (39)	(-43) – (21)	(-7) – (88)	(20) – (92)	(-93) – (-5)	(-76) – (-23)	(-103) – (-20)	(-49) – (20)
Crow Creek (date-end)	(-114) – (-64)	(-168) – (-139)	(-128) – (-65)	(-142) – (-96)	(-130) – (-37)	(-81) – (-25)	(-198) – (-125)	(-175) – (-144)	(-206) – (-138)	(-153) – (-101)
Crow Creek (begin-date)	(-90) – (-1)	(-159) – (-80)	(-105) – (-19)	(-133) – (-45)	(-69) – (33)	(-74) – (20)	(-173) – (-65)	(-166) – (-88)	(-198) – (-100)	(-150) – (-74)
Crow Creek (end-date)	(-65) – (25)	(-134) – (-55)	(-84) – (6)	(-90) – (-9)	(-50) – (51)	(-26) – (59)	(-143) – (-34)	(-138) – (-59)	(-140) – (-40)	(-83) – (4)

Table 4.4 (Cont.): Difference in overlap between the establishment (Begin Boundary), abandonment (End Boundary), and main occupation (results of the Date command) between Middle Missouri (rows) and Initial Coalescent (columns) villages. The numerical ranges were calculated using the Difference command. If a numerical range crosses zero, then there is a likelihood that the two elements overlapped in time (green highlighted cells). In the first column, “begin” represents the Begin Boundary, or establishment of a village; “end” represents the End Boundary, or abandonment of a village; and “date” represents the main occupation of a village as reported by the Date command. All ranges are reported at 68% probability.

	Alberts Creek	Antelope Dreamer	Cattle Oiler Late	Cheyenne River	Durkin	Indian Creek Early	Jiggs Thompson	Ketchen	Stony Point	Sully School
Whistling Elk (begin-begin)	(-31) – (41)	(-91) – (-31)	(-51) – (14)	(-56) – (40)	(-25) – (68)	(-25) – (69)	(-125) – (-25)	(-99) – (-41)	(-136) – (-55)	(-86) – (-29)
Whistling Elk (end-begin)	(-12) – (65)	(-72) – (-8)	(-34) – (56)	(-30) – (60)	(-10) – (87)	(20) – (104)	(-97) – (5)	(-77) – (-15)	(-87) – (0)	(-27) – (39)
Whistling Elk (begin-end)	(-50) – (22)	(-108) – (-49)	(-65) – (-4)	(-74) – (24)	(-38) – (51)	(-40) – (51)	(-142) – (-44)	(-115) – (-59)	(-158) – (-75)	(-103) – (-45)
Whistling Elk (end-end)	(-30) – (45)	(-87) – (-28)	(-49) – (38)	(-45) – (41)	(-23) – (70)	(4) – (85)	(-115) – (-15)	(-92) – (-33)	(-108) – (-21)	(-44) – (21)
Whistling Elk (date-date)	(-31) – (43)	(-89) – (-29)	(-50) – (15)	(-50) – (36)	(-24) – (69)	(-6) – (74)	(-120) – (-20)	(-94) – (-38)	(-124) – (-39)	(-70) – (2)
Whistling Elk (date-begin)	(-21) – (53)	(-81) – (-20)	(-43) – (24)	(-41) – (46)	(-18) – (79)	(5) – (85)	(-111) – (-10)	(-85) – (-29)	(-114) – (-28)	(-60) – (15)
Whistling Elk (date-end)	(-40) – (34)	(-98) – (-38)	(-58) – (6)	(-59) – (31)	(-30) – (61)	(-16) – (63)	(-129) – (-29)	(-104) – (-46)	(-133) – (-49)	(-82) – (-10)
Whistling Elk (begin-date)	(-41) – (31)	(-100) – (-40)	(-58) – (5)	(-65) – (31)	(-33) – (60)	(-32) – (59)	(-134) – (-34)	(-108) – (-50)	(-147) – (-65)	(-95) – (-37)
Whistling Elk (end-date)	(-21) – (55)	(-79) – (-18)	(-41) – (23)	(-35) – (47)	(-15) – (78)	(13) – (94)	(-106) – (-5)	(-84) – (-24)	(-97) – (-10)	(-35) – (30)

Chapter 4 Figures

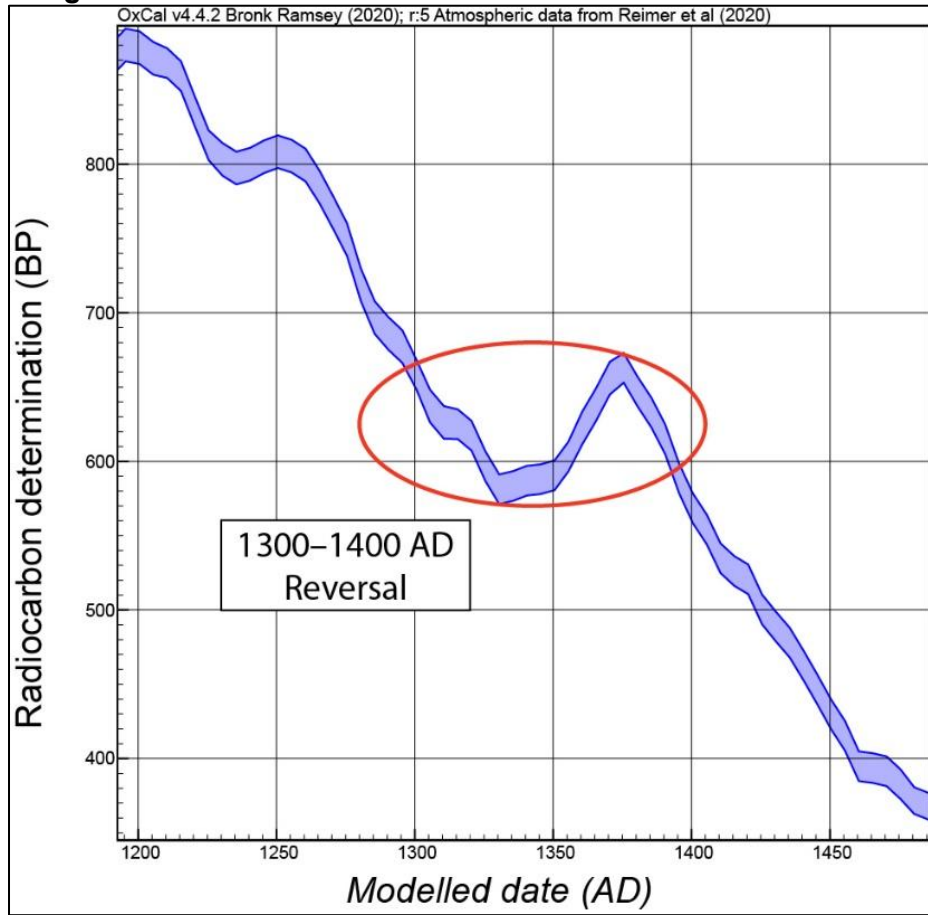


Figure 4.1: The AD 1300–1400 reversal in the Radiocarbon calibration curve.

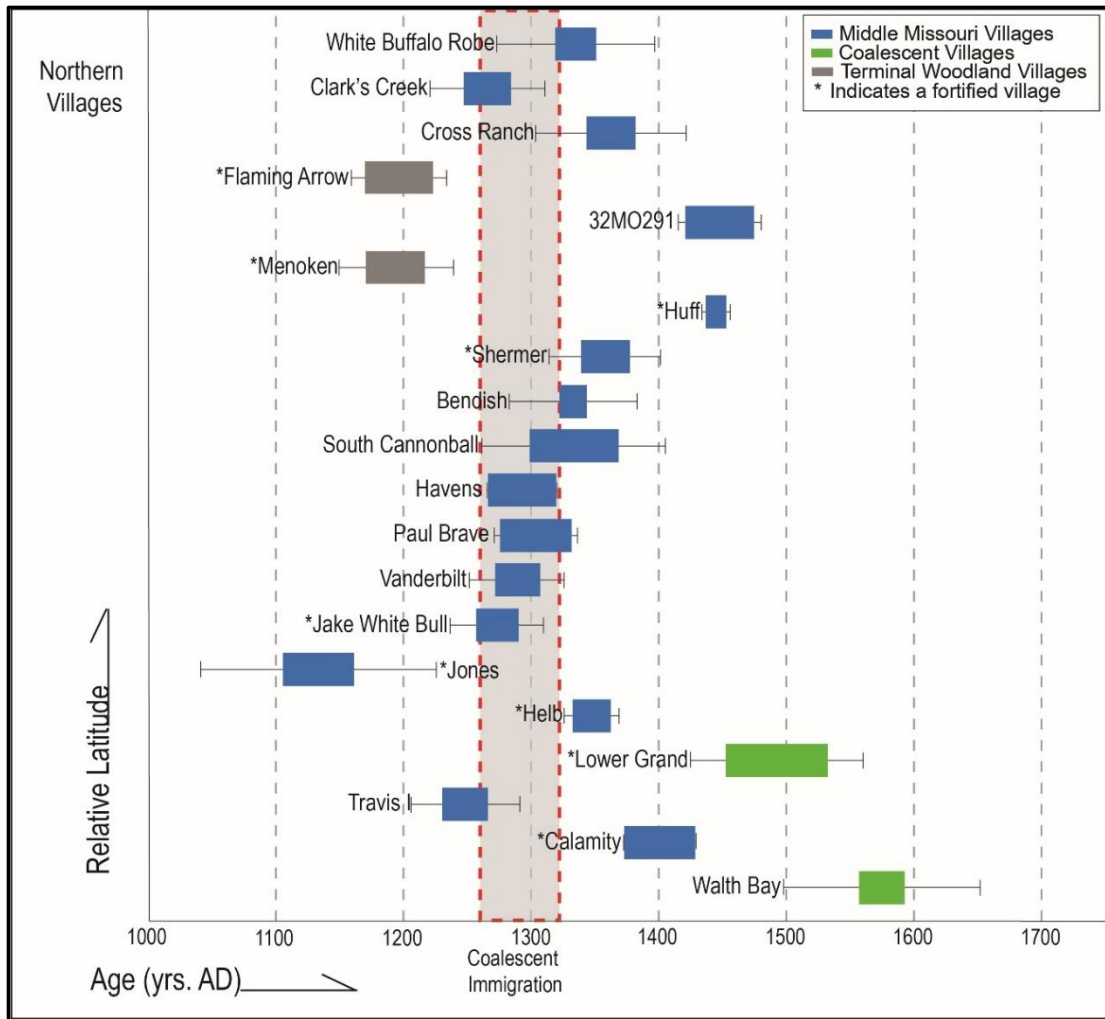


Figure 4.2: The chronology of all villages dated in this study. Note that in each box-and-whisker plot, the colored box representing the village's maximum temporal occupation is reported by the Interval function. The 'whiskers' on each end of a box represent the maximum possible date-range in which a village could have occurred based upon the Start and End Boundaries in each model. For simplicity, the box was not weighted to either side and placed at the center of the date-range. All ranges are reported at 68% probability.

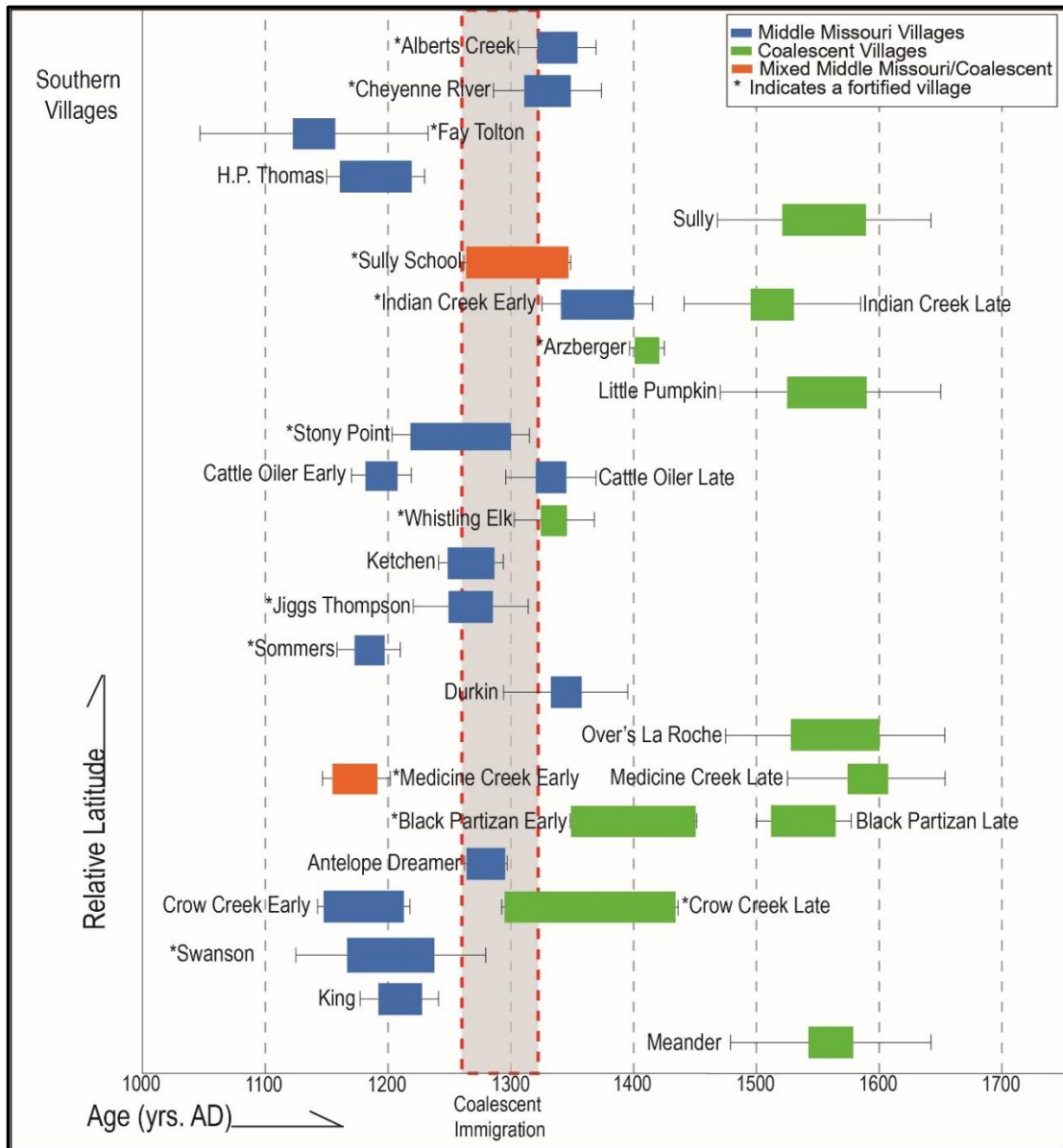


Figure 4.2 (Cont.): The chronology of all villages dated in this study. Note that in each box-and-whisker plot, the colored box represented the village occupation is reported by the *Interval* function. The 'whiskers' on each end of a box represent the maximum possible date-range in which a village could have occurred based upon the Start and End Boundaries in each model. For simplicity, the box was not weighted to either side and placed at the center of the date-range. All ranges are reported at 68% probability.

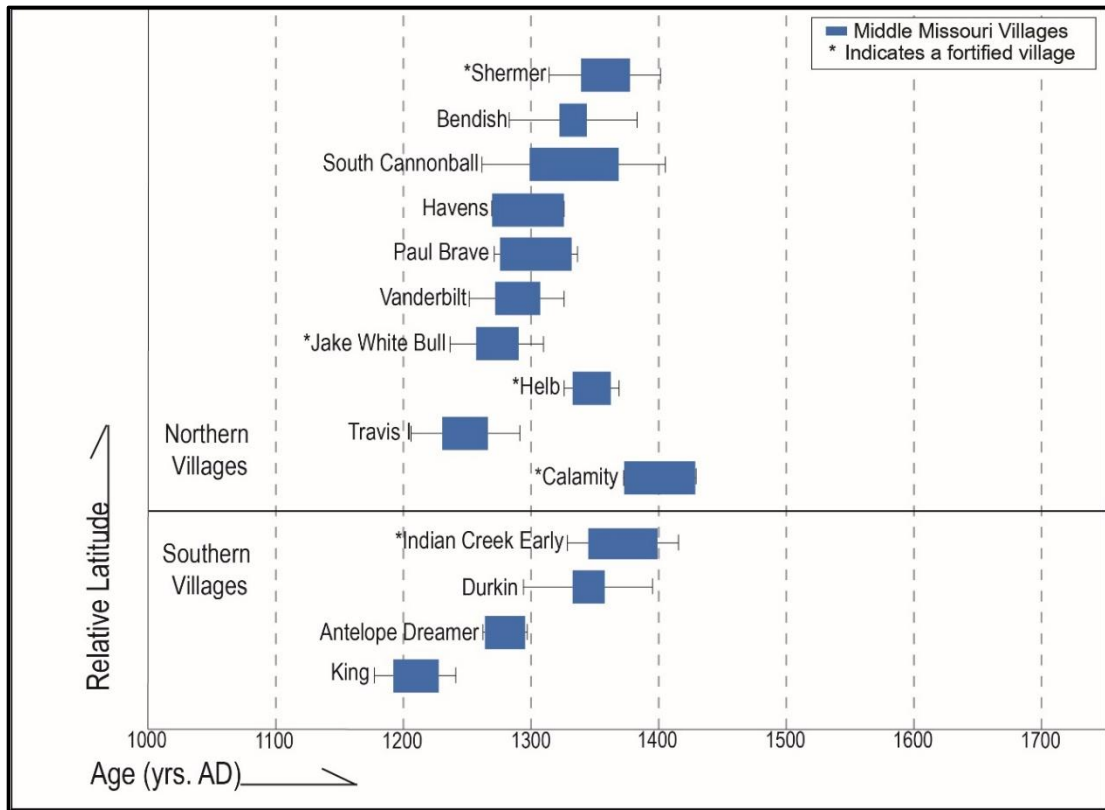


Figure 4.3: The northward movement of Middle Missouri Tradition villages. Villages in each subregion trend northward over time. Among the northern villages there is a movement south among some village groups (Helb and Calamity) that coincides with a return to the practice of fortifying villages. All ranges are reported at 68% probability.

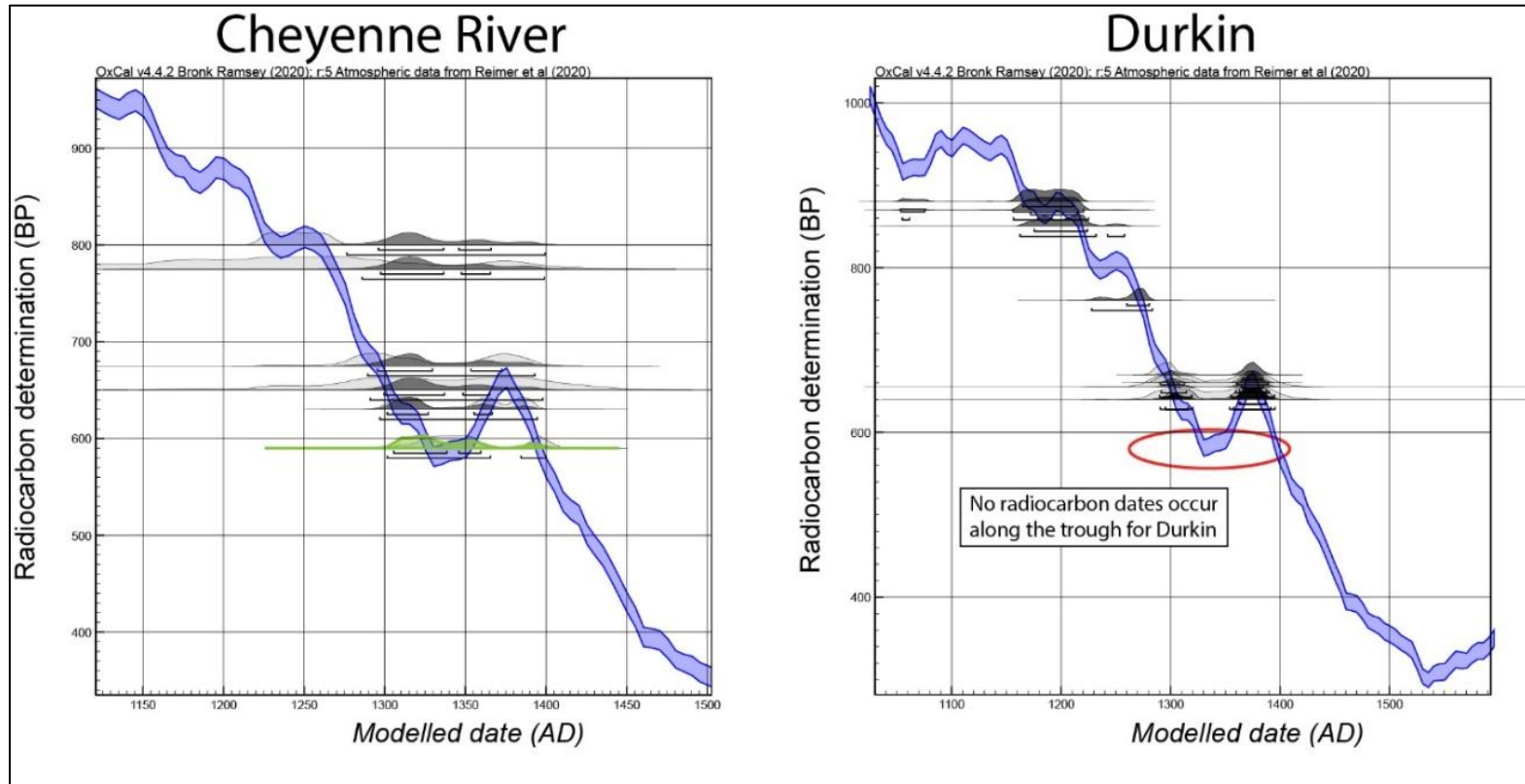


Figure 4.4: A comparison of dates from Cheyenne River and Durkin villages plotted along the AD 1300–1400 radiocarbon curve reversal. A single date (green) from Cheyenne River occurs across the trough of the curve, while no dates from Durkin fall along this segment of the calibration curve (circled in red). The result is modeled date ranges for the beginning and end Boundaries of Durkin that are spread farther apart in time than Cheyenne River.

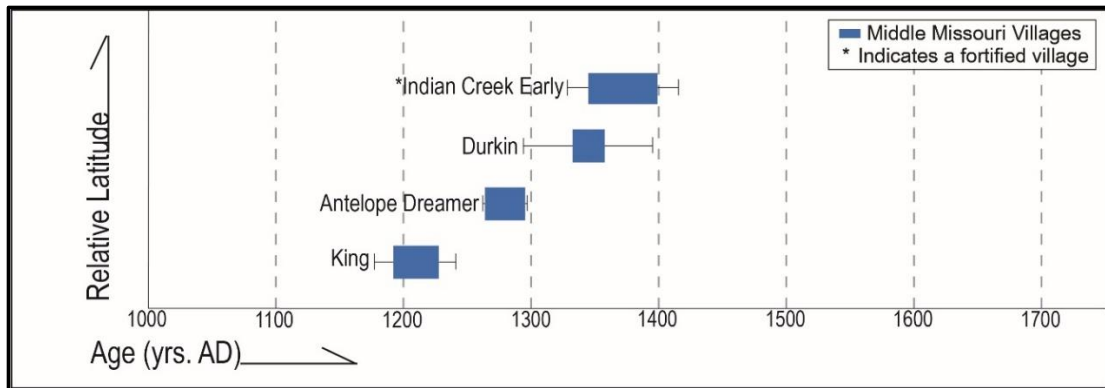


Figure 4.5: The northward movement of Middle Missouri Tradition villages in the south (below the Cheyenne River). Each of these villages is the southernmost village in the subregion for that time period it was occupied. All ranges are reported at 68% probability.

CHAPTER 5

A NEW NARRATIVE FOR MIGRATION AND WAR IN THE MISSOURI TRENCH

This chapter addresses the intersection of migration and warfare between the thirteenth and sixteenth centuries AD in the Missouri River Trench. It incorporates the frameworks and existing archaeological evidence established in the first two chapters and the results of the new radiocarbon chronology from the preceding chapter. Two narratives incorporating conditions that may contribute to peaceful or contentious migrant-local relations are established below. These ultimately result in two different resolutions to the migrant paradox (Clark et al. 2019). In the first narrative, Middle Missouri villagers migrate from the southern Missouri River Trench into the north and integrate with local Woodland groups. The other narrative involves Coalescent groups immigrating into the southern Missouri Trench, where migrant-local violence likely occurred and only subsided when local Middle Missouri groups migrated out of the area.

Migration Out of the South and a Decline in Warfare

The new chronology demonstrates that the northward migration of Middle Missouri villagers began during a continental mega-drought in the thirteenth century (e.g., Benson et al. 2009; Cobb & Butler, 2002; Cobb et al. 2023; Cook et al. 2016; Krus and Cobb, 2018; Meeks and Anderson, 2013; Williams 1983, 1990). This migration was a sustained, multigenerational process that did not temporally overlap with evidence for warfare in the north. As discussed in the previous chapters, the northern Missouri Trench was not an empty landscape at the time of migrant arrival. Although the overall density of settlements was low, Late/Terminal Woodland groups consisting of settled villagers and

nomadic groups also resided in the area (Johnson 2001; Weston et al. 1980). Similarities in architecture, ceramics, lithics, bone tool technology, and exchange goods suggest migrants and locals likely interacted regularly and integrated to some degree (Ahler 2007; Johnson 2007a:109-111; Krause 2007; Mitchell 2013:56-59; Swenson 2003:351-352). The new chronology also demonstrates that the Late/Terminal Woodland villages of Flaming Arrow and Menoken were abandoned at approximately the same time as the first northern Middle Missouri villages of Clark's Creek and Travis I were established (Figure 4.2). The question then is, what facilitated this apparently peaceful integration? Combining the new chronology and existing archaeological evidence, multiple processes become apparent as the migration proceeded. In the northern extent of the study area, population aggregation, inclusive institutions related to plazas and ceremonial lodges, and the preexisting social ties between migrants and locals likely contributed to a seemingly peaceful integration

Village Aggregation

The new chronology demonstrates that while Middle Missouri villages in the Big Bend and Knife subregions were not the product of village aggregations, those in the Cannonball subregion experienced significant population and village growth through aggregation. Villages clustering in the Big Bend and Knife subregions did not overlap temporally and likely resulted from groups abandoning one village to establish another over time. These village clusters also maintained lower populations (by house number) than those in the Cannonball subregion (Table 5.1). In the Big Bend subregion, Ketchen and Durkin are smaller villages with lower populations (12 and 15 houses, respectively). In the Knife subregion, Clark's Creek and Cross Ranch were also relatively small (14 and 11 houses, respectively).

The two village clusters in the Cannonball subregion have a growth trajectory different from any others in the Trench. The chronology demonstrates significant temporal overlap among the Cannonball village clusters, suggesting that this was not the same population of villagers abandoning one village to found another (Figure 5.1). Increasing numbers of houses in each village, increases in house size, and evidence for village expansions suggests that villages in the Cannonball subregion experienced growth through aggregation as Middle Missouri migrants and Woodland locals began to co-reside and integrate. This argument is bolstered by a contemporaneous decrease in the number of villages in the south (Figure 4.2).

The southernmost Cannonball cluster, between the Grand and Cannonball Rivers, began as villages similar in size and population to those of the Big Bend and Knife subregions. Later, the village populations appear to grow over time with later villages being significantly larger. Jake White Bull, the earliest village in the area with adequate size and population data (neither Jones nor Clark's Creek have adequate site data), consisted of only 11 houses. Later villages like Vanderbilt (over 22 houses) or Bendish (over 45 houses) had at least double the population of Jake White Bull. Vanderbilt and Bendish also temporally overlap with other villages in the Cannonball, suggesting population growth outpaced the possibility of increasing village size through natural population increase.

Most villages in the Cannonball subregion also occupied sprawling, unfortified areas much larger than previous or contemporary villages to their north and south. Havens, one of the longer-occupied villages (30–60 yrs, 68% probability), covers approximately 6 hectares. It is also evident at Havens that the house rows were irregular and somewhat clustered in areas (Sperry 1982:7) (Figure 5.2). South Cannonball village, an equally large (6.5 hectares, 40 houses) and possibly long-lived (15–70 yrs, 68%

probability) has a similar organizational pattern to Havens (Griffin 1984:7). The size, longevity, and organization of intra-site settlement patterns suggest that villages in the Cannonball may have expanded over time with new migrants and local Woodland groups adding to existing house rows or starting new rows as they arrived.

Increasing House Size

The new chronology and existing archaeological evidence demonstrate that while Middle Missouri house size generally increases over time, greater variability in house size also occurs (compare Lensink 2005:133-135 to Mitchell 2013:220; see also Winham and Calabrese 1998:287). Although generally larger than earlier houses, the average house size at Cattle Oiler Late (70 m²) and Shermer (158 m²) demonstrate variability between villages (Table 5.1). The range of house sizes within a single village varied from relatively uniform (Bendish standard deviation is 4.9) to highly variable (Shermer standard deviation is 71.1). Notably, multiple villages established during the course of migration fall well below the average for earlier houses in the south. For instance, the mean at Sommers (98.3 m²; calculated from Lensink 2005:Table 7.4) is far larger than Cross Ranch (68.1 m²).

Variability of inter- and intra-village house size suggests that while residential structures grew, possibly to accommodate multi or extended family households, this growth was not evenly distributed, even within the same village. Mitchell (2013:195-196) uses ethnohistoric evidence of house size variability among the Mandan to suggest that the disparity in house sizes with later Middle Missouri villages is evidence of wealth accumulation. However, among these later Middle Missouri villages, there is less evidence of exchange/prestige goods or intervillage conflict that accompanied wealth accumulation among the later Mandan. If there was inequality between households,

perhaps it was achieved through ceremony and ceremonial rites associated with plazas and ceremonial lodges. Hosting feasts and ceremonies was sometimes an alternate route to status and wealth accumulation among the Mandan (Bowers 1991).

Since there is no evidence of wealth accumulation among new villages in the north, an alternative explanation is that reorganization among household memberships and house groups occurred as people migrated north, aggregated into new and larger villages, and integrated with local groups. Tiffany (2007:11) suggests that the overall increase in house size may indicate a need to accommodate multi- or extended-family households. As people chose to abandon their homes and villages to start a new life in the north, a restructuring of household membership may have occurred. As Middle Missouri migrants and Woodland locals began to integrate, shifts in kinship and corporate group membership/residence would likely have occurred. The new, larger houses may be evidence of shifts in post-marriage locality or kinship practices among some households. Larger, extended family residences like those found in later villages often coincide with matrilocal residences among middle-range societies (Ember 1973; Ensor 2013:64-67). Similarly, the larger houses may have been attempts to form extended or multifamily households as a risk-mitigation strategy in a new landscape with larger village populations.

Regardless of the reasons for increasing house size, it appears that a certain amount of autonomy in residence at the household level occurs during the processes of migration out of the south and aggregation in the Cannonball subregion. This phenomenon is not uncommon during population aggregations (Birch and Williamson 2018:93). The migration and subsequent aggregation in new landscapes and village communities necessarily require negotiations between social units at various levels that lead to a restructuring of both space, group memberships, and social interactions (Birch

2013). These can include anything from everyday practices related to scheduling and resource use to memberships in corporate and ceremonial groups (Kowalewski 2006). All of this is inherent in what Cobb (2005) refers to as “placemaking.”

The Spread of Plazas and Ceremonial Lodges

According to the new chronology, plazas and adjacent ceremonial lodges become more common among villages up and down the Trench during migration. As with the size of aggregated villages and their constituent households, patterns associated with plazas and ceremonial lodges vary spatially and temporally. Not all Middle Missouri villages contain these two elements. The occurrence of plazas and ceremonial lodges are rare among pre-migration villages. Later, during the migration, people incorporated these structural elements into their village layouts at small and large northern and southern villages.

Of the 21 villages dated in this study, nine villages do not have adequate excavation or documentation to determine the presence/absence of plazas, one village does not contain evidence of a plaza, and 11 villages have plazas or likely plazas (Table 5.1). Mitchell (2013:218) presents a similar distribution of settlement data with ~50% of Extended variant villages containing documented or probable plazas.

Among the larger villages located in the Cannonball subregion (e.g., Havens and South Cannonball), migrants from multiple southern villages and Woodland locals would be (re)forming networks of social bonds with their new neighbors in these villages as they worked to produce a sense of place within their new landscape (*sensu* Cobb 2005). This requires integrative practices and institutions that help to establish and reify social ties. A community’s recognition of shared and highly visible spaces that they actively maintain and use for public interactions can be a strong integrative mechanism (e.g.,

Birch 2013; Rautman 2000; Rapoport 1994; Rodning 2013). These highly visible spaces promote community integration through participation in shared institutions and public face-to-face interactions (Holland-Lulewicz et al. 2020). Ceremonial lodges and plazas were key elements of life among the Mandan for public ceremonies such as the Okipa (Bowers 1991; Lowie 1917). The deliberate incorporation and utilization of such structures in villages during the migration north would have brought together migrants and locals.

Although plazas and ceremonial lodges occur among the large, aggregated villages in the Cannonball subregion, some smaller villages also have evidence of these practices. Clark's Creek is a smaller village on the northern fringe of Middle Missouri settlement distribution with a plaza (Mitchell 2013:390; Figure 2.2). This village is one of the earliest northern migrant villages and displays no signs of being a large, multi-village aggregation site in terms of size or location. The lack of evidence for aggregation at Clark's Creek suggests smaller villages with plazas may have utilized the public displays and interactions associated with them as a tool to integrate primarily with the local Woodland groups rather than large aggregations of migrants arriving from the south. The Late Woodland village of Flaming Arrow is much closer to the village cluster associated with Clark's Creek (in the Knife subregion) than any other village cluster.

Temporally, plazas and ceremonial lodges become common during migration out of the south. However, the new chronology also demonstrates the possible use of plazas and adjacent lodges as early as the mid-to-late twelfth century at Sommers, prior to the beginning of the migration. As discussed, Sommers is larger than other contemporaneous villages established prior to the migration and it contains evidence of at least one possible plaza and ceremonial lodge (Figure 2.6). The new chronology suggests that Sommers was likely a short-lived village (0–30 yrs, 68% probability),

suggesting the village was the site of a rapid aggregation of individuals from other villages, pre-migration. The construction of plazas and ceremonial lodges among these groups may have begun here in an attempt to integrate disparate groups from multiple villages.

At one of the latest northern villages dated in this study (Huff village) the practice of building house rows with plazas and ceremonial lodges appears to have become more standardized. At this short-lived village (0–25, 68% probability), houses are in noticeably straighter rows, and the village's plaza and adjacent ceremonial lodge are central to the village layout (Ahler 2000; Wood 1967). The village was also fortified with a bastioned palisade and ditch. Unlike earlier aggregation villages where new migrants and locals may have added households and house clusters to villages over time (e.g., Havens, Helb, Bendish), the borders or surrounding fortifications at Huff appear to have been pre-planned.

The construction and use of plazas and ceremonial lodges that began at Sommers became more common among communities well into later periods, regardless of village size. The inhabitants of Sommers began historical precedent for integration that began the practice of integrating larger, rapidly aggregating populations. This precedent may have been a historical referent in the social memories of migrants, one that migrants and locals were able to reinterpret under these new circumstances and utilize to bring people together into new social formations. The reinterpretation and implementation of such practices can be vital for new groups aggregating into growing villages, especially if they are actively integrating with local societies (Clark et al. 2019).

Migrant-Local Relations in the North (Putting the Pieces Together)

From the evidence above, it appears the process of integration proved to be the beginning of a transformational period for migrants and locals in the north. During this period, an observable shift in several practices occurred at the household and village levels. Migrants arriving in the north abandoned practices associated with intervillage warfare, possibly due to a decline in exchange networks to the south. Population aggregation at villages in the Cannonball subregion occurred as Middle Missouri migrants and Woodland locals began living together. People also developed practices related to community integration as village populations increased and household memberships diversified. Overall, these changes may have worked to discourage intervillage warfare and conflict between migrants and locals.

In these changes are the conditions discussed in the introduction chapter that may contribute to less contentious interactions and greater migrant-local integration. These conditions include migration scale, specialized knowledge, a lack of social distance, inclusive institutions, and decreased opportunities for sanctioned violence. Below, each condition is identified and related to the evidence above.

The scale of the migration north was a multigenerational process that began relatively small in scale. Early migrant villages like Clark's Creek and Jake White Bull established in the early-to-mid-thirteenth century were small (~1.5–2 ha) and comprised a dozen or so households (Table 5.1). These early villages were also established over 100 hundred miles apart (Figure 2.2). The small scale and geographic distance between the first migrant villages may not have been seen as an imposing threat or strain on resources by local groups. It was only after the abandonment of the Woodland villages of Menoken and Flaming Arrow and the establishment of later villages like Vanderbilt

and Havens in the mid-to-late thirteenth century that the village growth and aggregation observed in the Cannonball region occurred (Figure 4.2).

By the early-to-mid-thirteenth century, both migrants and locals had preexisting relationships they could utilize to reduce tensions as both groups came into more sustained contact. Frequent interactions owing to previous exchanges involving Knife River Flint would have produced networks of relationships involving known exchange partners and possibly kinship ties. When Middle Missouri groups migrated north, they would have had access to these preexisting relationships. Knife River Flint was still frequently used among these newly forming migrant-local communities. Locals' specialized knowledge of where to procure this material may have strengthened relations even more. The long history of interaction between these people and specialized knowledge among locals would have facilitated interaction and contributed to decreasing social distance.

The spread of plazas and ceremonial lodges among many newly formed northern villages would have been another avenue for decreasing tensions between migrants and locals as they were brought into more sustained contact. The employment of public and communal rituals would have helped to produce a greater sense of shared space and community identity that would have aided in integrating Middle Missouri migrants (likely from multiple southern villages) and local Woodland groups. These practices may have acted to reinforce heterarchical ideologies, placing migrants and locals at similar social and political levels and creating fewer opportunities for competitive interactions that could lead to violence. After all, migrant shifts away from previous practices (competitive exchange and intervillage warfare) that had lasted generations may have required the (re)assertion of practices contributing to community building and integration among new groups of coresidents.

The spread of plazas and the breakdown of north-south exchange networks would also have reduced incentives and opportunities for participation in collective violence. Establishing new community-focused practices related to plazas and ceremonial lodges would have also provided ways for individuals to achieve or increase status without participating in collective violence. Among the later Mandan, leading and hosting public ceremonies significantly increased one's status (Bowers 1991).

During integration, domestic life was also in flux, signaled by a broadening of household and village memberships. The broadening of these memberships and preexisting relationships may have also prompted more intervillage connections. As newcomers arrived in a village, they might have sought broader networks of mutual support within and outside their new villages to mitigate personal and household risk. Broader intervillage networks would have also decreased opportunities for intervillage warfare, as the number of individuals considered as acceptable to attack diminished.

Many of the factors identified in the introductory chapter that support chances for less tenuous and more integrative interactions between migrants and locals were present among both the Middle Missouri migrants and local Woodland groups with which they came into contact. The results of the chronology show that warfare did not overlap with migration in the north and support the conclusion that these factors contributed to more peaceful relations. The smaller initial migration among widely-spaced villages, familiarity with locals with beneficial skills, community-centered inclusive institutions, and fewer incentives/opportunities for social or political mobility through sanctioned violence acted to decrease social distance relatively quickly and peacefully.

Overall, Middle Missouri migrants may have begun to migrate north to buffer themselves from the edge effects of the turbulent continental mega-drought and associated large-scale population movements to their south (Chapters 2 and 4). It

appears that this resulted in integration with local Woodland groups, large aggregated villages, and less intervillage warfare. As the previous exchange networks contributing to intervillage competition and warfare diminished, newer integrative practices and inclusive ideologies emerged among locals and migrants. This integration was also a regional process, as the social changes discussed above appear to have occurred across nearly all later Middle Missouri villages.

The lack of warfare between the mid-thirteenth and early-fourteenth centuries may have been tenuous. After a few generations, intervillage conflict appears to increase in the Cannonball and Bad-Cheyenne subregions. Newly forming east-west long-distance exchange networks may have contributed to increasing competition, violent interactions, and new pretenses to raid another village. The latter landscape is similar to the highly competitive, intervillage competition for trade and exchange networks that predates migration and, once reestablished, lasts until post-European contact (Mitchell 2007; 2018).

The Arrival of Migrants in the South and the Occurrence of War

Unlike the northern Missouri River Trench, the new chronology demonstrates that migration and warfare overlap meaningfully in the south. There is also little evidence that Coalescent (the migrants) and Middle Missouri villagers (now the locals) attempted to integrate. Alongside evidence of warfare and simultaneous lack of integration, many of the conditions facilitating peaceful interactions were not present between migrants and locals in the south. The new chronology and existing archaeological evidence suggest that as migrants arrived in the south, initial attempts at peaceful interaction and possible integration were attempted at least one village (Sully School). However, overall, migrants and locals had limited interactions. Multiple conditions related to a growing number of

migrants, their increasing visibility on the landscape, and possibly incongruent ideologies related to village life acted to maintain a measure of social distance between these two groups. These external conditions and a long tradition of war among local groups ultimately contributed to a situation in which at least two migrant villages were attacked in substantial raids (Whistling Elk and Crow Creek).

Early Migrant-Local Relations

In the late thirteenth century, Coalescent villagers from the Central Plains migrated into the south as Middle Missouri villagers were abandoning the area (Figure 4.2). Both the chronology and archaeological evidence suggest that the arrival of these newcomers began with a relatively small number of people taking up residence among local Middle Missouri hosts. Burmeister suggests that the initial arrival of migrants into a region is often small, with newcomers seeking coresidence among locals with whom they already have established relationships (2000). The initial arrival of migrants appears to have begun at the fortified village of Sully School as early as the mid-to-late thirteenth century. Although previously considered two separate occupations, the new chronology demonstrates that Sully School was a single-occupation village with simultaneous Middle Missouri and Coalescent occupants (see Chapter 4). The likelihood that these first migrants may have had previous relationships with their local hosts is supported by evidence of interaction between Middle Missouri and Coalescent groups farther south, in Nebraska (e.g., Gover et al. 2021:223). Sully School was occupied for multiple generations, at least until the establishment of Black Partizan Early in the mid-fourteenth century (Figure 5.3). However, it is unclear whether migrants lived in the village the entire duration of its occupation.

The inference that early migrant groups may have had previous relationships with locals does not mean that migrants entered a region where all locals welcomed them. These newcomers were entering a landscape in flux as some locals were migrating north, and those still residing in the south appear to have maintained their long, if intermittent, history of intervillage warfare at fortified villages like Stony Point and Jiggs Thompson. Similarly, the fortifications at Sully School indicate the possibility of tensions between the locals hosting these newcomers and members of other Middle Missouri villages.

A Rise in Migration

The new chronology also shows us that a generation or two after Sully School was founded, during the end of the thirteenth century drought (Chapter 4), the first distinctly migrant communities were founded in the Big Bend at Whistling Elk and Crow Creek Late (Figure 5.3). This is followed by the establishment of a third large Coalescent village, Black Partizan, during or just prior to the late fourteenth century drought. The establishment and growth of these villages would have significantly contributed to the visibility of distinctly migrant communities in the area, which could have contributed to possible resentment among some locals.

Crow Creek Late was likely founded in the late thirteenth century, a generation (maybe two) after Sully School. Located 100 feet above the adjacent floodplain, Crow Creek Late commanded a prominent, highly visible, and defensible point on the landscape (Bamforth and Nepstad-Thornberry 2007a:157; Haug 1986; Kivett and Jensen 1974). The full size of the village is unknown due to erosion into Wolf Creek. At its height, Crow Creek Late not only held a commanding view of the surrounding landscape at over 7.3 hectares in size and with more than 50 house depressions, it was

one of the largest, if not the largest, village in the south. The outer palisade spanned over 1200 feet with at least 10 evenly spaced bastions. The outer fortification ditch was between 15 and 50 feet wide and 6-to-12 feet deep (Kivett and Jensen 1974).

Although the migration of the first Middle Missouri households may have been a relatively discreet event, the establishment of large, fortified villages like Crow Creek Late at prominent locations on the Missouri River would not have gone unnoticed by the local population. The establishment of new and distinctly migrant villages signals an increase in the scale of migration and visible persistence of these newcomers' practices on the landscape. Some locals may have seen this increase in scale and visibility as disruptive (*sensu* Anthony 1990; Baker and Tsuda 2015).

Integration and Interaction

Aside from initial attempts at Sully School, there is little evidence of integration between migrants and locals in the southern area. The chronology and archaeological data verify that separate local and migrant practices persisted through the fourteenth and fifteenth centuries. A distinctly Coalescent way of living only became more visible with the increase in migration and establishment of independent migrant villages. There are multiple reasons why separate migrant and local practices might have persisted, including incongruent ideologies related to village life or that members from one or both groups were simply unwilling to integrate.

That both Coalescent and Middle Missouri groups originated from different ancestral and geographic backgrounds likely contributed to fewer mutually recognizable ideologies and practices (Caldwell and Henning 1978:133; Lehmer 1954:159, 1971:115, 120, 127; Ludwickson 1979:57; Mitchell 2013; Spaulding 1956:109; Strong 1940:382; Wood and Irwin 2001; Zimmerman and Bradley 1993:224). How Coalescent and Middle

Missouri groups organized their villages signals different ideological views on day-to-day interactions and overall village living (see Chapter 2). The persistence of greater dispersion and clustering house groups among migrant households (even in the early fortified villages), as opposed to the more structured and densely packed irregular house rows of locals, suggests these groups likely held incongruent and perhaps even irreconcilable views of how everyday life and interactions in a village should be conducted. Such views were likely not conducive to coresidence within the same village.

There is limited evidence of inclusive institutions and migrant-local interactions in the south. The Middle Missouri village of Durkin contained a plaza and ceremonial lodge, while Alberts Creek contained a possible plaza (Table 5.1). The Coalescent village of Whistling Elk contained a large, central/ceremonial lodge (Toom and Kvamme 2002). As noted in Chapter 2, there is also limited ceramic evidence of interaction between migrants and locals before and during migration (see also Bamforth and Nepstad-Thornberry 2007b; Caldwell 1966b:84; Gover 2021:223). Some villagers in the south utilized public spaces that would have facilitated integration within their own communities or between communities. However, this is evident in only a few villages. Likewise, the limited evidence for substantial migrant-local interactions within any southern village assemblages (except perhaps Sully School) makes it unclear whether these migrants and locals ever used public spaces to facilitate interactions.

The above narrative suggests a decline in migrant-local interactions after initial attempts at coresidence at Sully School. After Sully School, the establishment and persistence of distinct migrant villages containing little evidence of interaction with locals indicate that a reasonable amount of social distance existed between these groups throughout the fourteenth and fifteenth centuries. This distance may have been partly maintained due to a lack of historical interactions and incongruent ideologies about

village life that prevented the establishment of meaningful intervillage ties (e.g., marriages, kinship ties, exchange partners). Perhaps, even if migrants and locals wished to integrate, the structure of daily life and interpersonal interactions within each group may have been so dissimilar that integration was never attainable without active commitments to comprehensive social restructuring and compromise.

New Enemies: Migrant-Local Violence in the South

Based on the spatiotemporal distribution of village fortifications, migrant-local violence likely began shortly after the establishment of the first migrant villages in the early fourteenth century. This violence appears to have persisted until the abandonment of the last Middle Missouri village in the south. During Coalescent migration, the question of with *whom to war* among Middle Missouri locals apparently shifted to incorporate the rising number of migrant communities in the south. Whether all Middle Missouri villages participated in this violence is unclear.

The new chronology demonstrates that Coalescent groups typically only fortified their villages when they resided alongside Middle Missouri groups in the south (Figure 4.2). Prior to migration into the Big Bend, Coalescent groups and their Central Plains ancestors had few examples of fortification building (Chapter 2, see also Johnson 1998; Roper 2006:120). Coalescent migrants only abandoned this practice after the last Middle Missouri groups migrated out of the south (Figure 5.4). Evidence that Crow Creek Late (the earliest migrant village in this study) was not initially fortified suggests that village attacks may not have been anticipated by migrants in the earliest stages of migration (Bamforth and Nepstad-Thornberry 2007a). However, the chronology demonstrates that all Coalescent villages were fortified from the time Whistling Elk was burned and rapidly abandoned (likely the mid-thirteenth century) until the abandonment of the last Middle

Missouri village in the south (Indian Creek Early) in the late fifteenth century. This fortification pattern does not significantly overlap with the thirteenth or late fourteenth century droughts (Chapter 4). This evidence suggests that migrant decisions to aggregate and fortify, a new practice among these people, reflected uncertainty about the intentions of their new Middle Missouri neighbors.

Similarly, regional fortification patterns of Middle Missouri villages after Coalescent arrival show that warfare was more common where migrants and locals were closest to one another. During Coalescent migration in the late thirteenth and early fourteenth centuries, fortifications among Middle Missouri villages occur primarily in the south (Figure 4.2). During this period, Jake White Bull and possibly Helb are the only fortified villages in the north. This further supports the notion that at least some warfare in the south occurred between migrants and locals.

The distribution of fortified contemporaneous Middle Missouri and Coalescent villages also supports the likelihood of migrant-local warfare. The new chronology points to possible buffer zones between Coalescent and fortified Middle Missouri villages. While the Coalescent villages of Black Partizan, Crow Creek Late, and Whistling Elk were occupied, most contemporaneous southern Middle Missouri villages were clustered in the Bad-Cheyenne locality, over 30 miles upstream (Figure 5.5). These villages were also fortified. The geographic gap between migrant and fortified local villages is part of a buffer zone identified by Clark, who also proposes possible tensions between Coalescent and Middle Missouri groups (2018:315).

It should be noted here that Whistling Elk's relationship to two unfortified Middle Missouri villages makes it unclear whether all southern Middle Missouri villages participated in anti-migrant violence. As the new chronology demonstrates, two Middle Missouri villages (Cattle Oiler Late and Durkin) were occupied in the fourteenth century,

at the same time as the earliest Coalescent villages (Whistling Elk, Crow Creek, and possibly Black Partizan Early)(Figure 5.6). Cattle Oiler Late and Durkin were neither fortified nor in a recognizable buffer zone separating themselves from Coalescent villages. In fact, both villages were virtually directly across the Missouri River from Whistling Elk and may have been established and abandoned at similar times (Figure 5.7). Durkin also has limited ceramic evidence of interaction with Coalescent groups (Bamforth and Nepstad-Thornberry 2007b:Table 11.3).

The cooccurrence of two unfortified Middle Missouri villages just across the river from a Coalescent village may be evidence that not all locals distanced themselves from the newcomers. The possible simultaneous abandonment of all three (Figure 5.6) may also signal a point when migrant-local relations further deteriorate. Both Durkin and Whistling Elk have some evidence of abandonment due to warfare. Although Durkin was not fortified, four out of five excavated houses were burned (the fifth house was inconclusive; Johnson 1977:72-81). The Middle Missouri village of Cattle Oiler Late contained no evidence of warfare (i.e., fortifications, burning, or human remains with evidence of violent trauma) (Jones 1969). However, only one house from Cattle Oiler Late was excavated. It is unclear what occurred in the northern Big Bend in the early-to-mid-fourteenth century. Among the villages in this study, only two Middle Missouri villages (Cattle Oiler Late and Durkin) and one Coalescent village (Whistling Elk) occupied the northern Big Bend during the early-to-mid-fourteenth century. Two out of these three villages had some evidence of village attacks.

The evidence for an attack at Whistling Elk and a possible attack at Durkin may have resulted from migrant-local conflict as the northern and southern extents of each group's settlement distribution overlapped in the northern Big Bend. The chronology shows us that in the early-to-mid-fourteenth century, Whistling Elk was the northernmost

migrant village and Durkin the most southern Middle Missouri village. Alternatively, an attack on Durkin signaled that Middle Missouri villagers in the Bad-Cheyenne subregion saw locals living beside and interacting with migrants as targets of attack just as much as migrants themselves. As mentioned, there is little evidence of Coalescent groups participating in warfare before or after migration, so they may not have been the aggressors. A final possibility is that the violence could be evidence of a deterioration in relations between previously peaceful migrant and local communities. The mixed migrant-local village of Sully School also appears to have been abandoned at this time.

Migrant-Local Relations in the South (Putting the Pieces Together)

The discussion above suggests that as migration increased in the south, early attempts at integration between locals and migrants failed, and warfare between these groups was likely. This section argues that external relationships between migrants and locals, as well as an internal tradition of war among Middle Missouri locals, contributed to a lack of integration and migrant-local violence. Using this information, an interpretation of what contributed to the Crow Creek massacre is then presented.

After initial attempts at coresidence at Sully School, it is apparent that efforts to integrate were abandoned, and independent migrant villages at Crow Creek Late and Whistling Elk were founded. Few historical (pre-migration) interactions existed between Middle Missouri locals and Coalescent migrants in the south (Chapter 2). This is unlike Middle Missouri migrants and Woodland locals in the north, who could have utilized previous relationships related to the exchange of Knife River Flint to interact. In the south, neither Middle Missouri locals nor Coalescent migrants possessed specialized knowledge that would have been desirable to the other, and they lacked previous social ties that would have contributed to familiarity between these groups. It is also apparent

that Middle Missouri migrants and Coalescent locals held unique and possibly contradictory ideologies related to daily life and interactions. This may have made coresidence and even frequent interactions between separate villages challenging. A lack of historical relationships and distinct ideologies could have decreased possibilities and reasons for interactions between migrants and locals, resulting in fewer social and political ties. Fewer crosscutting ties would have acted to preserve social distance between these groups, ultimately contributing to the persistence of separate identities. Limited interactions and the resulting persistence of separate identities would have increased opportunities for misunderstandings and violent interactions that would contribute to mistrust, territoriality, and contentious relations. If this was the case, the rise in migration and its visibility on the landscape (e.g., the large and highly visible Crow Creek Late) may have led some locals to see the arrival of migrants as disruptive and unwanted.

Simultaneously, a tradition of war likely existed within Middle Missouri society (Chapter 2). Middle Missouri locals participated in competitive, extra-regional exchange networks that underwrote much of the warfare prior to Coalescent migration (Mitchell 2013, 2018; Tiffany 2007). During this period, the sanctioning of collective violence against members of other villages likely went hand-in-hand with a competitive environment within villages where individuals obtained social and political status through combat. When these longstanding networks broke down, they may have restricted some justifications to sanction violence, thus limiting opportunities for social and political mobility.

Together, these external and internal conditions may have contributed to sanctioned attacks on migrants. For Middle Missouri locals, reasons to justify war with the newcomers would have likely compounded with the increasing number and visibility

of migrant communities as well as every misunderstanding, faux pas, or threat (real and perceived). The resulting animosity may have been used to justify attacks on migrants, while individual pursuit of social status through war would have further incentivized participation in those attacks. The breakdown in competitive exchange that provided opportunities to increase status would have also contributed to participation. Ultimately, contentious external interactions between migrants and locals, as well as an internal tradition of war among Middle Missouri locals, generated a landscape of increasing anti-migrant violence in the southern Missouri Trench during the fourteenth century.

What Happened at Crow Creek?

Crow Creek Late is the site of the largest known pre-European contact massacre in North America (Figure 5.8). The scale of the attack suggests an attempted erasure of the entire village population (Bamforth and Nepstad-Thornberry 2007a). Since the discovery of over 486 individuals with evidence of violent deaths and post-mortem mutilation, multiple studies have discussed this site and the apparent massacre (Bamforth 2007a; Gregg et al. 1981; Gregg and Zimmerman 1981; Haug 1986; Kendell 2018; Owsley 1994; Willey 1982, 1990, 2018; Willey and Emerson 1993; Zimmerman and Bradley 1993; Zimmerman et al. 1981). The most informative works discussing the cultural and osteological aspects of the massacre can be found in Bamforth and Nepstad-Thornberry (2007a) and Willey and Emmerson (1993), while Willey's (2018) newest insights into the massacre may enhance the interpretations of the prior two studies.

The attack on Crow Creek Late may have occurred while the outer fortifications were being constructed or repaired (Bamforth and Nepstad-Thornberry 2007a; Kivett and Jensen 1974). Evidence for violence consists of structure fires as well as the human remains recovered from the village's external fortification ditch and within the village

proper (Bamforth and Nepstad-Thornberry 2007a; Kivett and Jensen 1974; Willey 2018; Willey and Emerson 1993). Among the evidence of skeletal trauma, at least one-fourth of all victims were decapitated, 95% were scalped, and numerous others have evidence of mutilation, including hand and foot removal (Willey 1990, 2018; Willey and Emerson 1993). The amount of destruction and post-mortem alteration to remains within the village is extensive enough to suggest the attackers remained in the village after the initial attack ended (Willey 2018).

What precipitated violence of this scale and who orchestrated the attack are questions multiple archaeologists have attempted to answer (e.g., Bamforth 2006; Bamforth and Nepstad-Thornberry 2007a; Zimmerman and Bradley 1993). Just before abandoning the region in the mid-to-late fourteenth century, Crow Creek may have been a significant target for attack by locals. The internal and external conditions discussed above suggest that tensions between migrants and locals increased over time. That the residents of Crow Creek were actively building or repairing fortifications at the time of the attack supports the idea that migrants were aware of possible increasing tensions between themselves and local groups. The chronology and archaeological evidence also suggest that by this time, large, well-defended, and distinctly migrant villages had become more numerous and visible on the landscape. Crow Creek Late was the largest, earliest, longest occupied, and arguably most visible migrant village on the landscape in the fourteenth century (Figure 4.2; Bamforth and Nepstad-Thornberry 2007a). The persistence of this distinctive migrant village would likely have been well-known among migrant groups. The village served as a destination for many migrants entering the region. During periods of conflict, it may even have been seen as a sign of migrant perseverance and identity within a sometimes-hostile landscape. The prominence of Crow Creek Late also means that similar views of the village's importance and

persistence would have also stood out in the minds of locals who increasingly saw migrants as possible enemies.

A single incident or the pursuit of individual status was likely not the only reason for the massacre. Common justifications sanctioning intervillage violence like murder, kidnapping, or intrusion into a perceived territory or buffer zone may have provided a proximate cause for the attack. Likewise, individual incentives related to status would have been present among the attackers of Crow Creek Late. There is ample evidence of trophy-taking (Willey 2018; Willey and Emerson 1993). However, the scale of violence and the number of attackers required suggests that the reason for this unprecedented attack had deeper origins. The animosity toward Crow Creek Late appears to have transcended the interests of members of multiple villages. The necessary size of the attacking party would have required the participation of members from multiple other villages. The population of Crow Creek (over 50 houses and at least 500 individuals) was larger than any known contemporaneous village in the south (Table 5.1) (Bamforth and Nepstad-Thornberry 2007a; Zimmerman and Bradley 1993). The thoroughness and scale of the violence (i.e., prevalence of post-mortem mutilation and total number of dead) also suggest the attack may have been directed toward the destruction of the entire population. Thus, the existence of Crow Creek itself seemed to be a serious problem for multiple other villages.

It is not unreasonable to assume from the evidence provided in this chapter that at times of heightened migrant-local tensions, Middle Missouri locals from multiple villages came together to justify a coordinated attack on Crow Creek Late. They may have discussed specific indiscretions or threats (real or perceived) by Coalescent migrants. These justifications, coupled with processes of dehumanizing/villainizing outsiders and the potential for personal gain that exist within longstanding traditions of

war would likely have incentivized numerous volunteers. If locals intended to send a grim message to their migrant neighbors, the attempted erasure of the oldest, largest, and most visible migrant village would likely accomplish that task. If the limited evidence suggesting the attack occurred in the mid-to-late fourteenth century is accurate (Chapter 4), it may have occurred as the last Middle Missouri villages were abandoning the south.

Conclusion

It is clear from the case studies discussed above that people residing in the Missouri River Trench between the thirteenth and sixteenth centuries navigated the migrant paradox in two very different ways. In the northern case study, Middle Missouri groups began immigrating into the area as early as the mid-thirteenth century. These migrants integrated with local Woodland groups quickly with little evidence of violence. In the southern case study, migrant-local tensions increased through time, possibly reaching a crescendo in the mid-to-late-fourteenth. The earliest migrant groups lived alongside locals in at least one instance (Sully School). Shortly after the establishment of the first distinctly migrant villages, evidence of intervillage violence occurs where migrant and local settlement distributions overlap in the northern Big Bend subregion (i.e., Cattle Oiler Late, Durkin, and Whistling Elk) (Figure 5.7). By the mid-to-late fourteenth century, migrant-local tensions had risen to a point where Middle Missouri locals from multiple villages organized and attempted to erase the migrant population at Crow Creek Late. However, as local groups migrated out of the south in the mid-to-late fourteenth century, tensions subsided and warfare was less common as migrant groups abandoned the practice of building fortifications and went back to living in unfortified, dispersed settlements.

The conditions identified in the introductory chapter were relevant to these two histories of migration, integration, and violence. The scale of migrations likely affected relations between migrants and locals in the south. As social distance persisted between migrants and locals, an increasing number of highly visible migrant communities may have contributed to animosity between the two groups. Also, the destination conditions where migrants arrived were factors in the northern and southern migrations. In the north, a lower density of Woodland villages may have contributed to less territoriality and more peaceful interactions between migrants and locals. In the south, a preexisting landscape of intervillage war existed, and the arrival of migrants may have broadened avenues for prestige and status among locals. Drought periods may correlate with the movement of people on the landscape; however, their association with war is less clear.

While scale, destination conditions, and drought may have played roles in the outcomes of the case studies, what affected migrant-local interactions most were factors associated with familiarity, communication, and incentives to interact. In the north, Middle Missouri migrants and Woodland locals participated in longstanding exchange networks that would have generated preexisting relationships and likely resulted in some shared practices and ideologies. These conditions would have been valuable to daily interactions and communication. The utilization of public plazas and ceremonial lodges would have incorporated inclusive practices and ideologies that contributed to shared identities. Ultimately, these conditions created broader networks of relationships between migrants and locals, decreased social distance, and promoted shared identities. A different process occurred in the south. Coalescent migrants and Middle Missouri locals appear to have lacked extensive preexisting relationships or valued specialized knowledge to aid in interactions during migration. Similarly, these groups did not share many of the same practices and ideologies. Without other incentives for

peaceful interaction, these conditions would have restricted some interactions between migrants and locals. This would have resulted in fewer crosscutting relationships between these groups. Continued misunderstandings, threats, and improprieties (perceived or real) due to a lack of interactions and social distance may have compounded through time, creating more opportunities for violent interactions.

Although migrant-local interactions in the south likely contributed to warfare, internal factors also played a significant part. As mentioned, contentious interactions do not dictate that violence or war will occur. We must also consider ways in which each group viewed collective violence as a form of communication and how sanctioned forms of collective violence are incentivized and embedded within a community (Chapter 1). Prior to migrant arrival, a decline in competitive exchange networks occurred. These longstanding exchange networks underwrote much of the region's warfare before migrant arrival. The decline in competition for the flow of goods would have restricted the ability of individuals and households to increase their status through exchange and war. While the existence of specialized local knowledge regarding Knife River Flint and alternate routes of status accumulation through participation in public ceremonies may have limited incentives to go to war among northern Middle Missouri villages, these conditions did not exist in the south. It is not hard to imagine a landscape in which contentious relations with migrants in the south and a tradition of war allowed Middle Missouri locals to quickly (and frequently) sanction war against migrant communities that were growing in both number and visibility.

Chapter 5 Tables

Table 5.1: Extended Middle Missouri villages with available spatial data. Data compiled from Bamforth and Nepstad-Thornberry 2007b:Table 11.2; Lensink 2005:Table 7.4; Mitchell 2013:Tables A3 and A4; Wood 1967:Table 2.

Site Number	Site Name	Fortification	Plaza	Central Lodge	House number	Mean Floor Area (m ²)	SD for Mean House (m ²)	Site Area (ha)
39ST1	Cheyenne River	Yes	N?	ND	33	ND	ND	2+
39AR8	Alberts Creek	Yes	Y?	ND	15+	ND	ND	2.8+
39ST15	Indian Creek Early	Yes	ND	ND	ND	ND	ND	2.8+
39ST223	Ketchen	No	Y	Y?	12	88	14.4	1.4
39ST238	Durkin	No	Y	Y	15	119	7.3	2.1
39ST224	Cattle Oiler Late	No	ND	ND	ND	70	(only 1 house)	ND
32OL14	Cross Ranch	No	ND	ND	11+	68	8.7	1.3
39CO6	Jake White Bull	Yes	ND	ND	11	ND	ND	1.6
39CA1	Vanderbilt	No	Y	ND	22+	ND	ND	3.5
32SI4	Paul Brave	No	Y?	ND	14	120	21	1.5
32EM1	Havens	No	Y?	Y	56+	110	12.5	5.9
32SI19	South Cannonball	No	Y	ND	40	110	28.7	6.5
32MO2	Bendish	No	Y	Y?	45	109	4.9	6.2
39CA208	Helb	Yes	ND	ND	40	76	9.2	1.3+
32EM10	Shermer	Yes	Y	Y	79	158	71.1	3.8
32MO291	N/A	ND	ND	ND	ND	ND	ND	ND
32MO11	Huff	Yes	Y	Y	116	106	28.6	4.4
39DW231	Calamity Village	Yes	ND	ND	ND	87	(only 1 house)	4.1
39CO213	Travis I	No	ND	ND	ND	ND	ND	ND
32ME1	Clark's Creek	No	Y	ND	14	ND	ND	2
32ME7	White Buffalo Robe	No	ND	ND	ND	ND	ND	ND

Chapter 5 Figures

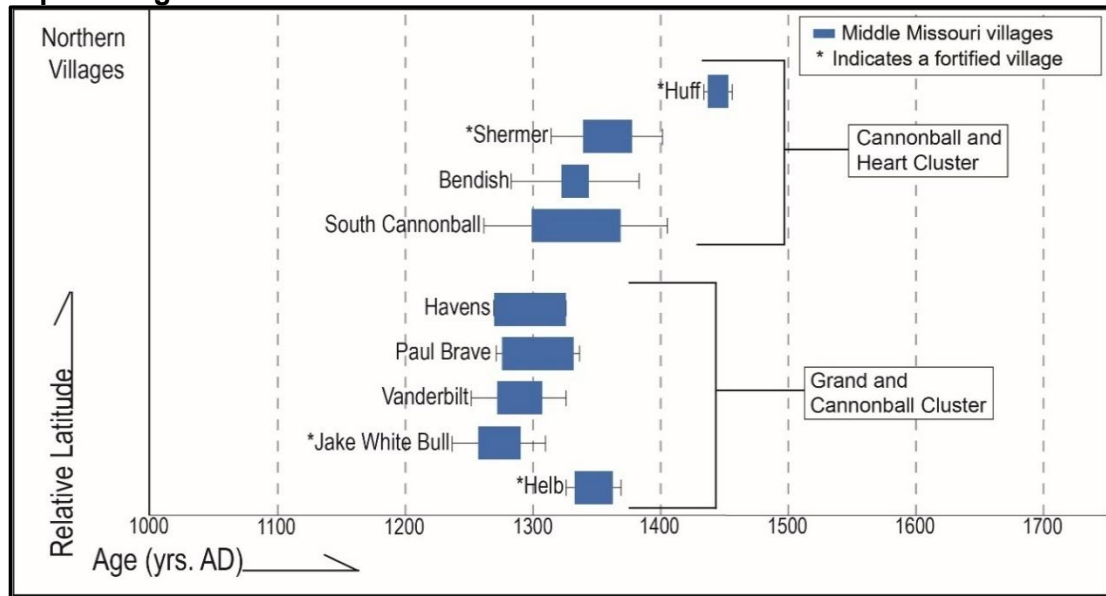


Figure 5.1: Occupational durations of village clusters in the Cannonball subregion. These villages are typically larger and show greater temporal overlap. All ranges are reported at 68% probability.

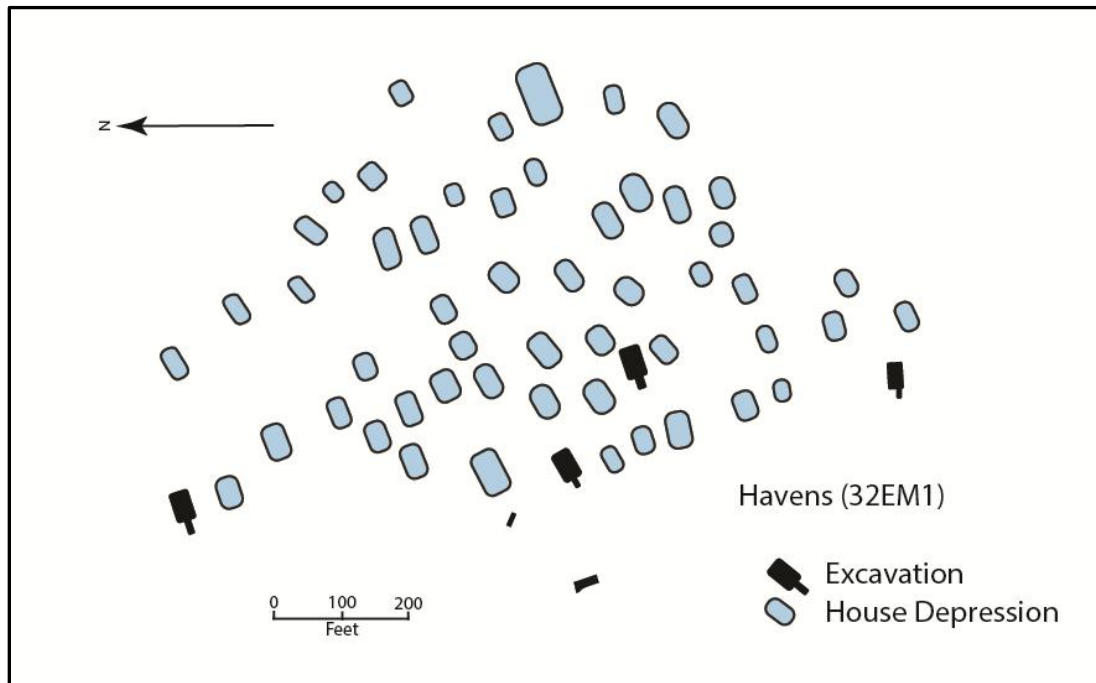


Figure 5.2: Havens village is an example of the larger Middle Missouri villages found in the Cannonball subregion. The size and number of irregular rows suggest these villages may have grown over time as more migrants entered the region.

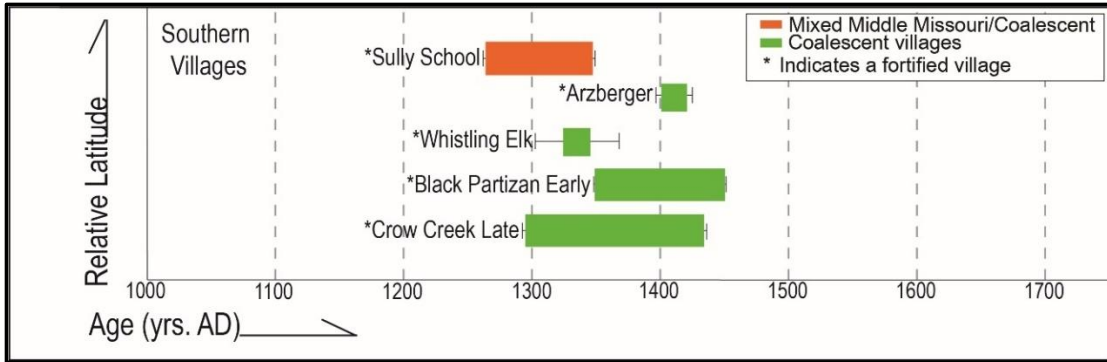


Figure 5.3: Initial Coalescent migration. The new chronology demonstrates that initial migration of Coalescent groups began small, at the mixed Middle Missouri-Coalescent village of Sully School. It is not until later that the first distinct Coalescent villages are founded in the Big Bend subregion to the south. All ranges are reported at 68% probability.

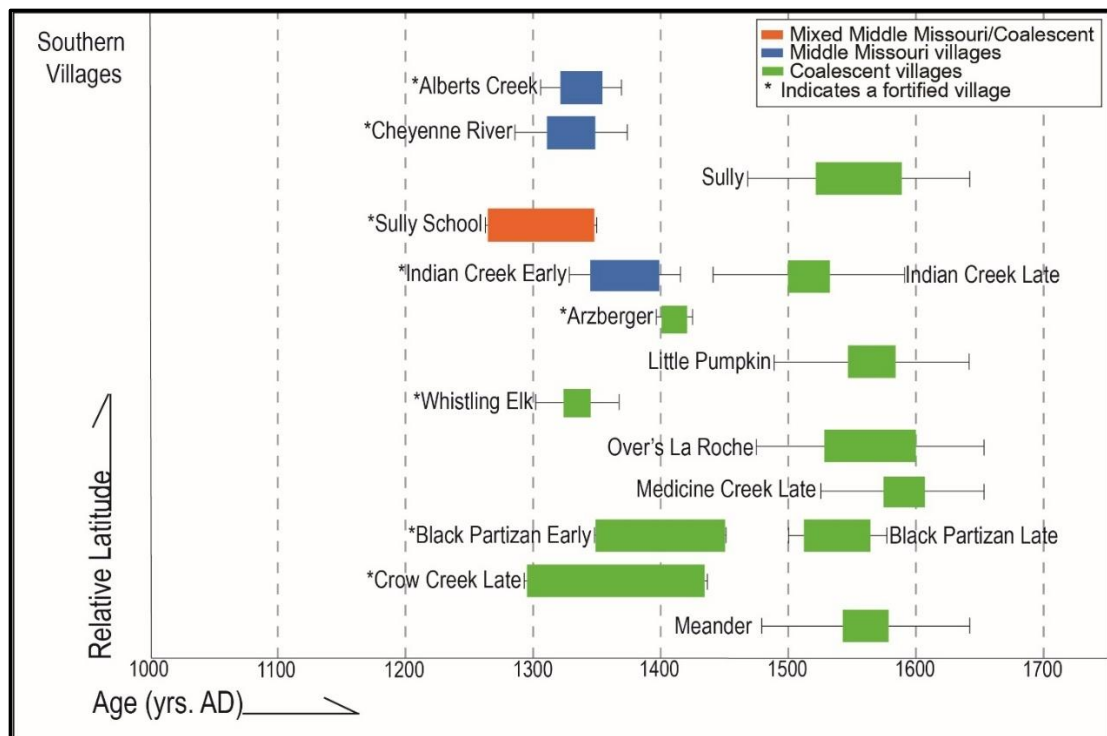


Figure 5.4: All Coalescent villages dated in this study. The chronology shows that the first migrant villages were fortified. It is not until the abandonment of the south by the last Middle Missouri village (Indian Creek) that Coalescent migrants abandoned the practice of building fortified villages. All ranges are reported at 68% probability.

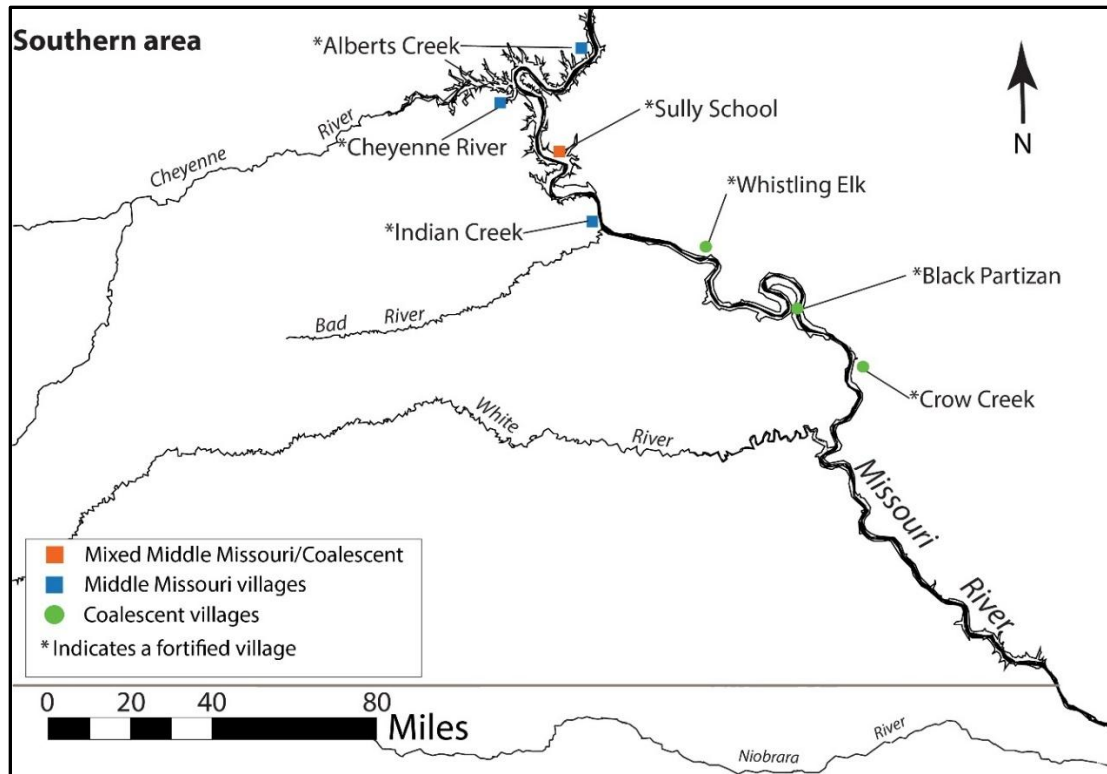


Figure 5.5: Map depicting fortified villages simultaneously occupied in the south during the fourteenth century. There is a distinct gap between Middle Missouri and Coalescent villages.

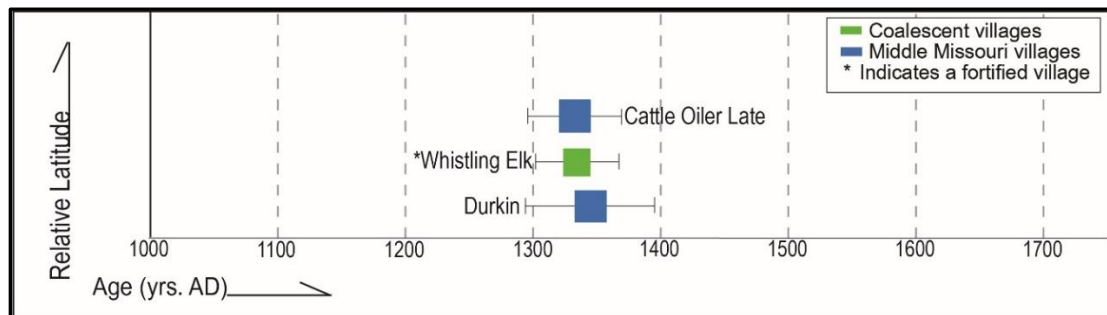


Figure 5.6: Contemporaneity of Cattle Oiler, Whistling Elk, and Durkin. Although Cattle Oiler and Durkin were the closest Middle Missouri villages to and Coalescent village, neither Middle Missouri village was fortified. This suggests that at least some Middle Missouri locals did not fear attack from nearby Coalescent groups. All ranges are reported at 68% probability.

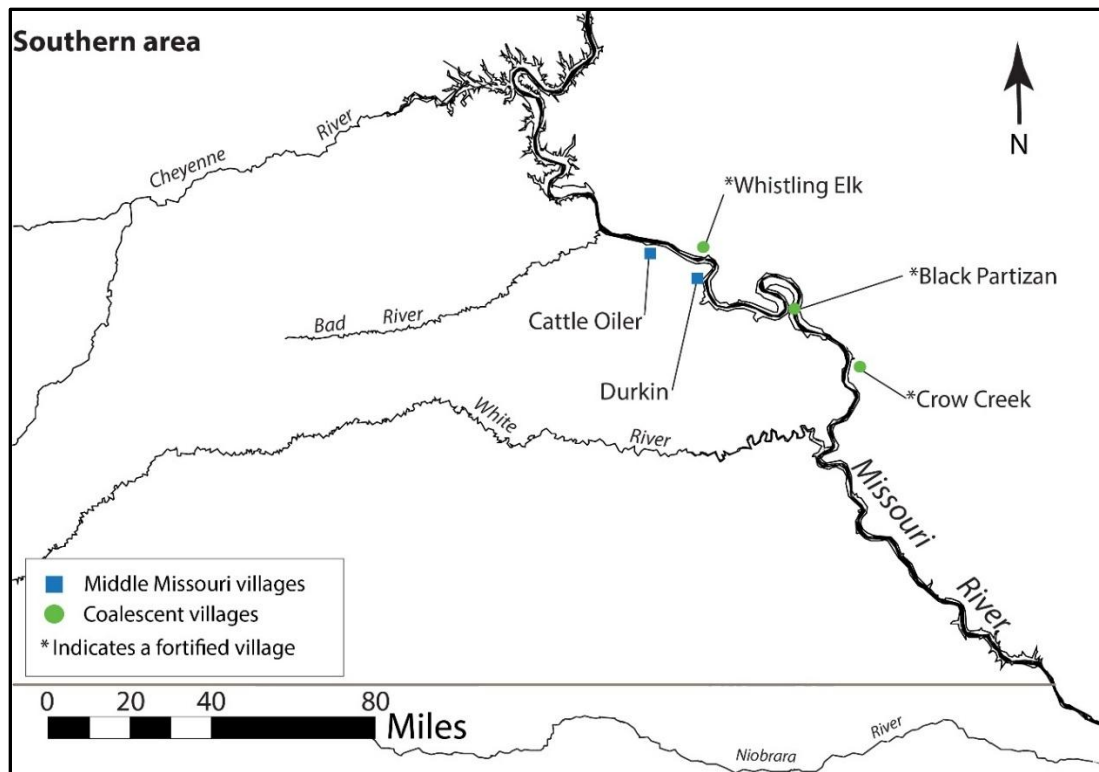


Figure 5.7: Map depicting the closest contemporaneous Middle Missouri villages to any Coalescent villages through the fourteenth century. That neither Cattle Oiler nor Durkin were fortified suggests they may not have feared attack by Coalescent villages of superior sizes and populations.

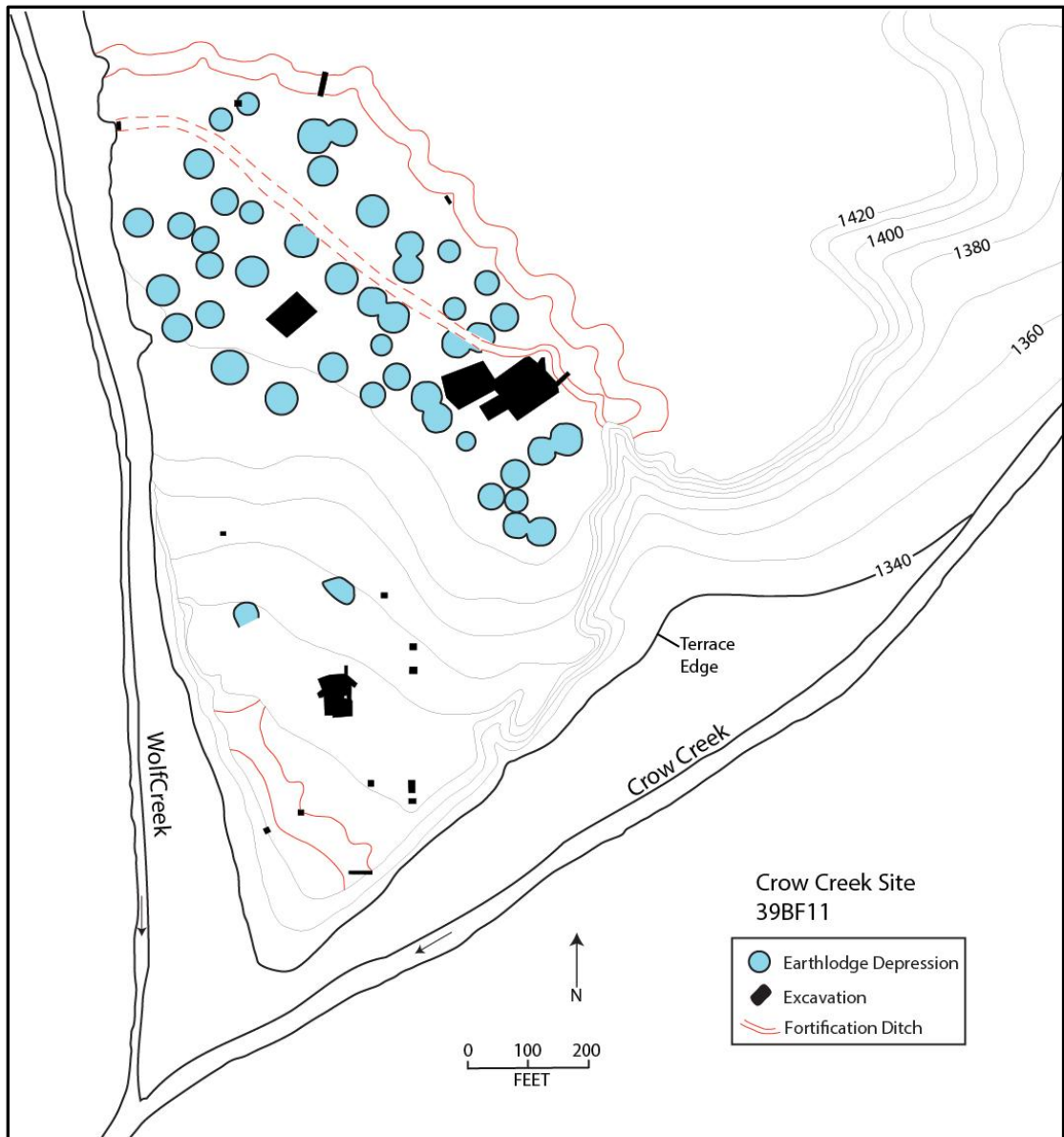


Figure 5.8: Plan view of the Crow Creek site (adapted from Kivett and Jensen 1974:Figure 1)

CHAPTER 6

CONCLUSIONS

This study incorporated a new, high-resolution radiocarbon chronology of village occupations and existing archaeological information to understand how warfare and migration influenced the landscape of middle-range village societies in the Missouri River Trench of the North American Plains between the thirteenth and sixteenth centuries AD. Despite decades of research, previous regional chronologies—based predominantly on ceramic sequences, limited numbers of radiocarbon dates, and wedded to taxonomic, culture-historical constructs—lack the temporal resolution required to establish historical relationships between migration and warfare. The new chronology and factors related to the directionality of warfare and migrant-local interactions contribute to understanding *how* war and migration were related during this period.

The goal of understanding the intersection of migration and warfare was accomplished in two parts. First, the study posed five chronological questions related to migration and warfare among two distinct indigenous societies associated with the Middle Missouri and Coalescent archaeological traditions. To answer these questions, Bayesian chronological models were generated by incorporating new and legacy radiocarbon dates to produce estimates of individual village occupations (Appendices B, C, and D). Data on village occupations were then compiled to produce a high-resolution regional chronology encompassing the eleventh to sixteenth centuries AD (Figure 4.2). The timing and temporality of villages associated with events of migration and warfare were then used to answer the five research questions.

Next, the answers to the research questions, as well as existing archaeological information, were then used to craft a multiscale, narrative-driven history that contextualized the intersection of migration and warfare between the thirteenth and sixteenth centuries. During this investigation, it became apparent that multiple preconditions—including droughts, migrations, social distance, and longstanding traditions of war—intersected at various points in time and space to contribute to intervillage warfare both among and between Middle Missouri and Coalescent Tradition villagers.

Below is a brief description of how well this study accomplished its intended purpose. A discussion of the project's broader regional, methodological, and theoretical contributions follows this. Last, a brief discussion of future research directions is offered, considering work that would strengthen the original research questions and looking ahead toward productive research avenues that would strengthen the regional archaeological narrative outside this project's scope.

Research Questions and Expectations

Question 1: Does Middle Missouri migration into the northern areas of the Trench coincide with evidence for violence?

The new chronology adequately answered question 1. During the initial migration of Middle Missouri groups into the northern Missouri River Trench, there is little evidence of warfare. Of the earliest villages established in the north (often referred to as Extended Middle Missouri villages), only Jake White Bull was fortified. The practice of building fortifications only becomes commonplace in the north generations later, in mid-fourteenth century. The increase in war (or the threat thereof) may have been related to the establishment of new long-distance, competitive exchange networks to the east and

west. This would have also been enough time for newly arriving migrants from villages in the south to integrate with Woodland villagers and establish a new sense of place, space, and territoriality (*sensu* Cobb 2005).

It is evident that groups began immigrating into the area as early as the mid-thirteenth century with the establishment of Travis I and Clark's Creek (Figure 4.2). As these groups arrived, they appeared to have quickly integrated with existing Woodland groups.

Question 2: Does the adoption of integrative practices (that would help to create inclusive ideologies) cooccur with the migration north?

The new chronology adequately answered this question. The new chronology shows that the first implementation of integrative practices such as village plazas and ceremonial lodges did not occur with the emergence of the first Extended Middle Missouri villages (as has been suggested) or the Middle Missouri migration out of the south. The first evidence of plazas and ceremonial lodges occurs at a southern aggregation site named Sommers Village (Figure 2.6), which was occupied slightly before the first Extended variant villages were founded and the migration north began (Figure 4.2). However, the use of plazas and ceremonial lodges does not become widespread until Middle Missouri groups begin resettling in the north. This suggests that, although the development of these integrative practices occurred earlier, they were undoubtedly used by migrants and locals in the north. Later groups in the north may have utilized the integrative practices and inclusive ideologies that developed at Sommers during integration with local Woodland groups.

Question 3: Does Coalescent migration occur while some Middle Missouri groups still occupy the southern extent of the study region?

The new chronology answered Question 3 the most unequivocally of all the questions posited in this study. It is clear that both Middle Missouri locals and Coalescent migrants occupied the southern Missouri River Trench simultaneously (Figure 4.2). Perhaps the most surprising revelation from the new chronology was that Coalescent groups likely migrated in small numbers and lived with Middle Missouri locals before establishing distinctively Coalescent villages. Previously believed to have separate Middle Missouri and Coalescent occupations, the new chronology demonstrated that the fortified village of Sully School may have been a mixed, migrant-local village that occurred as early as the mid-thirteenth century. This suggests that at least some locals welcomed early migrants and even attempted to live together. This was a long-lived village, though it is not clear if both groups cohabited there the entire length of the village's occupation.

Later, in the terminal thirteenth or early fourteenth centuries the establishment of distinctly-migrant villages occurs at Crow Creek Late and Whistling Elk (Figure 4.2). All early migrant villages were fortified, but fortified and unfortified Middle Missouri villages occurred in the south during and after Coalescent migration into the area. Interestingly, the Middle Missouri villages (Durkin and Cattle Oiler Late) closest to any contemporaneous Coalescent village (Whistling Elk) were unfortified, while those Middle Missouri villages further upriver were fortified. Durkin has limited evidence of interactions with Coalescent villagers (Bamforth and Nepstad-Thornberry 2007b). This suggests that while some locals may have been distancing themselves from the arrival of an increasing number of migrants, others (e.g., the villagers at Durkin) continued interacting with the newcomers into the mid-fourteenth century. The attack and subsequent rapid

abandonment of Whistling Elk and the possible attack on Durkin may signal deterioration in relations between migrants and locals in the south. If the massacre at Crow Creek did occur in the mid-to-late fourteenth century (see Chapter 5), then this massive attack may have been a final break in relations between locals and migrants in the south.

Question 4: Do Coalescent groups abandon the practice of building fortifications after Middle Missouri groups leave the area?

The new chronology did answer Question 4, but the temporal resolution is less than desirable. It is clear that Coalescent groups stopped building fortifications and moved back to previous practices of living in dispersed villages as early as the mid-fifteenth century (Figure 4.2). This transition occurs after the final abandonment of the south by Middle Missouri in the late fourteenth or early thirteenth centuries. However, the chronology includes only a portion of the total number of later Coalescent villages. Furthermore, those later Coalescent villages that are dated are based on a limited number of radiocarbon dates. The lack of an adequate number of dates creates possible occupational durations much longer than the archaeological evidence suggests. Due to these issues, there is a significant temporal gap in the abandonment of the last Middle Missouri villages in the south and the establishment of unfortified Coalescent villages.

Question 5: Does evidence for intervillage warfare and/or migration among either Middle Missouri or Coalescent groups coincide with evidence for climatic shifts like drought cycles?

Whether the new chronology adequately answered Question 5 is somewhat vague. Evidence suggests drought occurred throughout the thirteenth to sixteenth centuries (Cook et al. 2016; Trabert and Hollenback 2021:91, 118). Drought does

correlate with the Middle Missouri and Coalescent migrations. The beginning of Middle Missouri migration north in the thirteenth century coincided with periods of major drought. These droughts may have been more severe in the southern portion of the Trench (Cook et al. 2016:Figures 2 and 3). The initial migration of Coalescent groups coincides with drought in the Northern and Central Plains.

Correlations between drought and violence are less clear. As demonstrated by the chronology, the migration north of Middle Missouri groups does coincide with drought, but the arrival of groups in the north lacks evidence of intervillage violence. The decision later to begin fortifying villages in the north coincided with a major drought in the Northern Plains in the mid-fourteenth century. However, according to Cook and colleagues (2016:Figure 3), this drought did not severely affect the Missouri River Trench as much as the surrounding areas. The attacks at Whistling Elk and possibly Durkin in the south do not coincide with a major drought cycle in the region. The possibility of drought during the attack on Crow Creek Late remains unresolved.

A New Narrative for War and Migration in the Missouri Trench

The history of village occupations in the Missouri River Trench from the thirteenth to the sixteenth centuries is one of multiple migrations, dynamic social change, and frequent instances of war (or the threat thereof). This is underwritten by a complex interplay of social, political, economic, and sometimes environmental factors. Warfare in the region was not necessarily the product of territorial encroachments by different sociocultural groups or the direct results of drought and population pressure. Although conditions like drought may have contributed to some conflicts, participation in warfare itself was deeply embedded within the social structures and daily practices of southern Middle Missouri locals and would have affected choices to go to war. Ultimately, external

factors related to historical interactions between migrants and locals, as well as the internal development of integrative practices among migrants in the north, would provide the groundwork for peaceful interaction and integration. Meanwhile, in the south, incongruent ideologies contributing to few migrant-local interactions produced growing enmity between migrants and locals. This simultaneously provided locals with new opportunities for social and political mobility through war with migrant groups, producing a landscape of increasing migrant-local violence.

Control of exchange networks and strategic alliances between Middle Missouri villages may have shaped the earlier sociopolitical landscape of the south (*sensu* Mitchell 2018). As these people interacted with Woodland groups to the north to secure Knife River Flint, the lithic material flowed down through early villages as exchange goods flowed up from the south (Ahler 2007; Johnson 2019). From these interactions, competitive exchange networks evolved, and members of villages competed or cooperated to gain access to and control over these goods and networks in the north and south. The patchwork pattern of fortified and unfortified early Middle Missouri villages through time, shown by the chronology, supports this narrative.

The mass redistribution of North American populations in association with continent-wide droughts of the mid-to-late thirteenth century (Bamforth 2006; Benson et al. 2009; Cobb & Butler 2002; Cobb et al. 2023; Krus & Cobb 2018; Meeks & Anderson 2013; Trabert and Hollenback 2021:91, 118; Williams 1983, 1990) likely disrupted north-south exchange networks. This would have simultaneously restricted opportunities for social, political, and economic gain through exchange and war. The decline in north-south trade coincided with the migration of many Middle Missouri villagers north. From the results of the chronology, it now appears more likely that the establishment of villages in the north was not the result of independent formation of an 'Extended Middle

Missouri' population in the north and their subsequent migration south (e.g., Ahler 2007; Caldwell 1966b; Lehmer and Caldwell 1966; Tiffany 2007; Toom 1992b), but a situation where multiple changes were occurring in the south and as many of these groups migrated north they came into contact with and integrated with Woodland groups. While the Extended variant villages in the north likely represent the integration of Middle Missouri and Woodland villagers, the Extended variant villages in the south were occupied by the same groups who had always lived in the south. The idea of an Extended Middle Missouri variant representing a completely socioculturally different people is more complex than that. This brings into question the utility of taxonomic "variants" when discussing villagers of the region.

The evolution of Middle Missouri communities, for example the adoption of plazas and ceremonial lodges as well as village growth and aggregation, reflect significant shifts in community integration and social dynamics that were occurring as groups migrated north and integrated with local populations. It appears that conflict between villages waned as Middle Missouri groups resettled in the north. The lack of evidence for village raids or fortifications at the time suggests that Middle Missouri and Woodland groups were able to resolve the "migrant paradox" (Clark et al. 2019). For the migrants and locals in the north, a long history of interactions involving Knife River Flint that would have created networks of cooperation and kinship may have contributed to the ability of both groups to engage with integrative practices and inclusive ideologies, thus reducing misunderstandings and sources of possible contention.

With an increasing number and visibility of Coalescent migrants in the south throughout the fourteenth century (Figure 4.2), the directionality and proximate causes for war may have shifted from competition for dwindling north-south exchange networks between Middle Missouri villages to animosity toward newcomers that were building

large, highly visible villages in the Big Bend. Social distance, the persistence of incongruent ideologies, and a tradition of war among Middle Missouri locals may have contributed to increasing violence that ultimately culminated in the massacre of the migrant village of Crow Creek.

The new chronology also demonstrates that a previous lack of war among northern villages later reverts to a more violent landscape by the mid-fourteenth century. This new, more competitive northern landscape resembles earlier Middle Missouri villages in the south and later villages in the Heart and Knife localities (*sensu* Mitchell 2007, 2018). Shortly after this sociopolitical shift in the north, Coalescent groups in the south began to experience a time of relative peace as the last southern Middle Missouri villages were abandoned, and Coalescent groups ended the practice of fortifying villages, opting for their pre-migration practices of building dispersed villages and possibly farmsteads.

Significance

This research emphasizes the complexity of human behavior over time, demonstrating how methodological approaches that combine radiocarbon dating and Bayesian chronological modeling can refine our understanding of the temporal subtleties of cultural interactions and transformations while highlighting the importance of precision in reconstructing past human actions and behaviors. In this study, the use of Bayesian chronological modeling demonstrates the importance of a detailed, chronologically precise understanding of past events that comprise the multigenerational processes of migration, conflict, and social integration. At a broader scale, the significance of this research lies in its historical and multiscale approach to understanding the interplay between social dynamics and human agency in relation to migrant-local interactions.

Using Bayesian chronological modeling to produce more detailed frameworks of past human activities represents a significant methodological contribution to advancing historical understandings by moving from chronicle to narrative (Bayliss and Whittle 2019; Whittle 2018). As this study demonstrates, the investigation of generational changes in settlement patterns, such as the spread of plazas or village aggregations, offers insights into the processes of community integration and the development of social practices among middle-range villagers. These findings, in turn, emphasize the fluid nature of social organization and the importance of shared spaces and practices in fostering community cohesion.

At the regional level, this study builds on generations of previous work in the Missouri River Trench by testing and incorporating the observations of archaeologists, both past and current (Ahler and Kay 2007; Bamforth 2006, 2021; Caldwell 1966a; Clark 2018; Johnson 2007a; Lehmer 1971; Mitchell 2007, 2013, 2018; Roper and Pauls 2005; Toom 1992a; Trabert and Hollenback 2021; Wood 1974, 1998). The study makes several key contributions to the archaeology of the region. These contributions include refining the region's settlement chronology between the eleventh and sixteenth centuries, often within generational timescales (Figure 4.2). The increased resolution allows for a more precise placement of the timing and sequence of important historical events and processes. Identifying patterns like the timing and directionality of conflict through the identification of contemporaneous village types (Middle Missouri/Coalescent, fortified/unfortified) was not possible prior to this study. Combined with concepts of historical narrative and emplotment, the more precise temporal placement or ordering of these events allows for the detailed narrative of war, migration, and social change provided in Chapters 4 and 5. This new narrative expands our understanding of the processes that shaped the lives of Middle Missouri and Coalescent Tradition villagers by

emphasizing the complexity of human relationships and the variability in social responses to migration and intervillage competition.

The relevance of this study reaches beyond the culture history of war and migration in the Missouri River Trench. Exploring the relationship between migration and conflict is highly relevant in the context of the twenty-first century. In an era when large populations of people throughout the world are being displaced at ever-growing numbers (UNHCR 2024), it is essential to understand the dynamics of interaction between diverse social groups to address the rise of collective violence. The geopolitical conflicts of the late twentieth and early twenty-first centuries across regions like Africa, Eastern Europe, the Middle East, and South America illustrate the profound impacts of warfare and migration on individuals, communities, and societies (Agier et al. 2002; Can 2017; Hermenau et al. 2013; Knudsen et al. 2013; Knudsen and Hanafi 2010; Kononov 2024; Kronfeld 2008; Peteet 2010; Rellstab and Scholte 2015; Toal and Dahlman 2011). Currently, as global conflicts and the threats of war escalate, migrant and refugee crises are also intensifying (UNHCR 2024). In the United States, misleading narratives in the media and on social platforms are contributing to a rise in anti-migrant and anti-minority violence (Conzo et al. 2021; Medel-Herrero et al. 2021). Similar dynamics are evident internationally, where the resurgence of harsh political rhetoric aims to vilify and dehumanize migrants and refugees (Kim 2024; Noury and Roland 2020).

This study merely touches on these complex and contentious issues. The case studies discussed here focus on pre-modern, non-state societies not influenced by contemporary global media, economies, geopolitical dynamics, or military-industrial frameworks. Nonetheless, if we recognize that many core motivations prompting individuals to fight or flee remain consistent across sedentary societies with territorial awareness and engagement in regional sociopolitical and economic interactions, the

archaeological record offers a valuable resource (*sensu* Clark et al. 2019; Cobb 2005). This research seeks to contribute to broader discussions about the significance of both internal and external conditions, as well as historical context, in understanding interactions between migrant and local populations. The decision to migrate to these societies often stems from uneven sociopolitical and economic factors (Anthony 1990; Clark 2001; Clark et al. 2019). Similarly, the motivations for engaging in warfare can range from basic self-defense against external threats to fulfilling obligations, as well as seeking prestige and economic gain (i.e., social, economic, and political objectives) (Fearon and Laitin 2000; Glowacki et al. 2016; Haas 1996; Keeley 1996; Otterbein 2009; Roscoe 2008). Broader frameworks for understanding war that consider political and economic ties among these societies suggest that competition and cooperation coexist and that collective violence can serve as a form of communication akin to trade and exchange (Blyth 2012; Brooks 2002; Dye 2009; Haas 1996).

Chapter 5 explicitly provides two detailed case studies that explore how socially distinct groups navigate migrant-local relations through the “migrant paradox” (Clark et al. 2019). It illustrates how migration can lead to complex patterns of conflict and cooperation, challenging assumptions about the inevitability of conflict between socially distant groups occupying the same landscape (Kay 1996; Lehmer 1971) and highlighting the role of social strategies and institutions in mediating intergroup dynamics. By detailing the transitions in social organization, settlement patterns, and the directionality of conflict through time, the chapter also contributes to broader anthropological debates about the nature of social complexity. Likewise, analysis of the directionality of warfare and the dual internal and external conditions that must be present to lead to war contributes to anthropological understanding of collective violence and conflict. It moves beyond viewing warfare solely as a response to resource scarcity by emphasizing the

importance of social structures, individual agency, and historical context in shaping the occurrence and nature of conflict. The chapter also challenges narratives of cultural evolution by showing how changes in social practices are contingent upon a variety of factors, including environmental conditions, intergroup relations, and internal social dynamics. Overall, this work's broader anthropological and archaeological significance lies in examining migration, conflict, social change, and the construction of place and identity among residents of newly aggregated communities.

In summation, the argument I make above is that over the course of the fourteenth century, external conditions related to social distance, migration scale, and visibility contributed to tensions that would have provided socially sanctioned opportunities for war. Simultaneously, the breakdown in competitive exchange networks restricted avenues for social and political mobility among Middle Missouri locals. This would have further contributed to the use of these tensions as proximal opportunities for justifying and sanctioning war against migrants. These two processes ultimately contributed to a shift in the directionality of warfare in the southern Missouri Trench. Regardless of the proximal causes for violence against migrant communities, a tradition of war existed in Middle Missouri societies that, without substantial alternatives for social mobility, incentivized individuals to organize and produce collective violence. Unlike Middle Missouri and Woodland groups in the north that were aggregating, reorganizing, and engaging with more inclusive institutions that could have simultaneously provided opportunities for social mobility, southern Middle Missouri villagers perhaps lacked (or simply chose not to engage with) these alternatives.

Future Directions

Bridging Research Paradigms

The historical approach and absolute chronology presented in this dissertation serves as a bridge between previous culture-historical framings and more contemporary research agendas. This study was able to utilize useful elements of concepts previously developed through culture-historical paradigms (i.e., archaeological traditions) to develop a high-resolution chronology of village occupations. Instead of using taxonomic nomenclature to assign these archaeological traditions to broad, static time periods presenting step-wise patterns of change, the approach allowed for a more dynamic and process-oriented view of the past. As a result, this study not only documents specific historical events (village establishments, abandonments, raids) and longer-term processes (migration and paths to war) but also provides a template for analyzing how similar processes might manifest in other places, in both historic and contemporary contexts. This study will further allow researchers in the region to break away from reliance on static archaeological cultures bound to broad/relative time periods, and move toward discussing permeable social groups made up of individuals creating their own histories through practices that they (re)shape and (re)interpret through time.

Improving Chronology and Narrative

Multiple decisions early on in the sampling and modeling phases of this study produced unanticipated outcomes. Most of these issues derived from the use of animal bone as primary material for dating. Focusing on a material that is abundant at virtually all village sites in the Missouri Trench enabled me to incorporate more contexts/villages. However, this choice impacted the study in the following ways: First, the decision to focus on bison bone as a primary focus for dating may have produced a slight offset in

the modeling results. As the ratios of carbon used to measure a date are in fact a time average of an animal's date since death and incorporation in the archaeological record, these dates may be slightly earlier (~0–10 years) than dates from short-lived botanicals. Second, a number of dates derived from animal bone were rejected because they were hundreds of years different from other dates associated with the same village. Some of these dates were even reported as modern. When reviewing their contexts, it was apparent that these samples came from deposits with looser matrices such as hearths and storage pits. This suggests that there could be far more instances of bioturbation (likely rodent burrowing) within village contexts than is reported in field notes and reports. For this reason, future sampling should focus primarily on large bone samples that are less likely to be subject to bioturbation. Third, much of the modified bone from these sites have been treated with stabilizing compounds. These compounds are often biological and can contaminate bone. If the proper solvent(s) are not used during the pretreatment process this contamination will produce inaccurate dates. The contamination was not discovered until after many samples from multiple village sites had been collected for dating. Because of this, numerous contexts from multiple sites could not be dated as the contamination was found and the samples were never dated. Where possible, future research should be conducted comparing the dates on bone to recently produced dates on other materials such as short-lived botanicals from contexts similar to those from which bison bone was sampled. It is important to understand the dynamics of dating animal bone in this region as in many cases it is the only available material to date.

Another way of improving the chronology is simply supplementing some village occupations with more dates. Some of these villages will be hard to supplement with an adequate number of dates. Villages, like Travis I, are completely inundated. Even when

incorporating animal bone into the datable materials for a site, some villages like Alberts Creek may not have the materials to date without further excavation. As mentioned above, other villages have collections where a significant number of artifacts were treated with chemicals to stabilize the materials or avoid insect infestation (e.g., Crow Creek and Arzberger). However, Fourier Transform Infrared (FTIR) spectroscopy may help with identifying the polymers present and solvents required to remove contamination and successfully date some of these materials (D'Elia et al. 2007). This would greatly increase the number of datable contexts from multiple village sites, including Crow Creek. For those villages eligible for more dating, the occupational durations may increase with more dates.

Specific chronological research could also supplement the questions posed by this study. Although each of the research questions were answered to varying degrees, further chronological work could be done to clarify some of the vagaries left within these questions. To supplement Question 1, a more detailed chronology for the emergence of Extended Middle Missouri villages, including a larger number of dates for Ketchen, Travis I, and Clark's Creek, would help to better identify which Extended variant villages were established first. Questions 3 and 4, regarding the initial migration of Coalescent villagers and the later abandonment of fortified villages, could be supplemented by dating Talking Crow, the Initial Coalescent village with datable material that was not dated by this study. Understanding the temporality of Talking Crow could push the migration of Initial Coalescent groups earlier in time. Alternatively, if Talking Crow dates after Black Partizan Early, it could show that fortified, Initial Coalescent villages were not fully abandoned until later than this chronology shows. Another way in which chronological studies could better supplement Question 3 would be to gain better chronological control over the occupation(s) for the mixed Initial Middle Missouri/Initial

Coalescent village of Medicine Creek Early. It is unclear if the Middle Missouri and Coalescent Tradition components from this site date to the same period or some type of post-depositional (re)mixing occurred at the site. Question 4 could also be supplemented by producing more dates for the Extended Coalescent villages dated in this study as well as dating other, undated Extended variant villages. There are hundreds of Extended Coalescent villages in the region, and only nine were dated in this study. The more Extended Coalescent villages we add to the chronology, the better we can understand exactly when the practice of living in aggregated, fortified villages was abandoned.

Outside of simply improving the chronology, multiple research trajectories would supplement the narrative of war and migration presented here. A better understanding of the north-south and east-west exchange networks Middle Missouri villagers engaged in would help us to better understand the directionality of conflict between and among some villages. Deeper research on house and village sizes for both Middle Missouri and Coalescent villages would better improve our understandings of emerging inequality, shifts in kinship or post-marital locality, or variability in the size/membership of households.

Conclusion

This study demonstrates how new high-resolution chronologies and historical narratives can lead to a deeper understanding of the past. The chronology presented in this study was used to reevaluate historical narratives surrounding interactions between Middle Missouri, Coalescent, and Late/Terminal Woodland groups in the Missouri Trench between the AD thirteenth and sixteenth centuries. This narrative is a story of human resilience, adaptation, and complexity, challenging some traditional interpretations and highlighting the importance of nuanced, evidence-based approaches to history.

There are two main points to take from this study. First, highly resolved temporal resolution is the key to unlocking specific human histories. This should not be a revelation to scholars engaged in historicizing the archaeological record (e.g., Bayliss et al. 2007; Braudel 1980; Ingold 1993; Whittle 2018; Whittle et al. 2011). In this study, understanding the temporal overlap in village occupations significantly contributed to the ability to document when people moved through the landscape and when they participated in war. Without the generational, and sometimes decadal, resolution brought to most villages in this study, it would still be impossible to know the order of specific events and processes, such as whether the Middle Missouri migration into the north coincided with evidence of war. Without the resolution of the new chronology, it would still be unknown if Coalescent migrants and Middle Missouri locals coresided in the southern Trench. Answering simple, scalarly appropriate temporal questions like these enabled this study to address more complex social questions related to migrant-local relationships.

The second point may be more speculative, but it is nonetheless important to understand collective violence and make archaeological endeavors relevant to our current world. Rousseauian and Hobbesian arguments on human violence are tantamount to a geologic peneplain. Collective violence and warfare have always existed among human groups. The archaeological record shows us that the rise of more complex forms of governance or greater social integration among larger groups neither created nor quelled that tendency for violence. Collective violence and, thus, war will continue to exist in human society with or without larger preconditions like social distance, drought, xenophobia, population pressure/resource shortages, or competitive exchange networks. Such preconditions can undoubtedly contribute to proximal reasons/justifications (e.g., revenge or theft) to go to war, but without the social

structures in place that present war as a viable avenue of communication the act of organizing for and participating in collective violence is often not identified as an option. Conversely, war will always exist as a form of communication as long as the historical precedent for going to war, social structures sanctioning war, and personal incentives for participation in war (i.e., Traditions of War) exist within a society.

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Appendix A: Provenience of Each Sample Dated for This Study

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46696	39AR8	Alberts Creek	48.00	F32	Bison Bone	Collagen
46697	39AR8	Alberts Creek	53a	F64	Bison Bone	Collagen
46698	39AR8	Alberts Creek	53b	F124	Bison Bone	Collagen
43159	39HU6	Arzberger	AIII-61	H3, F4	Bison Bone	Collagen
43160	39HU6	Arzberger	AIV-34	H4, F3	Bison Bone	Collagen
43161	39HU6	Arzberger	AII-76	H2, F5	Bison Bone	Collagen
43162	39HU6	Arzberger	H3 Cache	H3, Cache	Bison Bone	Collagen
43163	39HU6	Arzberger	AI-210	H1, F9	Bison Bone	Collagen
43164	39HU6	Arzberger	AI-225	H1, F10	Bison Bone	Collagen
43165	39HU6	Arzberger	AI-229	H1, F10	Bison Bone	Collagen
43166	39HU6	Arzberger	AI-219	H1, F9	Bison Bone	Collagen
32644	32MO2	Bendish	357.00	H3, F3	Tooth Enamel	Bioapatite
32645	32MO2	Bendish	380.00	H3, F4	Bison Bone	Collagen
32646	32MO2	Bendish	418.00	H3, F8	Bison Bone	Collagen
32647	32MO2	Bendish	433.00	H3, F12	Deer Bone	Collagen
32648	32MO2	Bendish	298.00	H3, Floor	Deer Bone	Collagen
32649	32MO2	Bendish	590.00	H3, PH124	Bison Bone	Collagen
32650	32MO2	Bendish	881.00	H6, F28	Bison Bone	Collagen
32651	32MO2	Bendish	924.00	H6, F39	Bison Bone	Collagen
32652	32MO2	Bendish	937.00	H6, PH170	Bison Bone	Collagen
32653	32MO2	Bendish	967.00	H7, 'test'	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
43135	39LM218	Black Partizan	1882.00	XU-8, Floor	Bison Bone	Collagen
43136	39LM218	Black Partizan	809.00	UX-2, F16	Bison Bone	Collagen
43137	39LM218	Black Partizan	1737.00	XU-8, F6	Bison Bone	Collagen
43138	39LM218	Black Partizan	3112.00	XU-11, F18	Bison Bone	Collagen
43139	39LM218	Black Partizan	2805.00	XU-11, F8	Bison Bone	Collagen
43140	39LM218	Black Partizan	2829.00	XU-11, F9	Bison Bone	Collagen
43141	39LM218	Black Partizan	1789.00	XU-8, F7	Bison Bone	Collagen
43142	39LM218	Black Partizan	1720.00	XU-8, F5	Bison Bone	Collagen
43143	39LM218	Black Partizan	2985.00	XU-11, F16	Bison Bone	Collagen
43144	39LM218	Black Partizan	796.00	XU-2, F12	Bison Bone	Collagen
43145	39LM218	Black Partizan	1847.00	XU-8, F10	Bison Bone	Collagen
43146	39LM218	Black Partizan	2958.00	XU-11, F15	Bison Bone	Collagen
43147	39LM218	Black Partizan	2658.00	XU-11, F1	Bison Bone	Collagen
43148	39LM218	Black Partizan	1820.00	XU-8, F7	Bison Bone	Collagen
45838	39DW231	Calamity	F56	F56, Inner Palisade	Wood	Charred
45839	39DW231	Calamity	175.00	F10, Outer Palisade	Wood	Charred
45840	39DW231	Calamity	1085.00	F56, Outer Palisade	Wood	Uncharred
45841	39DW231	Calamity	1065.00	F55, Inner Palisade	Wood	Charred
45842	39DW231	Calamity	788.00	F13, Outer Palisade	Wood	Charred
45843	39DW231	Calamity	772.00	F10, Inner Palisade	Wood	Charred
45844	39DW231	Calamity	789.00	F13, Outer Palisade	Wood	Uncharred
46677	39DW231	Calamity	859.00	F38, Inner Palisade	Bison Bone	Collagen
43101	39ST224	Cattle Oiler	837.00	H7, F27	Bison Bone	Collagen
43102	39ST224	Cattle Oiler	837.00	H7, F27	Bison Bone	Collagen
43183	39ST224	Cattle Oiler	1836.00	F71 Pit outside H3	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
43184	39ST224	Cattle Oiler	2350.00	H1, Floor	Bison Bone	Collagen
43185	39ST224	Cattle Oiler	1128.00	H2, F54	Bison Bone	Collagen
43189	39ST224	Cattle Oiler	1973.00	H3, Floor	Bison Bone	Collagen
43190	39ST224	Cattle Oiler	3466.00	H6, F135	Bison Bone	Collagen
43191	39ST224	Cattle Oiler	1179.00	H2, F55	Bison Bone	Collagen
45192	39ST224	Cattle Oiler	1177.00	H2, F54	Bison Bone	Collagen
45193	39ST224	Cattle Oiler	3287.00	H5, F137	Bison Bone	Collagen
45194	39ST224	Cattle Oiler	3471.00	H6, F145	Bison Bone	Collagen
45195	39ST224	Cattle Oiler	3438.00	H2, Floor F13	Bison Bone	Collagen
45196	39ST224	Cattle Oiler	1157A	H2, F43	Bison Bone	Collagen
45197	39ST224	Cattle Oiler	766.00	H7, F17	Bison Bone	Collagen
45198	39ST224	Cattle Oiler	963.00	H3, F49	Bison Bone	Collagen
45199	39ST224	Cattle Oiler	1356.00	H4, F64	Bison Bone	Collagen
45200	39ST224	Cattle Oiler	1157A	H2, F43	Bison Bone	Collagen
45201	39ST224	Cattle Oiler	2368.00	H1, F88	Bison Bone	Collagen
45202	39ST224	Cattle Oiler	860.00	H7, F32	Bison Bone	Collagen
45203	39ST224	Cattle Oiler	1356.00	H4, F64	Bison Bone	Collagen
45204	39ST224	Cattle Oiler	3162.00	H5, Floor F124	Bison Bone	Collagen
45205	39ST224	Cattle Oiler	814.00	H7, F24	Bison Bone	Collagen
45206	39ST224	Cattle Oiler	3223.00	H5, Floor F124	Bison Bone	Collagen
45207	39ST224	Cattle Oiler	2364.00	H1, F88	Bison Bone	Collagen
45208	39ST224	Cattle Oiler	3438.00	H6, Floor F130	Bison Bone	Collagen
45209	39ST224	Cattle Oiler	766.00	H7, F17	Bison Bone	Collagen
46670	39ST1	Cheyenne River	4565.00	F34	Wood	Uncharred
46678	39ST1	Cheyenne River	3408.00	F34	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46679	39ST1	Cheyenne River	3370.00	F3	Bison Bone	Collagen
46680	39ST1	Cheyenne River	1581.00	F	Bison Bone	Collagen
41522	39BF11	Crow Creek	40799C	House Post	Wood	Charred
43100	39BF11	Crow Creek	40799B	House Post	Wood	Charred
46651	39BF11	Crow Creek	40802B	-	Wood	Charred
46652	39BF11	Crow Creek	40804B	-	Wood	Charred
46654	39BF11	Crow Creek	40814.00	-	Wood	Charred
46655	39BF11	Crow Creek	-	-	Wood	Charred
46656	39BF11	Crow Creek	40804.00	-	Wood	Charred
46657	39BF11	Crow Creek	40798.00	F82	Wood	Uncharred
46658	39BF11	Crow Creek	40800.00	-	Wood	Uncharred
46659	39BF11	Crow Creek	40795.00	-	Wood	Charred
46660	39BF11	Crow Creek	40810B	-	Wood	Uncharred
46661	39BF11	Crow Creek	40795C	-	Wood	Charred
46662	39BF11	Crow Creek	40802.00	-	Wood	Charred
46663	39BF11	Crow Creek	40814.00	-	Wood	Charred
46664	39BF11	Crow Creek	F50	F50	Wood	Charred
46665	39BF11	Crow Creek	40803.00	-	Wood	Charred
46666	39BF11	Crow Creek	40806.00	-	Wood	Uncharred
46709	39BF11	Crow Creek	10275.00	F18, HII	Bison Bone	Collagen
46710	39BF11	Crow Creek	10276.00	F18, HII	Bison Bone	Collagen
46711	39BF11	Crow Creek	10277.00	F18, HII	Bison Bone	Collagen
46712	39BF11	Crow Creek	10331.00	F19, HII	Bison Bone	Collagen
46713	39BF11	Crow Creek	10742.00	F21, HIII	Seed	Charred
46714	39BF11	Crow Creek	11472.00	F23, HII	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46715	39BF11	Crow Creek	13706.00	F44, HII	Bison Bone	Collagen
46716	39BF11	Crow Creek	17411.00	F43, HII	Bison Bone	Collagen
46717	39BF11	Crow Creek	17447.00	F52, HVI	Bison Bone	Collagen
46718	39BF11	Crow Creek	17505.00	F61A, HIII	Bison Bone	Collagen
46719	39BF11	Crow Creek	17504.00	F61, HIII	Bison Bone	Collagen
46720	39BF11	Crow Creek	24790.00	F88, HVI	Bison Bone	Collagen
46721	39BF11	Crow Creek	35129.00	F115, HV	Bison Bone	Collagen
46722	39BF11	Crow Creek	35169.00	F115, HV	Bison Bone	Collagen
46723	39BF11	Crow Creek	36185.00	F133, HIV	Bison Bone	Collagen
46724	39BF11	Crow Creek	38408.00	F180, HV	Bison Bone	Collagen
46725	39BF11	Crow Creek	38705.00	F185 House J	Bison Bone	Collagen
46726	39BF11	Crow Creek	39064.00	F195, HVII	Bison Bone	Collagen
46727	39BF11	Crow Creek	39065.00	F195, HVII	Bison Bone	Collagen
46728	39BF11	Crow Creek	39066.00	F195, HVII	Bison Bone	Collagen
46729	39BF11	Crow Creek	39323.00	F148, HV	Cucurbita	Charred
46731	39BF11	Crow Creek	3633.00	F2, HI	Maize	Charred
46733	39BF11	Crow Creek	5125.00	F2, HI	Bison Bone	Collagen
46734	39BF11	Crow Creek	5976.00	F2, Posthole #29, HI	Bison Bone	Collagen
46735	39BF11	Crow Creek	6030.00	F2, Posthole, HI	Grass	Charred
46736	39BF11	Crow Creek	6398.00	F2, Floor & Below, HI	Bison Bone	Collagen
46737	39BF11	Crow Creek	40128.00	F2, Floor, HI	Bison Bone	Collagen
46738	39BF11	Crow Creek	27319.00	F30, Posthole #59, HII	Bison Bone	Collagen
46739	39BF11	Crow Creek	27321.00	F30, Posthole #59, HII	Bison Bone	Collagen
46740	39BF11	Crow Creek	31007.00	F100, Post #53, HIV	Bison Bone	Collagen
46741	39BF11	Crow Creek	31125.00	F100, Post holes, HIV	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46742	39BF11	Crow Creek	32129.00	F102, HVIII	Bison Bone	Collagen
46743	39BF11	Crow Creek	25367.00	F90, HVI	Bison Bone	Collagen
46744	39BF11	Crow Creek	17450.00	F52, HVI	Bison Bone	Collagen
46745	39BF11	Crow Creek	9496.00	F14, HII	Deer Bone	Collagen
41523	39ST238	Durkin	-	XU-6	Bark	Charred
41524	39ST238	Durkin	-	XU-3	Bison Bone	Collagen
41525	39ST238	Durkin	-	XU-3	Bison Bone	Collagen
41527	39ST238	Durkin	6809.00	XU-5	Bison Bone	Collagen
45845	39ST238	Durkin	6.00	XU-6	Wood	Charred
45846	39ST238	Durkin	2.00	XU-3	Wood	Charred
46648	39ST238	Durkin	1.00	XU-3	Wood	Charred
46649	39ST238	Durkin	139.00	XU-5	Wood	Charred
46650	39ST238	Durkin	5.00	XU-6	Wood	Charred
46681	39ST238	Durkin	82.00	XU-3 , Floor	Bison Bone	Collagen
46683	39ST238	Durkin	138.00	XU-5, Post	Bison Bone	Collagen
43093	32ML4	Flaming Arrow	394.00	Sq. 34 Roof/Floor	Bison Bone	Collagen
43094	32ML4	Flaming Arrow	198.00	sq. 15 - above 438	Bison Bone	Collagen
43095	32ML4	Flaming Arrow	438.00	sq. 15 - Roof/Floor	Bison Bone	Collagen
43096	32ML4	Flaming Arrow	368.00	sq. 13 - Roof/Floor	Bison Bone	Collagen
43097	32ML4	Flaming Arrow	604.00	sq.3 - Roof/Floor	Bison Bone	Collagen
43098	32ML4	Flaming Arrow	624.00	sq. 12 - Floor	Bison Bone	Collagen
43099	32ML4	Flaming Arrow	416.00	sq. 26 - Roof/Floor	Bison Bone	Collagen
43088	39ST12	H. P. Thomas	1043.00	XU2:Subfloor	Bison Bone	Collagen
43089	39ST12	H. P. Thomas	1725.00	XU4:Subfloor	Bison Bone	Collagen
43179	39ST12	H.P. Thomas	691.00	XU1:F26	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
43180	39ST12	H.P. Thomas	744.00	XU1:F42	Bison Bone	Collagen
43181	39ST12	H.P. Thomas	846.00	XU2:F21	Bison Bone	Collagen
43182	39ST12	H.P. Thomas	874.00	XU2:F32	Bison Bone	Collagen
41518	32EM1	Havens	-	H1, F123	Bison Bone	Collagen
41519	32EM1	Havens	-	H1, F124	Bison Bone	Collagen
41520	32EM1	Havens	-	H1, F129	Bison Bone	Collagen
41521	32EM1	Havens	-	H1, F130	Bison Bone	Collagen
41526	32EM1	Havens	-	H3, F859 (P17)	Bison Bone	Collagen
43104	32EM1	Havens	-	X109 H4 F679 Pit	Bison Bone	Collagen
43105	32EM1	Havens	-	X102 F441	Bison Bone	Collagen
43106	32EM1	Havens	-	X102 F216	Bison Bone	Collagen
43108	32EM1	Havens	-	X109 H4 Floor	Bison Bone	Collagen
43109	32EM1	Havens	-	X102 F204	Bison Bone	Collagen
43110	32EM1	Havens	-	X109 H4 F681 Pit Fill	Bison Bone	Collagen
43111	32EM1	Havens	-	X102 H2 Floor	Bison Bone	Collagen
43112	32EM1	Havens	-	X102 H2 F210	Bison Bone	Collagen
43113	32EM1	Havens	-	X109 H4 F608	Bison Bone	Collagen
43114	32EM1	Havens	-	X109 H4 F541 Pit	Bison Bone	Collagen
45212	39CA208	Helb	548.00	F106, Palisade Post	Wood	Charred
45213	39CA208	Helb	1369.00	F310, House 14, Post	Wood	Charred
45837	39CA208	Helb	280.00	F49, House 7, Post	Wood	Charred
46671	39CA208	Helb	2264.00	F464, House 15, Pit	Bison Bone	Collagen
46672	39CA208	Helb	2087.00	F382, House 14, Pit	Bison Bone	Collagen
46673	39CA208	Helb	1918.00	F352, House 14, Pit	Bison Bone	Collagen
46674	39CA208	Helb	391.00	F88, House 7, Pit	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46675	39CA208	Helb	2277.00	F480, House 15, Pit	Bison Bone	Collagen
46676	39CA208	Helb	1762.00	House 15, Floor	Bison Bone	Collagen
32654	32MO11	Huff	-	H1, cache F	Small Wood	Charred
32655	32MO11	Huff	2461.00	H1, F4	Bison Bone	Collagen
32656	32MO11	Huff	850.00	H1, Floor	Bison Bone	Collagen
32657	32MO11	Huff	2665.00	H2, F1	Bison Bone	Collagen
32658	32MO11	Huff	2822.00	H2, Floor	Bison Bone	Collagen
32659	32MO11	Huff	14711.00	H6, F104	Bison Bone	Collagen
32660	32MO11	Huff	14711.00	H6, F101	Bison Bone	Collagen
32661	32MO11	Huff	14711.00	H6, F87	Bison Bone	Collagen
32662	32MO11	Huff	5008.00	H3, F4	Bison Bone	Collagen
32663	32MO11	Huff	4360.00	H3, Floor	Bison Bone	Collagen
32664	32MO11	Huff	4728.00	H3, F2	Bison Bone	Collagen
32665	32MO11	Huff	5016.00	Test A, F501	Bison Bone	Collagen
32666	32MO11	Huff	5018.00	Test A, F501	Bison Bone	Collagen
32667	32MO11	Huff	5020.00	Test A, F501	Bison Bone	Collagen
34753	32MO12	Huff	5010.00	Test A, F501	Bison Bone	Collagen
34754	32MO13	Huff	5013.00	Test B, F502	Bison Bone	Collagen
34755	32MO14	Huff	5019.00	Test B, F502	Bison Bone	Collagen
43103	32MO11	Huff	14711.00	H12 F162	Bison Bone	Collagen
46699	ST15	Indian Creek	5-B Feat. 8, Stain A	F24	Bison Bone	Collagen
46700	ST15	Indian Creek	5-BB-76 (B1)	F124	Bison Bone	Collagen
46701	ST15	Indian Creek	5-BB-DD-Z-67 (B7)	F88	Bison Bone	Collagen
46702	ST15	Indian Creek	5-BB-DD-Z-67 (B8C)	F130	Bison Bone	Collagen
46703	ST15	Indian Creek	5-HH-II-84 (B3)	F17	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46704	ST15	Indian Creek	5-HH-II-84 (B13)	F106	Bison Bone	Collagen
46705	ST15	Indian Creek	5-F	F310	Bison Bone	Collagen
46706	ST15	Indian Creek	5-HH-II-93 (B9)	F49	Bison Bone	Collagen
46707	ST15	Indian Creek	5-HH-II-93 ("Fragments")	F56	Bison Bone	Collagen
46684	32ME59	Ketchen	74.00	XU2, F3, Floor	Bison Bone	Collagen
46685	32ME59	Ketchen	137.00	XU11, F12, 2.0-2.5 BS	Bison Bone	Collagen
43090	39LM55	King	139.00	XU2:F6 (occupation lvl.)	Bison Bone	Collagen
43091	39LM55	King	-	XU1:Floor	Bison Bone	Collagen
43092	39LM55	King	184.00	XU1:Cache Pit A	Bison Bone	Collagen
43115	39LM2	Medicine Creek	1109.00	House C:Floor	Seeds	Charred
43116	39LM2	Medicine Creek	2148.00	House I: Fill	Maize	Charred
43118	39LM2	Medicine Creek	2218.00	House I: Floor	Bison Bone	Collagen
43119	39LM2	Medicine Creek	2219.00	House I, Floor	Bison Bone	Collagen
43120	39LM2	Medicine Creek	2229.00	House I, Floor	Bison Bone	Collagen
43122	39LM2	Medicine Creek	2254.00	House I: F78	Bison Bone	Collagen
43123	39LM2	Medicine Creek	2262.00	Exc Unit J: 1-1.5'	Bison Bone	Collagen
43124	39LM2	Medicine Creek	2275.00	Exc Unit J: 5-5.5'	Bison Bone	Collagen
43125	39LM2	Medicine Creek	1459.00	House D: F39 (lower lvl.)	Bison Bone	Collagen
43127	39LM2	Medicine Creek	1473.00	House D: F40	Bison Bone	Collagen
43128	39LM2	Medicine Creek	1606.00	House D: Fill	Bison Bone	Collagen
43129	39LM2	Medicine Creek	1142.00	House C: Floor	Bison Bone	Collagen
43130	39LM2	Medicine Creek	784.00	House K: F12	Bison Bone	Collagen
43131	39LM2	Medicine Creek	826.00	House K: Between Floors	Bison Bone	Collagen
43132	39LM2	Medicine Creek	782.00	House K: F12	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
43133	39LM2	Medicine Creek	2046.00	House B: Floor	Bison Bone	Collagen
43134	39LM2	Medicine Creek	1528.00	House D: F47	Bison Bone	Collagen
46667	39LM2	Medicine Creek	2079.00	House B: King Post	Wood	Uncharred
46668	39LM2	Medicine Creek	2257.00	House I: King Post	Wood	Uncharred
46669	39LM2	Medicine Creek	2086.00	House B: House post	Wood	Uncharred
31414	32BL2	Menoken	2335.00	H2, F204	Bison Bone	Collagen
31415	32BL2	Menoken	2761.00	H2, Floor	Bison Bone	Collagen
31416	32BL2	Menoken	2805.00	H2, Floor	Bison Bone	Collagen
31417	32BL2	Menoken	4171.00	H2, Floor	Bison Bone	Collagen
31418	32BL2	Menoken	2177.00	H2, F16	Seed	Charred
31419	32BL2	Menoken	239.00	H2, F4	Seed	Charred
31420	32BL2	Menoken	283.00	H2, F4	Bison Bone	Collagen
32336	32BL2	Menoken	1713.00	H17, F135	Bison Bone	Collagen
32337	32BL2	Menoken	1422.00	F114	Bison Bone	Collagen
32338	32BL2	Menoken	1097.00	H17, F101	Bison Bone	Collagen
32339	32BL2	Menoken	1154.00	H17, F103	Seed	Charred
32340	32BL2	Menoken	1098.00	H17, F5	Seed	Charred
32341	32BL2	Menoken	608.00	Ditch	Bison Bone	Collagen
31414-2	32BL2	Menoken	2335.00	H2, F204	Bison Bone	Collagen
31415-2	32BL2	Menoken	2761.00	H2, Floor	Bison Bone	Collagen
32342	32SI4	Paul Brave	-	H1, F82	Bison Bone	Collagen
32343	32SI4	Paul Brave	-	H1, F75	Deer Bone	Collagen
32344	32SI4	Paul Brave	415.00	H1, F85	Bison Bone	Collagen
32345	32SI4	Paul Brave	-	H2, F90	Deer Bone	Collagen
32346	32SI4	Paul Brave	-	H2, F26	Deer Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
32347	32SI4	Paul Brave	794.00	H2, F97	Bison Bone	Collagen
32640	32SI4	Paul Brave	-	H3, F59	Deer Bone	Collagen
32641	32SI4	Paul Brave	-	H3, F55	Deer Bone	Collagen
32642	32SI4	Paul Brave	-	H4, F30	Deer Bone	Collagen
32643	32SI4	Paul Brave	1396.00	H4, F32	Bison Bone	Collagen
43070	39ST56	Sommers	1837.00	XU70, Floor	Maize	Charred
43071	39ST56	Sommers	3074a	XU85 (Bottom), F133	Bison Bone	Collagen
43072	39ST56	Sommers	1915.00	XU70, F88	Bison Bone	Collagen
43073	39ST56	Sommers	3055b	XU85 (6' BS), F133	Bison Bone	Collagen
43074	39ST56	Sommers	3055a	XU85 (6' BS), F133	Bison Bone	Collagen
43075	39ST56	Sommers	1352.00	XU21, F33	Bison Bone	Collagen
43076	39ST56	Sommers	1959.00	XU70, F95	Bison Bone	Collagen
43077	39ST56	Sommers	1333.00	XU21, F41	Bison Bone	Collagen
43078	39ST56	Sommers	3042b	XU85 (5-5.5' BS), F134	Bison Bone	Collagen
43079	39ST56	Sommers	3074b	XU85 (Bottom), F133	Bison Bone	Collagen
43080	39ST56	Sommers	862.00	XU18, F59	Bison Bone	Collagen
43081	39ST56	Sommers	902.00	XU18, F69	Bison Bone	Collagen
43082	39ST56	Sommers	3048b	XU85 (5.5-6' BS), F133	Bison Bone	Collagen
43083	39ST56	Sommers	3048a	XU85 (5.5-6' BS), F133	Bison Bone	Collagen
43084	39ST56	Sommers	3042a	XU85 (5-5.5' BS), F134	Bison Bone	Collagen
43085	39ST56	Sommers	1352.00	XU21, F33	Bison Bone	Collagen
43086	39ST56	Sommers	2210.00	XU75, Floor	Bison Bone	Collagen
43176	39ST56	Sommers	284.00	XU17, Floor	Bison Bone	Collagen
43177	39ST56	Sommers	305.00	XU17, F46	Bison Bone	Collagen
43178	39ST56	Sommers	839.00	XU18, F56	Bison Bone	Collagen

Lab Number (UGAMS)	Site #	Site Name	Field Catalog Number	Provenience	Material	Type
46686	39SL7	Sully School	390.00	F4, Floor	Bison Bone	Collagen
46687	39SL7	Sully School	409.00	F4, C1 (F137)	Bison Bone	Collagen
46688	39SL7	Sully School	420.00	F4, C1 (F145)	Bison Bone	Collagen
46689	39SL7	Sully School	790a	F5, C4 (F13)	Bison Bone	Collagen
46690	39SL7	Sully School	790b	F5, C4 (F43)	Bison Bone	Collagen
46691	39SL7	Sully School	808a	F5, C4 (F17)	Bison Bone	Collagen
46692	39SL7	Sully School	808b	F5, C4 (F49)	Bison Bone	Collagen
46693	39SL7	Sully School	885a	F5, C8 (F64)	Bison Bone	Collagen
46694	39SL7	Sully School	885b	F5, C8 (F43)	Bison Bone	Collagen
46695	39SL7	Sully School	1585.00	F23, C1 (F88)	Bison Bone	Collagen
43149	39HU242	Whistling Elk	4722.00	H2, F23	Bison Bone	Collagen
43151	39HU242	Whistling Elk	1255.00	H1 (Fill/Roof/Floor)	Maize	Charred
43152	39HU242	Whistling Elk	2975.00	H2 (Fill/Roof/Floor)	Maize	Charred
43153	39HU242	Whistling Elk	2959.00	H2 (Fill/Roof/Floor)	Maize	Charred
43154	39HU242	Whistling Elk	4729.00	H2, F29	Maize	Charred
43155	39HU242	Whistling Elk	1171.00	H1 (Fill/Roof/Floor)	Maize	Charred
43156	39HU242	Whistling Elk	1217.00	H1 (Fill/Roof/Floor)	Maize	Charred
43174	39HU242	Whistling Elk	98-2a	Big House floor depression	Bison Bone	Collagen
43175	39HU242	Whistling Elk	98-2b	Big House floor depression	Bison Bone	Collagen
43157	39HU242	Whistling Elk	1168.00	H1	Bison Bone	Collagen

Appendix B: New Dates Produced for this Study

Laboratory Number (UGAMS)	Site Number	Site Name	$\delta^{13}\text{C},\text{‰}$	$\delta^{15}\text{N},\text{‰}$	^{14}C age years, BP	\pm	pMC	\pm	C:N ratio
46696	39AR8	Alberts Creek	-9.94	5.65	620	20	92.53	0.26	3.18
46697	39AR8	Alberts Creek	-18.41	6.30	600	20	92.84	0.26	3.18
46698	39AR8	Alberts Creek	-10.49	5.12	560	25	93.23	0.28	3.23
43159	39HU6	Arzberger	-15.52	6.85	562	18	93.23	0.22	3.17
43160	39HU6	Arzberger	-16.59	5.51	517	18	94.23	0.22	3.12
43161	39HU6	Arzberger	-18.37	5.41	524	18	94.50	0.22	3.11
43162	39HU6	Arzberger	-12.49	6.17	545	18	93.43	0.22	3.12
43163	39HU6	Arzberger	-16.91	6.33	547	18	93.41	0.22	3.18
43164	39HU6	Arzberger	-15.09	6.05	554	18	93.27	0.22	3.19
43165	39HU6	Arzberger	-10.83	5.52	523	18	93.68	0.22	3.16
43166	39HU6	Arzberger	-15.10	6.45	559	18	92.88	0.22	3.11
32644	32MO2	Bendish	-22.03	3.22	510	20	93.80	0.27	3.22
32645	32MO2	Bendish	-14.99	3.23	690	25	91.82	0.28	3.23
32646	32MO2	Bendish	-15.87	3.23	630	25	92.42	0.28	3.23
32647	32MO2	Bendish	-21.50	3.23	660	25	92.12	0.29	3.23
32648	32MO2	Bendish	-20.41	3.24	660	25	92.13	0.29	3.24
32649	32MO2	Bendish	-19.51	3.22	640	25	92.30	0.29	3.22
32650	32MO2	Bendish	-14.53	3.22	640	20	92.32	0.26	3.22
32651	32MO2	Bendish	-16.39	3.22	690	20	91.80	0.25	3.22
32652	32MO2	Bendish	-18.77	3.22	690	20	91.80	0.26	3.22
32653	32MO2	Bendish	-18.66	3.22	720	25	91.45	0.28	3.22

Laboratory Number (UGAMS)	Site Number	Site Name	$\delta^{13}\text{C},\text{‰}$	$\delta^{15}\text{N},\text{‰}$	^{14}C age years, BP	\pm	pMC	\pm	C:N ratio
43135	39LM218	Black Partizan	-12.23	6.54	650	19	92.20	0.22	3.24
43136	39LM218	Black Partizan	-18.85	6.76	290	19	96.47	0.23	3.19
43137	39LM218	Black Partizan	-14.83	6.71	620	19	92.60	0.22	3.20
43138	39LM218	Black Partizan	-14.32	6.17	560	19	93.22	0.22	3.21
43139	39LM218	Black Partizan	-16.87	6.30	690	19	91.75	0.23	3.25
43140	39LM218	Black Partizan	-9.73	6.58	680	19	91.83	0.22	3.19
43141	39LM218	Black Partizan	-11.56	6.27	650	19	92.27	0.22	3.23
43142	39LM218	Black Partizan	-17.96	7.78	600	20	92.83	0.24	3.20
43143	39LM218	Black Partizan	-13.13	6.40	510	19	93.90	0.23	3.24
43144	39LM218	Black Partizan	-12.79	5.12	300	18	96.36	0.23	3.20
43145	39LM218	Black Partizan	-19.17	8.05	190	19	97.67	0.24	3.25
43146	39LM218	Black Partizan	-18.06	6.80	460	19	94.49	0.23	3.25
43147	39LM218	Black Partizan	-16.59	7.30	553	18	93.33	0.22	3.15
43148	39LM218	Black Partizan	-10.38	5.53	640	19	92.34	0.23	3.20
45838	39DW231	Calamity	-26.50	n/a	550	20	93.34	0.24	n/a
45839	39DW231	Calamity	-23.48	n/a	530	20	93.60	0.24	n/a
45840	39DW231	Calamity	-20.71	n/a	610	20	92.73	0.23	n/a
45841	39DW231	Calamity	-21.70	n/a	530	20	93.65	0.25	n/a
45842	39DW231	Calamity	-23.91	n/a	560	20	93.27	0.24	n/a
45843	39DW231	Calamity	-26.30	n/a	530	20	93.57	0.24	n/a
45844	39DW231	Calamity	-23.92	n/a	600	20	92.77	0.23	n/a
46677	39DW231	Calamity	-12.79	5.15	650	20	92.25	0.26	3.23
43101	39ST224	Cattle Oiler	-18.04	7.11	600	19	92.76	0.23	2.91
43102	39ST224	Cattle Oiler	-15.04	5.93	630	19	92.40	0.23	3.15
43183	39ST224	Cattle Oiler	-13.23	5.79	884	18	89.57	0.21	3.15

Laboratory Number (UGAMS)	Site Number	Site Name	$\delta^{13}\text{C},\text{‰}$	$\delta^{15}\text{N},\text{‰}$	^{14}C age years, BP	±	pMC	±	C:N ratio
43184	39ST224	Cattle Oiler	-17.27	7.38	865	18	89.78	0.21	3.17
43185	39ST224	Cattle Oiler	-19.56	7.33	866	18	89.77	0.21	3.12
43189	39ST224	Cattle Oiler	-12.70	6.09	897	18	89.42	0.21	3.13
43190	39ST224	Cattle Oiler	-18.72	6.81	881	18	89.60	0.21	3.13
43191	39ST224	Cattle Oiler	-14.00	6.31	876	18	89.65	0.21	3.13
45192	39ST224	Cattle Oiler	-19.45	7.42	860	20	89.86	0.24	3.22
45193	39ST224	Cattle Oiler	-14.77	6.51	860	20	89.84	0.26	3.21
45194	39ST224	Cattle Oiler	-14.15	6.93	870	20	89.69	0.24	3.23
45195	39ST224	Cattle Oiler	-19.98	7.97	910	20	89.32	0.25	3.23
45196	39ST224	Cattle Oiler	-14.88	6.73	840	20	90.02	0.26	3.19
45197	39ST224	Cattle Oiler	-15.09	6.50	610	20	92.68	0.25	3.23
45198	39ST224	Cattle Oiler	-13.79	5.79	850	20	89.99	0.25	3.21
45199	39ST224	Cattle Oiler	-18.37	7.55	870	20	89.74	0.24	3.23
45200	39ST224	Cattle Oiler	-16.55	7.02	850	20	89.93	0.26	3.24
45201	39ST224	Cattle Oiler	-15.83	6.25	870	20	89.71	0.24	3.21
45202	39ST224	Cattle Oiler	-14.32	10.02	630	20	92.51	0.27	3.22
45203	39ST224	Cattle Oiler	-17.81	7.47	870	35	89.69	0.39	3.22
45204	39ST224	Cattle Oiler	-16.05	4.97	910	25	89.30	0.26	3.21
45205	39ST224	Cattle Oiler	-15.61	5.41	610	20	92.73	0.27	3.19
45206	39ST224	Cattle Oiler	-16.72	7.22	860	20	89.90	0.25	3.22
45207	39ST224	Cattle Oiler	-11.35	5.76	860	20	89.84	0.25	3.24
45208	39ST224	Cattle Oiler	-15.24	6.54	870	20	89.70	0.25	3.20
45209	39ST224	Cattle Oiler	-15.18	6.06	590	30	92.91	0.33	3.22
46670	39ST1	Cheyenne River	-21.22	n/a	800	20	90.47	0.24	n/a
46678	39ST1	Cheyenne River	-17.23	6.83	90	20	98.83	0.26	3.20

Laboratory Number (UGAMS)	Site Number	Site Name	$\delta^{13}\text{C},\text{‰}$	$\delta^{15}\text{N},\text{‰}$	^{14}C age years, BP	\pm	pMC	\pm	C:N ratio
46679	39ST1	Cheyenne River	-14.26	6.36	590	20	92.87	0.25	3.23
46680	39ST1	Cheyenne River	-15.10	6.35	630	20	92.47	0.26	3.19
41522	39BF11	Crow Creek	-14.77	n/a	600	20	92.82	0.23	n/a
43100	39BF11	Crow Creek	-17.61	6.94	610	20	92.68	0.24	n/a
46651	39BF11	Crow Creek	-24.24	n/a	930	20	89.07	0.23	n/a
46652	39BF11	Crow Creek	-22.61	n/a	630	20	92.49	0.24	n/a
46654	39BF11	Crow Creek	-21.36	n/a	890	20	89.52	0.23	n/a
46655	39BF11	Crow Creek	-21.82	n/a	940	20	89.00	0.23	n/a
46656	39BF11	Crow Creek	-21.26	n/a	500	20	93.92	0.25	n/a
46657	39BF11	Crow Creek	-20.76	n/a	870	20	89.77	0.24	n/a
46658	39BF11	Crow Creek	-21.28	n/a	1090	20	87.30	0.23	n/a
46659	39BF11	Crow Creek	-21.86	n/a	990	20	88.42	0.23	n/a
46660	39BF11	Crow Creek	-22.67	n/a	890	20	89.56	0.24	n/a
46661	39BF11	Crow Creek	-22.67	n/a	1030	20	87.97	0.24	n/a
46662	39BF11	Crow Creek	-22.58	n/a	850	20	89.96	0.24	n/a
46663	39BF11	Crow Creek	-21.01	n/a	870	20	89.77	0.24	n/a
46664	39BF11	Crow Creek	-21.26	n/a	860	20	89.90	0.24	n/a
46665	39BF11	Crow Creek	-20.79	n/a	1170	20	86.47	0.23	n/a
46666	39BF11	Crow Creek	-21.33	n/a	860	20	89.87	0.25	n/a
46709	39BF11	Crow Creek	-11.86	5.51	600	25	92.83	0.28	3.25
46710	39BF11	Crow Creek	-14.76	5.69	600	25	92.79	0.29	3.27
46711	39BF11	Crow Creek	-12.08	5.52	580	25	93.05	0.29	3.28
46712	39BF11	Crow Creek	-14.60	6.42	620	25	92.60	0.28	3.22
46713	39BF11	Crow Creek	-23.95	n/a	510	25	93.87	0.29	n/a
46714	39BF11	Crow Creek	-12.66	6.69	610	20	92.66	0.25	3.22

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46715	39BF11	Crow Creek	-12.72	5.66	530	25	93.56	0.29	3.21
46716	39BF11	Crow Creek	-12.80	6.39	620	20	92.52	0.26	3.27
46717	39BF11	Crow Creek	-14.30	6.22	860	25	89.85	0.26	3.19
46718	39BF11	Crow Creek	-14.62	6.49	510	25	93.85	0.29	3.26
46719	39BF11	Crow Creek	-13.85	6.28	560	25	93.21	0.27	3.20
46720	39BF11	Crow Creek	-14.28	5.85	860	25	89.85	0.27	3.27
46721	39BF11	Crow Creek	-13.85	5.72	950	20	88.84	0.25	3.33
46722	39BF11	Crow Creek	-17.74	6.22	640	20	92.33	0.26	3.24
46723	39BF11	Crow Creek	-8.93	5.78	620	25	92.58	0.27	3.24
46724	39BF11	Crow Creek	-12.26	5.77	620	25	92.61	0.30	3.20
46725	39BF11	Crow Creek	-16.25	6.07	610	20	92.65	0.26	3.33
46726	39BF11	Crow Creek	-13.88	5.50	780	20	90.78	0.26	3.30
46727	39BF11	Crow Creek	-14.03	5.94	790	25	90.67	0.27	3.26
46728	39BF11	Crow Creek	-11.94	5.42	910	20	89.33	0.25	3.26
46729	39BF11	Crow Creek	-24.40	n/a	460	25	94.48	0.29	n/a
46731	39BF11	Crow Creek	-9.46	n/a	520	25	93.73	0.30	n/a
46733	39BF11	Crow Creek	-16.71	6.80	890	20	89.55	0.24	3.27
46734	39BF11	Crow Creek	-17.47	7.15	920	20	89.21	0.25	3.21
46735	39BF11	Crow Creek	-11.59	n/a	900	20	89.40	0.25	n/a
46736	39BF11	Crow Creek	-10.81	4.93	880	20	89.63	0.25	3.29
46737	39BF11	Crow Creek	-9.14	5.88	630	20	92.45	0.26	3.23
46738	39BF11	Crow Creek	-14.41	6.36	600	20	92.81	0.25	3.25
46739	39BF11	Crow Creek	-14.18	5.81	570	20	93.09	0.25	3.24
46740	39BF11	Crow Creek	-15.19	5.89	660	20	92.07	0.25	3.34
46741	39BF11	Crow Creek	-14.87	5.51	610	20	92.66	0.26	3.27

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46742	39BF11	Crow Creek	-15.31	6.90	700	20	91.68	0.25	3.22
46743	39BF11	Crow Creek	-12.86	5.65	910	20	89.31	0.25	3.31
46744	39BF11	Crow Creek	-14.59	5.83	910	20	89.25	0.26	3.26
46745	39BF11	Crow Creek	-12.18	6.28	540	20	93.44	0.26	3.25
41523	39ST238	Durkin	-27.20	n/a	640	20	92.33	0.24	n/a
41524	39ST238	Durkin	-18.34	5.99	670	20	91.97	0.24	3.24
41525	39ST238	Durkin	-15.08	7.33	640	20	92.35	0.23	3.25
41527	39ST238	Durkin	-15.25	6.10	660	20	92.15	0.23	3.29
45845	39ST238	Durkin	-24.92	n/a	880	20	89.67	0.23	n/a
45846	39ST238	Durkin	-20.60	n/a	850	20	90.00	0.23	n/a
46648	39ST238	Durkin	-20.35	n/a	930	20	89.01	0.23	n/a
46649	39ST238	Durkin	-22.47	n/a	760	20	90.92	0.24	n/a
46650	39ST238	Durkin	-21.31	n/a	870	20	89.70	0.23	n/a
46681	39ST238	Durkin	-19.43	5.11	100	20	98.77	0.26	3.20
46683	39ST238	Durkin	n/a	n/a	930	50	89.03	0.58	n/a
43093	32ML4	Flaming Arrow	-16.69	6.45	3120	21	67.84	0.18	3.21
43094	32ML4	Flaming Arrow	-19.75	6.19	890	20	89.48	0.22	3.19
43095	32ML4	Flaming Arrow	-19.20	7.14	880	20	89.68	0.23	3.19
43096	32ML4	Flaming Arrow	-16.60	6.31	840	20	90.06	0.23	3.18
43097	32ML4	Flaming Arrow	-17.54	7.27	3350	20	65.86	0.17	3.20
43098	32ML4	Flaming Arrow	-16.98	7.42	890	20	89.56	0.23	3.16
43099	32ML4	Flaming Arrow	-18.62	7.31	820	21	90.27	0.24	3.22
43088	39ST12	H. P. Thomas	-14.68	6.59	890	20	89.48	0.23	2.76
43089	39ST12	H. P. Thomas	-15.75	6.70	870	20	89.68	0.23	3.22
43179	39ST12	H.P. Thomas	-15.14	5.54	212	18	97.39	0.23	3.18

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43180	39ST12	H.P. Thomas	-16.30	6.56	862	18	89.81	0.21	3.14
43181	39ST12	H.P. Thomas	-16.31	5.24	203	18	97.49	0.23	3.11
43182	39ST12	H.P. Thomas	-16.53	5.68	201	18	97.52	0.22	3.12
41518	32EM1	Havens	-14.42	6.50	630	20	92.48	0.24	3.23
41519	32EM1	Havens	-16.63	6.58	620	20	92.60	0.23	3.22
41520	32EM1	Havens	-15.92	6.13	640	20	92.32	0.24	3.21
41521	32EM1	Havens	-14.96	5.50	620	20	92.62	0.24	3.21
41526	32EM1	Havens	-14.06	5.85	670	20	91.97	0.24	3.23
43104	32EM1	Havens	-14.15	6.43	700	20	91.65	0.24	3.19
43105	32EM1	Havens	-14.31	6.06	630	20	92.42	0.24	3.22
43106	32EM1	Havens	-11.30	7.50	660	20	92.06	0.24	3.25
43108	32EM1	Havens	-18.47	7.02	670	22	91.95	0.26	3.26
43109	32EM1	Havens	-14.67	6.44	630	20	92.46	0.24	3.21
43110	32EM1	Havens	-11.91	5.70	670	20	92.00	0.24	3.24
43111	32EM1	Havens	-19.29	7.21	750	20	91.05	0.24	3.24
43112	32EM1	Havens	-17.16	6.87	750	21	91.09	0.25	3.23
43113	32EM1	Havens	-13.81	5.91	700	20	91.67	0.24	3.25
43114	32EM1	Havens	-18.20	6.78	680	20	91.93	0.24	3.20
45212	39CA208	Helb	-24.81	n/a	590	20	92.96	0.24	n/a
45213	39CA208	Helb	-23.45	n/a	590	20	92.91	0.24	n/a
45837	39CA208	Helb	-25.75	n/a	760	20	90.96	0.23	n/a
46671	39CA208	Helb	-13.62	5.77	610	20	92.72	0.26	3.18
46672	39CA208	Helb	-15.84	5.82	580	20	93.00	0.25	3.20
46673	39CA208	Helb	-13.87	6.21	590	20	92.89	0.25	3.24
46674	39CA208	Helb	-14.63	6.63	600	20	92.76	0.25	3.19

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46675	39CA208	Helb	-14.74	5.96	630	20	92.51	0.23	3.20
46676	39CA208	Helb	-14.42	5.70	610	20	92.67	0.24	3.18
32654	32MO11	Huff	-24.71	n/a	481	20	94.89	0.24	n/a
32655	32MO11	Huff	-17.76	3.23	460	20	94.48	0.26	3.23
32656	32MO11	Huff	-18.59	3.25	430	20	94.81	0.26	3.25
32657	32MO11	Huff	-12.53	3.24	450	20	94.51	0.26	3.24
32658	32MO11	Huff	-15.65	3.18	450	20	94.59	0.27	3.18
32659	32MO11	Huff	-14.50	3.22	450	20	94.55	0.27	3.22
32660	32MO11	Huff	-18.24	3.22	430	20	94.80	0.27	3.22
32661	32MO11	Huff	-14.56	3.20	430	20	94.77	0.26	3.20
32662	32MO11	Huff	-19.14	3.22	390	20	95.21	0.27	3.22
32663	32MO11	Huff	-19.78	3.22	350	20	95.73	0.27	3.22
32664	32MO11	Huff	-17.67	3.22	460	20	94.44	0.26	3.22
32665	32MO11	Huff	-17.81	3.22	410	20	94.99	0.27	3.22
32666	32MO11	Huff	-15.68	3.21	480	20	94.21	0.26	3.21
32667	32MO11	Huff	-15.19	3.18	460	20	94.42	0.27	3.18
34753	32MO12	Huff	-18.29	3.18	357	20	94.13	0.27	3.23
34754	32MO13	Huff	-19.35	5.24	438	20	94.51	0.26	3.29
34755	32MO14	Huff	-15.83	5.82	436	20	49.41	0.26	3.22
43103	32MO11	Huff	-19.83	4.65	450	21	94.56	0.25	3.21
46699	ST15	Indian Creek	-14.20	5.40	120	20	98.52	0.28	3.29
46700	ST15	Indian Creek	-17.40	7.08	620	20	92.58	0.25	3.25
46701	ST15	Indian Creek	-16.84	7.11	670	25	91.96	0.27	3.23
46702	ST15	Indian Creek	-19.92	4.78	540	25	93.48	0.28	3.28
46703	ST15	Indian Creek	-12.86	6.15	590	25	92.97	0.28	3.24

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46704	ST15	Indian Creek	-13.45	6.03	590	20	92.89	0.26	3.25
46705	ST15	Indian Creek	-15.05	5.90	580	20	93.07	0.27	3.31
46706	ST15	Indian Creek	-15.63	7.01	690	25	91.75	0.28	3.27
46707	ST15	Indian Creek	-20.29	5.26	660	25	92.16	0.29	3.20
46684	32ME59	Ketchen	-18.04	6.89	800	20	92.76	0.23	2.91
46685	32ME59	Ketchen	-15.04	6.19	730	20	92.40	0.23	3.15
43090	39LM55	King	-20.20	5.25	870	20	89.73	0.23	3.23
43091	39LM55	King	-19.04	6.77	860	19	89.81	0.22	3.14
43092	39LM55	King	-18.98	6.94	820	19	90.34	0.22	3.02
43115	39LM2	Medicine Creek	-	-	Modern	-	-	-	-
43116	39LM2	Medicine Creek	-10.91	n/a	884	18	89.57	0.21	n/a
43118	39LM2	Medicine Creek	-10.38	5.47	930	20	89.12	0.23	3.21
43119	39LM2	Medicine Creek	-15.99	6.58	940	19	89.00	0.22	3.17
43120	39LM2	Medicine Creek	-12.89	6.03	840	20	90.07	0.23	3.19
43122	39LM2	Medicine Creek	-15.94	7.30	820	20	90.26	0.23	3.19
43123	39LM2	Medicine Creek	-12.81	6.19	900	19	89.41	0.22	3.19
43124	39LM2	Medicine Creek	-14.35	6.46	900	19	89.35	0.22	3.16
43125	39LM2	Medicine Creek	-18.01	7.09	880	19	89.63	0.22	3.20
43127	39LM2	Medicine Creek	-16.58	6.06	1170	19	86.49	0.22	3.24
43128	39LM2	Medicine Creek	-19.39	4.07	590	19	92.94	0.23	3.16
43129	39LM2	Medicine Creek	-12.73	5.96	890	20	89.53	0.23	3.19
43130	39LM2	Medicine Creek	-16.00	5.49	340	19	95.88	0.23	3.17
43131	39LM2	Medicine Creek	-9.62	5.02	320	19	96.11	0.23	3.19
43132	39LM2	Medicine Creek	-13.82	5.18	290	19	96.46	0.24	3.20
43133	39LM2	Medicine Creek	-14.46	6.89	850	19	90.00	0.22	3.23

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43134	39LM2	Medicine Creek	-16.24	7.00	890	19	89.50	0.22	3.19
46667	39LM2	Medicine Creek	-20.75	n/a	920	25	89.17	0.26	n/a
46668	39LM2	Medicine Creek	-22.08	n/a	960	20	88.68	0.24	n/a
46669	39LM2	Medicine Creek	-21.19	n/a	940	20	88.93	0.24	n/a
31414	32BL2	Menoken	-14.90	7.25	780	20	90.74	0.26	3.31
31415	32BL2	Menoken	-18.94	6.39	830	25	90.20	0.26	3.26
31416	32BL2	Menoken	-16.63	6.03	840	25	90.09	0.26	3.25
31417	32BL2	Menoken	-16.53	6.86	830	25	90.19	0.27	3.28
31418	32BL2	Menoken	-	n/a	Modern	-	-	-	-
31419	32BL2	Menoken	-11.08	n/a	880	20	89.64	0.24	n/a
31420	32BL2	Menoken	-17.51	7.15	860	25	89.89	0.27	3.25
32336	32BL2	Menoken	-17.24	3.35	1030	25	87.92	0.27	3.35
32337	32BL2	Menoken	-17.72	3.21	850	25	89.99	0.27	3.21
32338	32BL2	Menoken	-19.23	3.28	820	25	90.31	0.28	3.28
32339	32BL2	Menoken	-23.99	n/a	420	20	94.93	0.26	n/a
32340	32BL2	Menoken	-23.78	n/a	900	20	89.45	0.24	n/a
32341	32BL2	Menoken	-15.86	3.26	1070	25	87.58	0.27	3.26
31414-2	32BL2	Menoken	-15.14	7.32	800	25	90.74	0.26	3.30
31415-2	32BL2	Menoken	-18.98	6.39	860	25	90.2	0.26	3.29
32342	32SI4	Paul Brave	-15.20	3.28	670	25	91.98	0.28	3.28
32343	32SI4	Paul Brave	-19.06	3.22	590	25	92.93	0.27	3.22
32344	32SI4	Paul Brave	-12.05	3.20	640	25	92.35	0.28	3.20
32345	32SI4	Paul Brave	-19.58	3.29	730	25	91.29	0.28	3.29
32346	32SI4	Paul Brave	-19.82	3.34	630	25	92.39	0.28	3.34
32347	32SI4	Paul Brave	-17.32	3.23	630	20	92.50	0.26	3.23

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32640	32SI4	Paul Brave	-21.58	3.22	590	25	92.91	0.28	3.22
32641	32SI4	Paul Brave	-23.49	3.22	700	20	91.71	0.26	3.22
32642	32SI4	Paul Brave	-20.42	3.23	680	25	91.84	0.27	3.23
32643	32SI4	Paul Brave	-9.70	5.37	650	25	92.20	0.29	3.26
43070	39ST56	Sommers	-10.63	n/a	960	19	88.74	0.22	n/a
43071	39ST56	Sommers	-11.82	6.26	920	20	89.16	0.23	3.24
43072	39ST56	Sommers	-16.12	7.34	870	20	89.74	0.23	3.14
43073	39ST56	Sommers	-12.98	6.09	890	20	89.53	0.23	3.15
43074	39ST56	Sommers	-16.47	7.10	880	20	89.61	0.23	3.19
43075	39ST56	Sommers	-16.82	7.21	870	20	89.75	0.23	3.15
43076	39ST56	Sommers	-14.25	6.07	890	20	89.53	0.23	3.15
43077	39ST56	Sommers	-14.29	5.98	870	19	89.70	0.23	3.20
43078	39ST56	Sommers	-15.46	5.91	870	20	89.75	0.23	3.16
43079	39ST56	Sommers	-16.86	6.80	880	20	89.65	0.23	3.17
43080	39ST56	Sommers	-18.87	7.28	900	20	89.37	0.23	2.75
43081	39ST56	Sommers	-17.88	7.82	880	20	89.66	0.23	2.72
43082	39ST56	Sommers	-15.33	6.90	900	20	89.43	0.23	3.19
43083	39ST56	Sommers	-14.52	6.06	900	20	89.40	0.23	3.19
43084	39ST56	Sommers	-14.85	6.03	860	21	89.82	0.24	2.97
43085	39ST56	Sommers	-17.97	7.57	860	20	89.88	0.24	3.24
43086	39ST56	Sommers	-14.81	6.14	910	20	89.33	0.23	3.18
43176	39ST56	Sommers	-18.01	6.44	903	18	89.36	0.21	3.13
43177	39ST56	Sommers	-19.34	7.55	859	18	89.84	0.21	3.11
43178	39ST56	Sommers	-12.85	5.91	835	18	90.11	0.21	3.15
46686	39SL7	Sully School	-14.33	6.40	550	25	93.40	0.28	3.22

Laboratory Number (UGAMS)	Site Number	Site Name	$\delta^{13}\text{C},\text{‰}$	$\delta^{15}\text{N},\text{‰}$	^{14}C age years, BP	\pm	pMC	\pm	C:N ratio
46687	39SL7	Sully School	-13.40	6.35	670	25	91.96	0.28	3.22
46688	39SL7	Sully School	-20.33	7.53	620	20	92.55	0.25	3.24
46689	39SL7	Sully School	-14.91	6.09	650	25	92.18	0.29	3.25
46690	39SL7	Sully School	-13.44	6.07	640	25	92.34	0.27	3.25
46691	39SL7	Sully School	-13.76	6.09	640	25	92.31	0.28	3.25
46692	39SL7	Sully School	-16.81	5.96	750	20	91.08	0.25	3.28
46693	39SL7	Sully School	-18.96	6.49	740	20	91.17	0.26	3.28
46694	39SL7	Sully School	-14.23	6.78	710	20	91.52	0.26	3.23
46695	39SL7	Sully School	-14.50	5.48	630	20	92.43	0.26	3.30
43149	39HU242	Whistling Elk	-14.14	5.55	580	19	93.03	0.22	3.23
43151	39HU242	Whistling Elk	-7.96	n/a	619	18	92.57	0.22	n/a
43152	39HU242	Whistling Elk	-11.75	n/a	616	18	92.60	0.22	n/a
43153	39HU242	Whistling Elk	-14.33	n/a	605	18	92.73	0.22	n/a
43154	39HU242	Whistling Elk	-12.89	n/a	613	18	92.64	0.22	n/a
43155	39HU242	Whistling Elk	-9.34	n/a	625	18	92.50	0.22	n/a
43156	39HU242	Whistling Elk	-8.68	n/a	608	18	92.69	0.22	n/a
43174	39HU242	Whistling Elk	-18.02	6.85	612	18	92.65	0.22	3.07
43175	39HU242	Whistling Elk	-17.23	6.18	609	18	92.68	0.21	3.18
43157	39HU242	Whistling Elk	-15.52	n/a	562	18	93.23	0.22	n/a

Appendix C: Code and Structure of Bayesian Models for Each Site in this Study

C.1 Multi-occupation Villages

C.1.1 Black Partizan

```
Plot("Black Partizan Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Black Partizan occupation")
  {
    Boundary("Black Partizan Early begin");
    Phase("Black Partizan Early")
    {
      R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18)
      {
        Outlier ("General",0.05);
      };
    };
  };
};
```

```

Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early Date Est.");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19)
{
Outlier ("General",0.05);
};
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18)
{
Outlier ("General",0.05);
};
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late Date Est.");
};
Boundary("Black Partizan Late end");
};
};

```

C.1.2 Cattle Oiler

Plot("Cattle Oiler Village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Cattle Oiler occupation")
  {
    Boundary("Cattle Oiler Early begins");
    Phase("Cattle Oiler Early")
    {
      R_Date("UGAMS45201, H1, F88, Collagen", 870, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45207, H1, F88, Collagen", 860, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43184, H1, Floor, Collagen", 865, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43185, H2, F54, Collagen", 866, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43191, H2, F55, Collagen", 876, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45192, H2, F54, Collagen", 860, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45195, H2, Floor, Collagen", 910, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45196, H2, F43, Collagen", 840, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45200, H2, F43, Collagen", 850, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45198, H3, F49, Collagen", 850, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43189, H3, Floor, Collagen", 897, 18)
      {
```

```

    Outlier ("General",0.05);
};
R_Date("UGAMS43183, F71 Pit outside H3, Collagen", 884, 20)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45199, H4, F64, Collagen", 870, 20)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45203, H4, F64, Collagen", 870, 35)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45193, H5, F137, Collagen", 860, 20)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45204, H5, Floor F124, Collagen", 910, 25)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45206, H5, Floor F124, Collagen", 860, 20)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45190, H6, F135, Collagen", 881, 18)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45194, H6, F145, Collagen", 870, 20)
{
    Outlier ("General",0.05);
};
R_Date("UGAMS45208, H6, Floor F130, Collagen", 870, 20)
{
    Outlier ("General",0.05);
};
Interval("Cattle Oiler Early interval",LnN(ln(25),ln(2)));
Date("Cattle Oiler Early Date Est. est.");
};
Boundary("Cattle Oiler Early end");
Interval("early to late occupations interval");
Boundary("Cattle Oiler Late begin");
Phase("Cattle Oiler Late")
{
    R_Date("UGAMS-43101, H7, F27, Collagen", 600, 20)
    {
        Outlier ("General",0.05);
    };
    R_Date("UGAMS-43102, H7, F27, Collagen", 630, 20)

```

```

{
  Outlier ("General",0.05);
};
R_Date("UGAMS-45197, H7, F17, Collagen", 610, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-45202, H7, F32, Collagen", 630, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-45205, H7, F24, Collagen", 610, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-45209, H7, F17, Collagen", 590, 30)
{
  Outlier ("General",0.05);
};
R_Date("ETH-11040, F98, Grass", 690 ,60)
{
  Outlier ("General",0.05);
};
Interval("Cattle Oiler Late interval",LnN(ln(25),ln(2)));
Date("Cattle Oiler Late Date Est.");
};
Boundary("Cattle Oiler Late end");
};
Difference("Early to Late diff", "Cattle Oiler Late begin", "Cattle Oiler Early end");
};

```

C.1.3 Crow Creek

Plot("Crow Creek Village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Crow Creek occupation")
  {
    Boundary("Crow Creek Early begin");
    Phase("Crow Creek Early dates")
    {
      R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 )
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("M-836, Charcoal", 900, 105)
      {
        Outlier(1);
      };
      R_Date("1-577, Charcoal", 850, 86)
      {
        Outlier(1);
      };
      R_Date("1-578, Charcoal", 900, 80)
      {
        Outlier(1);
      };
    }
  }
};
```

```

R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("post-Date Est. early-HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-Date Est. Late-HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-Date Est.), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};

```

```

Boundary("Crow Creek Late begin");
Phase("Crow Creek Late dates")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46712, F19, HII (pre-Date Est.), Collagen", 620, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-46745, F14, HII (post-Date Est.), Collagen", 540, 20)
  {
    Outlier ("General",0.05);
  };
};

```

```

R_Date("UGAMS-46713, F21, HIII (post-Date Est.), Collagen", 510, 25)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46718, F61A, HIII (pre-Date Est.), Collagen", 510, 25)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46723, F133, HIV (post-Date Est.), Collagen", 620, 25)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46724, F180, HV (pre-Date Est.), Collagen", 620, 25)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 )
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20)
{
  Outlier ("General",0.05);
};
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};

```

```
};  
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)  
{  
  Outlier(1);  
};  
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)  
{  
  Outlier(1);  
};  
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)  
{  
  Outlier(1);  
};  
Interval("Crow Creek Late interval");  
Date("Crow Creek Late dates");  
};  
Boundary("Crow Creek Late end");  
};  
};
```

C.1.4 Indian Creek

```
Plot("Indian Creek Villages")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Indian Creek occupations")
  {
    Boundary("Indian Creek Early begin");
    Phase("Indian Creek Early dates")
    {
      R_Date("UGAMS-46700, Collagen", 620, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46701, Collagen", 670, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46702, Collagen", 540, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46703, Collagen", 590, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46704, Collagen", 590, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46705, Collagen", 580, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46706, Collagen", 690, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46707, Collagen", 660, 25)
      {
        Outlier ("General",0.05);
      };
      Interval("Indian Creek Early interval",LnN(In(25),In(2)));
      Date("Indian Creek Early Date Est.");
    };
    Boundary("Indian Creek Early end");
    Interval("early to late interval");
    Boundary("Indian Creek Late begin");
    Phase("Indian Creek Late dates")
    {
      R_Date("I-18,039, F43", 330, 86)
```

```
{
  Outlier(1);
};
R_Date("I-18,040, F30", 450, 86)
{
  Outlier(1);
};
R_Date("I-18,041, F7", 300, 86)
{
  Outlier(1);
};
R_Date("I-18,042, F5", 330, 86)
{
  Outlier(1);
};
Interval("Indian Creek Late interval",LnN(ln(25),ln(2)));
Date("Indian Creek Late Date Est.");
};
Boundary("Indian Creek Late end");
};
};
```

C.1.5 Medicine Creek

```
Plot("Medicine Creek villages")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Medicine Creek occupation")
  {
    Boundary("Medicine Creek Early begin");
    Phase("Medicine Creek Early dates")
    {
      R_Date("UGAMS-46668, House I, King Post, Wood", 960, 20)
      {
        Outlier(1);
      };
      R_Date("UGAMS-46667, House B, King Post, Wood", 920, 25)
      {
        Outlier(1);
      };
      R_Date("UGAMS-46669, House B, House Post, Wood", 940, 20)
      {
        Outlier(1);
      };
      R_Date("UGAMS-43116, House I, Fill, Collagen", 884, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43118, House I, Floor, Collagen", 930, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43119, House I, Floor, Collagen", 940, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43120, House I, Floor, Collagen", 840, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43133, House B, Floor, Collagen", 850, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43129, House C, Floor, Collagen", 890, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43123, Unit J, 1-1.5', Collagen", 900, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43124, Unit J, 5-5.5', Collagen", 900, 20)
    }
  }
}
```

```

{
  Outlier ("General",0.05);
};
R_Date("UGAMS43125, House D, F39 (lower Lvl.), Collagen", 880, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS43134, House D, F47, Collagen", 890, 20)
{
  Outlier ("General",0.05);
};
Interval("Medicine Creek Early interval",LnN(ln(25),ln(2)));
Date("Medicine Creek Early Date Est.");
};
Boundary("Medicine Creek MMT/IC end");
Before("Post-Date Est. occupation")
{
  R_Date("UGAMS43128, House D, Fill above floor, Collagen", 590, 20);
  R_Date("UGAMS-43122, House I, F78 (intrusive), Collagen", 820, 20);
};
Interval("Early to Late interval");
After("Bone between floors")
{
  R_Date("UGAMS-43131, House K, between floors, Collagen", 320, 20);
};
Boundary("Medicine Creek Late begin");
Phase("Medicine Creek Late dates")
{
  R_Date("UGAMS-43130, House K, F12, Collagen", 340, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS43132, House K, F12, Collagen", 290, 20)
  {
    Outlier ("General",0.05);
  };
  Interval("Medicine Creek Late interval",LnN(ln(25),ln(2)));
  Date("Medicine Creek Late Date Est.");
};
Boundary("Medicine Creek Late end");
};
Difference("Early to Late Difference", " Medicine Creek Early Date Est.", " Medicine
Creek Late Date Est.");
};

```

C.1.6 Sully School

Plot("Sully School village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Sully School occupation")
  {
    Boundary("Sully School begin");
    Phase("Sully School dates")
    {
      R_Date("UGAMS-46686, F4, Floor (F54?), Collagen", 550, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46687, F4, C1, Collagen", 670, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46688, F4, C1, Collagen", 620, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46689, F5, C4, Collagen", 650, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46690, F5, C4, Collagen", 640, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46691, F5, C4, Collagen", 640, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46692, F5, C4, Collagen", 750, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46693, F5, C8, Collagen", 740, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46694, F5, C8, Collagen", 710, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46695, F23, C1, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
    }
  }
  Interval("Sully School interval",LnN(ln(50),ln(2)));
}
```

```
Date("Sully School Date Est.");  
};  
Boundary("Sully School end");  
};  
};
```

C.2 Woodland Villages

C.2.1 Flaming Arrow

Plot("Flaming Arrow Village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Flaming Arrow occupation")
  {
    After("pre-Date Est. House 1")
    {
      R_Date("SMU-1273, H1P", 830, 70);
      R_Date("SMU-1297, H1P", 900, 80);
      R_Date("SMU-1270, H1P", 1000, 50);
    };
    Boundary("Flaming Arrow begin");
    Phase("Flaming Arrow dates")
    {
      R_Date("UGAMS-43095, sq.15, Roof/Floor, Collagen", 880, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43096, sq.13, Roof/Floor, Collagen", 840, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43098, sq.12, Floor (outside house), Collagen", 890, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43099, sq.26, Roof/Floor, Collagen", 820, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43094, sq.15, above 438, Collagen", 890, 20)
      {
        Outlier ("General",0.05);
      };
      Interval("Flaming Arrow interval",LnN(ln(25),ln(2)));
      Date("Flaming Arrow Date Est.");
    };
    Boundary("Flaming Arrow end");
  };
};
```

C.2.2 Menoken

```
Plot("Menoken village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Menoken occupation")
  {
    Boundary("Menoken begin");
    Phase("Menoken dates")
    {
      R_Date("UGAMS-32340, H17, F5, Seed", 900, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-19576, H17, Floor, Seed", 870, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-19575, General Level above H17 Hearth, Seed", 845, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32338, F101, above H17 floor, Collagen", 820, 25)
      {
        Outlier ("General",0.05);
      };
      R_Combine("UGAMS-31414")
      {
        R_Date("UGAMS-31414-1, F204, Collagen", 780, 20);
        R_Date("UGAMS-31414-2, F204, Collagen", 800, 25);
        Outlier ("General",0.05);
      };
      R_Combine("UGAMS-31415")
      {
        R_Date("UGAMS-31415-1, H2, Floor, Collagen", 860, 25);
        R_Date("UGAMS-31415-2, H2, Floor, Collagen", 830, 25);
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-31416, H2, Floor, Collagen", 840, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-31417, H2, Floor, Collagen", 830, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-31419, H2, F4, Seed", 880, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-31420, H2, F4, Collagen", 860, 25)
```

```
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-32337, F114, Refuse pit, Collagen", 850, 25)
{
  Outlier ("General",0.05);
};
R_Date("ETH-19573, H2, Roof fall, Charcoal", 825, 55)
{
  Outlier(1);
};
R_Date("ETH-19574, H2, Roof fall, Charcoal", 905, 55)
{
  Outlier(1);
};
Interval("Menoken interval", LnN(ln(25),ln(2)));
Date("Menoken Date Est.");
};
Boundary("Menoken end");
};
};
```

C.3 Coalescent Villages

C.3.1 Arzberger

```
Plot("Arzberger Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Arzberger occupation")
  {
    Boundary("Arzberger begin");
    Phase("Arzberger")
    {
      R_Date("UGAMS43159, H3, F4, Collagen", 562, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43160, H4, F3, Collagen", 517, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43161, H2, F5, Collagen", 524, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43163, H1, F9, Collagen", 547, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43164, H1, F10, Collagen", 554, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43165, H1, F10, Collagen", 523, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43166, H1, F9, Collagen", 559, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
      {
        Outlier(1);
      };
      R_Date("M-1126, X28, Hearth", 500, 82)
      {
        Outlier(1);
      };
    }
  }
};
```

```
Interval("Arzberger interval",LnN(ln(25),ln(2)));  
Date("Arzberger Date Est.");  
};  
Boundary("Arzberger end");  
};  
};
```

C.3.2 Little Pumpkin

Plot("Little Pumpkin village")

```
{
  Sequence("Little Pumpkin occupation")
  {
    Boundary("Little Pumpkin begin");
    Phase("Little Pumpkin")
    {
      R_Date("SMU-2627, F1, charcoal", 330, 60);
      R_Date("SMU-2628, F1, charcoal", 330, 60);
      R_Date("SMU-2629, F4, charcoal", 320, 100);
      Interval("Little Pumpkin interval", LnN(ln(50), ln(2)));
      Date("Little Pumpkin Date Est.");
    };
    Boundary("Little Pumpkin end");
  };
};
```

C.3.3 Lower Grand

Plot("Lower Grand village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Lower Grand occupation")
  {
    Boundary("Lower Grand begin");
    Phase("Lower Grand dates")
    {
      R_Date("RL-300, F102, charcoal", 590, 96)
      {
        Outlier(1);
      };
      R_Date("RL-301, H12, F402, charcoal", 650, 124)
      {
        Outlier(1);
      };
      R_Date("RL-302, F582, charcoal", 490, 96)
      {
        Outlier(1);
      };
      R_Date("RL-303, T6, charcoal", 600, 96)
      {
        Outlier(1);
      };
      R_Date("I-17,912, Chace Pit 1, charcoal", 510, 96)
      {
        Outlier(1);
      };
      R_Date("I-17,913, Chace Pit 4, small wood", 270, 96)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-2689, F59, charcoal", 395, 57)
      {
        Outlier(1);
      };
      R_Date("SMU-2725, F102, charcoal", 326, 66)
      {
        Outlier(1);
      };
      R_Date("ETH-10112, F102, charcoal", 470, 55)
      {
        Outlier(1);
      };
      R_Date("ETH-10412, F3, Maize", 280, 55)
      {
        Outlier ("General",0.05);
      };
    }
  }
  Interval("Lower Grand interval",LnN(ln(50),ln(2)));
```

```
Date("Lower Grand Date Est.");  
};  
Boundary("Lower Grand end");  
};  
};
```

C.3.4 Meander

Plot("Meander village")

```
{
  Sequence("Meander occupation")
  {
    Boundary("Meander begin");
    Phase("Meander dates")
    {
      R_Date("ETH-10116, XU1, Maize", 350, 55);
      R_Date("ETH-10117, XU1, Maize", 395, 55);
      R_Date("ETH-10118, XU1, Fruit Pit", 275, 55);
      Interval("Meander interval", LnN(ln(25), ln(2)));
      Date("Meander Date Est.");
    };
    Boundary("Meander end");
  };
};
```

C.3.5 Over's La Roche

```
Plot("Over's La Roche village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Over's La Roche occupation")
  {
    Boundary("Over's La Roche begin");
    Phase("Over's La Roche dates")
    {
      R_Date("ETH-10414, H1, XU2A, Maize", 250, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-10415, H3, Maize", 420, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-11039, H1, XU2A, Maize", 345, 60)
      {
        Outlier ("General",0.05);
      };
      Interval("Over's La Roche interval",LnN(ln(50),ln(2)));
      Date("Over's La Roche Date Est.");
    };
    Boundary("Over's La Roche end");
  };
};
```

C.3.6 Sully

Plot("Sully village")

```
{
  Sequence("Sully occupation")
  {
    Boundary("Sully begin");
    Phase("Sully dates")
    {
      R_Date("ETH-10416, H1, C4, Maize", 365, 55);
      R_Date("ETH-10417, F206, C7, Squash Seed", 265, 55);
      R_Date("SMU-2726, F206, C8, Maize", 400, 63);
      Interval("Sully interval", LnN(ln(50), ln(2)));
      Date("Sully Date Est.");
    };
    Boundary("Sully end");
  };
};
```

C.3.7 Walth Bay

```
Plot("Walth Bay village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Walth Bay occupation")
  {
    Boundary("Walth Bay begin");
    Phase("Walth Bay dates")
    {
      R_Date("RL-304, H19, F116, Charcoal", 450, 96)
      {
        Outlier(1);
      };
      R_Date("RL-305, H9, F257, Charcoal", 450, 96)
      {
        Outlier(1);
      };
      R_Date("RL-306, H15, F593, charcoal", 380, 96)
      {
        Outlier(1);
      };
      R_Date("RL-307, H16, F741, charcoal", 310, 96)
      {
        Outlier(1);
      };
      R_Date("SMU-2685, H19, F116, charcoal", 320, 63)
      {
        Outlier(1);
      };
      R_Date("SMU-2687, H19, F318, Small Wood", 321, 57)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-2677, H19/21, F387, Charcoal", 322, 64)
      {
        Outlier(1);
      };
      R_Date("SMU-2678, H19/21, F387, Maize", 279, 46)
      {
        Outlier ("General",0.05);
      };
      Interval("Walth Bay interval",LnN(ln(25),ln(2)));
      Date("Walth Bay Date Est.");
    };
    Boundary("Walth Bay end");
  };
};
```

C.3.8 Whistling Elk

```
Plot("Whistling Elk Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Whistling Elk occupation")
  {
    Boundary("Whistling Elk begin");
    Phase("Whistling Elk dates")
    {
      R_Date("UGAMS43149, H2, F23, Collagen", 580, 19)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43154, H2, F29, Maize", 613, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43174, Big House, Collagen", 612, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS43175, Big House, Collagen", 609, 18)
      {
        Outlier ("General",0.05);
      };
      R_Date("UCR2035, H2, Maize,", 650, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("UCR2036, H2, Maize", 550, 70)
      {
```

```
    Outlier ("General",0.05);
  };
  R_Date("UCR2037, H2, Maize", 710, 70)
  {
    Outlier ("General",0.05);
  };
  Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
  Date("Whistling Elk Date Est.");
};
Boundary("Whistling Elk end");
};
};
```

C.4 Middle Missouri Villages

C.4.1 Alberts Creek

Plot("Alberts Creek Village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Alberts Creek occupation")
  {
    Boundary("Alberts Creek begin");
    Phase("Alberts Creek ")
    {
      R_Date("UGAMS-46696, Collagen", 620, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46697, Collagen", 600, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46698, Collagen", 560, 25)
      {
        Outlier ("General",0.05);
      };
      Interval("Alberts Creek interval",LnN(ln(25),ln(2)));
      Date("Alberts Creek Date Est.");
    };
    Boundary("Alberts Creek end");
  };
};
```

C.4.2 Antelope Dreamer

```
Plot("Antelope Dreamer Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Antelope Dreamer occupation")
  {
    Boundary("Antelope Dreamer begin");
    Phase("Antelope Dreamer")
    {
      R_Date("UCR2308, H11, F107, Maize", 660, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("UCR2309, H11, F107, Maize", 735, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("UCR2310, H11, F107, Maize", 720, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("UCR2311, H15, F100, Chrcl", 870, 90)
      {
        Outlier(1);
      };
      R_Date("UCR2312, H15, F103, Chrcl", 800, 90)
      {
        Outlier(1);
      };
      R_Date("UCR2313, H15, F101, Chrcl", 820, 90)
      {
        Outlier(1);
      };
      R_Date("OS-85448, midden, Twigs", 765, 25)
      {
        Outlier ("General",0.05);
      };
      Interval("Antelope Dreamer interval",LnN(ln(25),ln(2)));
      Date("Antelope Dreamer Date Est.");
    };
    Boundary("Antelope Dreamer end");
  };
};
```

C.4.3 Bendish

```
Plot("Bendish Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Bendish occupation")
```

```

{
After("pre-Date Est. occupation")
{
  R_Date("UGAMS-32645, pre-H3, F4, Collagen", 690, 25);
};
Boundary("Bendish begin");
Phase("Bendish")
{
  R_Date("UGAMS-32644, H3, F3, Tooth Enamel", 640, 24)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32646, H3, F8, Collagen", 630, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32647, H3, F12, Collagen", 660, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32648, H3, Floor, Collagen", 660, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32649, H3, PH124, Collagen", 640, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32650, H6, F28, Collagen", 640, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32651, H6, F39, Collagen", 690, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32652, H6, PH170, Collagen", 690, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-32653, H7, Collagen", 720, 25)
  {
    Outlier ("General",0.05);
  };
  R_Date("NWU-17, H7, Charcoal", 620, 105)
  {
    Outlier(1);
  };
  R_Date("NWU-18, H3, Charcoal", 980, 134)
  {
    Outlier(1);
  };
};

```

```
};  
R_Date("NWU-47, H3, F19, Charcoal", 730, 86)  
{  
  Outlier(1);  
};  
R_Date("NWU-48, H6, P169, Charcoal", 1000, 144)  
{  
  Outlier(1);  
};  
Interval("Bendish interval", LnN(ln(25), ln(2)));  
Date("Bendish Date Est.");  
};  
Boundary("Bendish end");  
};  
};
```

C.4.4 Calamity Village

```
Plot("Calamity Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Village occupation")
  {
    Boundary("Calamity begin");
    Phase("Calamity")
    {
      R_Date("UGAMS45838, F56, Inner palisade bastion post, Charcoal", 550, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45840, F56, Outer palisade bastion post, Wood", 610, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45842, F13, Outer palisade bastion, post, Charcoal", 560, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45844, F13, Outter rings of outter palisade bastion post, Wood",
600, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45839, F10, Outer palisade bastion post, Charcoal", 530, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45841, F55, Inner palisade/backing moat post, Charcoal", 530, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS45843, F10, Inner palisade bastion post, Charcoal", 530, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-10111, Uncertain prov., Maize", 665, 60)
      {
        Outlier ("General",0.05);
      };
      Interval("Calamity interval");
      Date("Calamity Date Est.");
    };
    Boundary("Calamity end");
  };
};
```

C.4.5 Cheyenne River

```
Plot("Cheyenne River Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Cheyenne River occupation")
  {
    Boundary("Cheyenne River begin");
    Phase("Cheyenne River")
    {
      R_Date("UGAMS46679, House (F34), Floor, Collagen", 590, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-10413, House (F34), cache 2, Bark", 675, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS46680, House (F5), Floor, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS46670, F34, House Post, Charcoal", 800, 20)
      {
        Outlier(1);
      };
      R_Date("M-840, F34, F103, Charcoal", 650, 105)
      {
        Outlier(1);
      };
      R_Date("I-581, F34, F103, Post, Charcoal", 775, 129)
      {
        Outlier(1);
      };
      Interval("Cheyenne River interval",LnN(ln(25),ln(2)));
      Date("Cheyenne River Date Est.");
    };
    Boundary("Cheyenne River end");
  };
};
```

C.4.6 Clark's Creek

```
Plot("Clark's Creek Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Clark's Creek occupation")
  {
    Boundary("Clark's Creek begin");
    Phase("Clark's Creek")
    {
      R_Date("M-2366, T1, F1", 670, 105)
      {
        Outlier ("General",0.05);
      };
      R_Date("M-2367, T1, F1", 770, 115)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-1286, T1, F1", 750, 59)
      {
        Outlier ("General",0.05);
      };
      Interval("Clark's Creek interval",LnN(ln(25),ln(2)));
      Date("Clark's Creek Date Est.");
    };
    Boundary("Clark's Creek end");
  };
};
```

C.4.7 Cross Ranch

```
Plot("Cross Ranch Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Cross Ranch occupation")
  {
    Boundary("Cross Ranch begin");
    Phase("Cross Ranch dates")
    {
      R_Date("M-2368, F105", 420, 105)
      {
        Outlier ("General",0.05);
      };
      R_Date("M-2369, F158-159", 590, 105)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-1059, H7, F53", 650, 51)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-1202, H7, F63", 530, 59)
      {
        Outlier ("General",0.05);
      };
      R_Date("Beta-66015, cache pit", 660, 77)
      {
        Outlier ("General",0.05);
      };
      R_Date("GX-19395, cache pit", 450, 129)
      {
        Outlier ("General",0.05);
      };
      Interval("Cross Ranch interval",LnN(ln(25),ln(2)));
      Date("Cross Ranch Date Est.");
    };
    Boundary("Cross Ranch end");
  };
};
```

C.4.8 Durkin

Plot("Durkin Village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Durkin occupation")
  {
    After("pre-Date Est.")
    {
      R_Date("UGAMS-45846, H3", 850, 20);
      R_Date("UGAMS-46648, H3", 930, 20);
      R_Date("UGAMS-45845, H6", 880, 20);
      R_Date("UGAMS-46650, H6", 870, 20);
      R_Date("UGAMS-46683, H5", 930, 50);
      R_Date("UGAMS-46649, H5", 760, 20);
    };
    Boundary("Durkin begin");
    Phase("Durkin")
    {
      R_Date("UGAMS-41525, H3, floor, Clgn", 640, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41527, H5, floor, Clgn", 660, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41523, H6, Bark", 640, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41524, H3, floor, Clgn", 670, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-746, H5 floor, chrcl", 655, 60)
      {
        Outlier(1);
      };
      R_Date("WIS-743, H6 floor, chrcl", 640, 55)
      {
        Outlier(1);
      };
      Interval("Durkin interval",LnN(ln(25),ln(2)));
      Date("Durkin Date Est.");
    };
    Boundary("Durkin end");
  };
};
```

C.4.9 Fay Tolton

Plot("Fay Tolton Village")

```

{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Fay Tolton occupation")
  {
    Boundary("Fay Tolton begin");
    Phase("Fay Tolton dates")
    {
      R_Date("M-1082, F2, P", 860, 82)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-722, H2, F10", 885, 59)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-728, H2, F10", 920, 68)
      {
        Outlier ("General",0.05);
      };
      R_Date("NWU-50, N/A", 850, 173)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-10113, H1,B 1B", 865, 60)
      {
        Outlier ("General",0.05);
      };
      Interval("Fay Tolton interval",LnN(ln(25),ln(2)));
      Date("Fay Tolton Date Est.");
    };
    Boundary("Fay Tolton end");
  };
};

```

C.4.10 H.P. Thomas

```
Plot("H.P. Thomas Village")
{
  Sequence("H.P. Thomas occupation")
  {
    Boundary("H.P. Thomas begin");
    Phase("HP Thomas dates")
    {
      R_Date("UGAMS 43088, XU2 subfloor/floor of MMT House below, Collagen", 890,
20);
      R_Date("UGAMS 43089, XU4, Subfloor (cache), Collagen", 870, 20);
      R_Date("UGAMS 43180, XU1, F42, Collagen", 861, 20);
      Interval("H.P. Thomas interval",LnN(ln(50),ln(2)));
      Date("HP Thomas Date Est.");
    };
    Boundary("H.P. Thomas end");
    Before("intrusive contexts")
    {
      R_Date("UGAMS 43179, XU1, F26, Collagen", 212, 20);
      R_Date("UGAMS 43181, XU2, F21, Collagen", 203, 20);
      R_Date("UGAMS 43182, XU2, F32 , Collagen", 201, 20);
    };
  };
};
```

C.4.11 Havens

```
Plot("Havens Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Havens occupation")
  {
    Boundary("Havens begin");
    Phase("Havens dates")
    {
      R_Date("UGAMS-41518, H1, F123, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41519, H1, F124, Collagen", 620, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41520, H1, F129, Collagen", 640, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41521, H1, F130, Collagen", 620, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-41526, H3, PH17, Collagen", 670, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43104, H4, F679, Collagen", 700, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43105, X102, F441, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43106, H2, F216, Collagen", 660, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43108, H4, Floor, Collagen", 670, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43109, H2, F204, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43110, H4, F681, Collagen", 670, 20)
```

```

{
  Outlier ("General",0.05);
};
R_Date("UGAMS-43111, H2, Floor, Collagen", 750, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-43112, H2, F210, Collagen", 750, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-43113, H4, F608, Collagen", 700, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-43114, H4, F541, Collagen", 680, 20)
{
  Outlier ("General",0.05);
};
R_Date("M-2362, F164, Charcoal", 730, 105)
{
  Outlier(1);
};
R_Date("M-2363, F164", Charcoal, 720, 105)
{
  Outlier(1);
};
Interval("Havens interval");
Date("Havens Date Est.");
};
Boundary("Havens end");
};
};
};

```

C.4.12 Helb

Plot("Helb Village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Helb occupation")
  {
    Boundary("Helb begin");
    Phase("Helb dates")
    {
      R_Date("UGAMS-45837, F49, House 7, Post, Charcoal", 760, 20)
      {
        Outlier(1);
      };
      R_Date("UGAMS-45213, F310, House 14, Post, Charcoal", 590, 20)
      {
        Outlier(1);
      };
      R_Date("UGAMS-46674, F88, House 7, Pit, Collagen", 600, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46672, F382, House 14, Pit, Collagen", 580, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46673, F352, House 14, Pit, Collagen", 590, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46671, F464, House 15, Pit, Collagen", 610, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46675, F480, House 15, Pit, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46676, House 15, Floor, Collagen", 610, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-11044, H15, F417, Maize", 600, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-11043, H14, F352, Maize", 515, 55)
      {
        Outlier ("General",0.05);
      };
    }
  }
};
```

```

R_Date("UGAMS-45212, F106, Palisade Post, Charcoal", 590, 20)
{
  Outlier(1);
};
R_Date("RL-299, H8, F12, Charcoal", 430, 96)
{
  Outlier(1);
};
R_Date("NWU-52, F106, H15, F417, Charcoal", 560, 85)
{
  Outlier(1);
};
R_Date("NWU-53, H14, F352, Charcoal", 570, 77)
{
  Outlier(1);
};
R_Date("NWU-55, F97, P, Charcoal", 660, 302)
{
  Outlier(1);
};
Interval("Helb interval",LnN(ln(25),ln(2)));
Date("Helb Date Est.");
};
Boundary("Helb end");
};
};

```

C.4.13 Huff

```
Plot("Huff Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Huff occupation")
  {
    Boundary("Huff begin");
    Phase("Huff dates")
    {
      R_Date("UGAMS-32662, H3, F4, Collagen", 390, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32654, H1, Cache F, Wood", 481, 20)
      {
        Outlier(1);
      };
      R_Date("UGAMS-32655, H1, F4, Collagen", 460, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32656, H1, Floor, Collagen", 430, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32657, H2, F1, Collagen", 450, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32658, H2, Floor, Collagen", 450, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-16071, H6, F87, Charcoal", 660, 60)
      {
        Outlier(1);
      };
      R_Date("UGAMS-32664, H3, F2, Collagen", 460, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32659, H6, F104, Collagen", 450, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32660, H6, F101, Collagen", 430, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32661, H6, F87, Collagen", 430, 20)
```

```

{
  Outlier ("General",0.05);
};
R_Date("UGAMS-34754, F502, Collagen", 438, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-43103, H12 F162, Collagen", 450, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-32666, Test A, F501, Collagen", 480, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-32667, Test A, F501, Collagen", 460, 20)
{
  Outlier ("General",0.05);
};
R_Date("UGAMS-32665, Test A, F501, Collagen", 410, 20)
{
  Outlier ("General",0.05);
};
R_Date ("UGAMS-34755, Test B, F502, Collagen", 436, 20)
{
  Outlier ("General",0.05);
};
R_Date("DRI-3114, H6, F87, Charcoal", 598, 39)
{
  Outlier(1);
};
R_Date("ETH-16072, H6, F102, Charcoal", 730, 65)
{
  Outlier(1);
};
R_Date("ETH-16073, H9, F147, Charcoal", 490, 60)
{
  Outlier(1);
};
R_Date("ETH-21584, Test B, Maize", 335, 50)
{
  Outlier ("General",0.05);
};
R_Date("ETH-21582, Test A, Maize", 355, 50)
{
  Outlier ("General",0.05);
};
R_Date("ETH-21583, Test A, Maize", 455, 50)
{
  Outlier ("General",0.05);
};
};

```

```
R_Date("ETH-21581, Test A, Maize", 475, 55)
{
  Outlier ("General",0.05);
};
R_Date("ETH-21585, Test B, Maize", 455, 50)
{
  Outlier ("General",0.05);
};
R_Date("ETH-21586, Test B, Maize", 500, 50)
{
  Outlier ("General",0.05);
};
Interval("Huff interval",LnN(ln(25),ln(2)));
Date("Huff Date Est.");
};
Boundary("Huff end");
};
};
```

C.4.14 Jake White Bull

```
Plot("Jake White Bull Village")
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Jake White Bull occupation")
  {
    Boundary("Jake White Bull begin");
    Phase("Jake White Bull dates")
    {
      R_Date("SMU2663, Outside and south of House 4, Charcoal", 747, 64)
      {
        Outlier(1);
      };
      R_Date("ETH10109, H4, Maize", 720, 60);
      R_Date("DRI3204, South fortification ditch, Charcoal", 770, 41)
      {
        Outlier(1);
      };
      Interval("Jake White Bull interval",LnN(ln(25),ln(2)));
      Date("Jake White Bull Date Est.");
    };
    Boundary("Jake White Bull end");
  };
};
```

C.4.15 Jiggs Thompson

```
Plot("Jiggs Thompson village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Jiggs Thompson occupation")
  {
    Boundary("Jiggs Thompson begin");
    Phase("Jiggs Thompson dates")
    {
      R_Date("I-1186, N/A", 670, 124)
      {
        Outlier ("General",0.05);
      };
      R_Date("I-1187, N/A", 670, 124)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-11041, X-4 Midden", 770, 60)
      {
        Outlier ("General",0.05);
      };
      Interval("Jiggs interval",LnN(ln(25),ln(2)));
      Date("Jiggs Date Est.");
    };
    Boundary("Jiggs Thompson end");
  };
};
```

C.4.16 Jones

```
Plot("Jones Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Jones occupation")
  {
    Boundary("Jones begin");
    Phase("Jones dates")
    {
      R_Date("DRI-3115, F43, Charcoal", 891, 45)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-16074, F43, Charcoal", 915, 65)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-16075, H2, Charcoal", 945, 65)
      {
        Outlier ("General",0.05);
      };
      R_Date("DRI-3116, T3 F59, Charcoal", 881, 37)
      {
        Outlier ("General",0.05);
      };
      R_Date("DRI-3117, T3 F59, Charcoal", 898, 30)
      {
        Outlier ("General",0.05);
      };
      Interval("Jones interval",LnN(ln(50),ln(2)));
      Date("Jones Date Est.");
    };
    Boundary("Jones end");
  };
};
```

C.4.17 John Ketchen

```
Plot("John Ketchen village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Ketchen occupation")
  {
    Boundary("Ketchen begin");
    Phase("Ketchen dates")
    {
      R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-759, F3, P14", 830, 68)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-762, F17, 157B", 725, 59)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20)
      {
        Outlier ("General",0.05);
      };
      Interval("Ketchen interval",LnN(ln(25),ln(2)));
      Date("Ketchen Date Est.");
    };
    Boundary("Ketchen end");
  };
};
```

C.4.18 King

```
Plot("King village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("King occupation")
  {
    Boundary("King begin");
    Phase("King dates")
    {
      R_Date("UGAMS-43090, XU2, F6", 870, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43091, XU1, Floor", 860, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-43092, XU1, Cache Pit A", 820, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-744, House Post?, Chrcl", 830, 60)
      {
        Outlier(1);
      };
      R_Date("WIS-748, House Post?, Chrcl", 855, 60)
      {
        Outlier(1);
      };
      Interval("King interval",LnN(ln(25),ln(2)));
      Date("King Date Est.");
    };
    Boundary("King end");
  };
};
```

C.4.19 Paul Brave

```
Plot("Paul Brave village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Paul Brave occupation")
  {
    Boundary("Paul Brave begin");
    Phase("Paul Brave dates")
    {
      R_Date("UGAMS-32342, pre-H1, F28, Collagen", 670, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32344, H1, F85, Collagen", 640, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32343, H1, F75, Collagen", 590, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32345, H2, F90, Collagen", 730, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32346, H2, F26, Collagen", 630, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32347, H2, F97, Collagen", 630, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32641, H3, F55, Collagen", 700, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32640, H3, F59, Collagen", 590, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32642, H4 ,F30, Collagen", 700, 20)
      {
        Outlier ("General",0.05);
      };
      R_Date("UGAMS-32643, H4 ,F32, Collagen", 680, 25)
      {
        Outlier ("General",0.05);
      };
      R_Date("M-2364, H2, F42, Charcoal", 920, 105)
    }
  }
}
```

```
{
  Outlier(1);
};
R_Date("M-2365, H2, F42, Charcoal", 850, 105)
{
  Outlier(1);
};
R_Date("DRI-3206, F32, Charcoal", 755, 71)
{
  Outlier(1);
};
R_Date("DRI-3207, F15, Charcoal", 783, 57)
{
  Outlier(1);
};
R_Date("DRI-3208, F46, Charcoal", 674, 70)
{
  Outlier(1);
};
Interval("Paul Brave interval", LnN(ln(50),ln(2)));
Date("Paul Brave Date Est.");
};
Boundary("Paul Brave end");
};
};
```

C.4.21 Shermer

Plot(Shermer village)

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence()
  {
    Boundary("Shermer begin");
    Phase("Shermer dates")
    {
      R_Date("ETH-11045, H4, F417, maize", 620, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("DRI-3205, XU692, F789, charred wood", 518, 51)
      {
        Outlier(1);
      };
      R_Date("ETH-17511, maize", 660, 50)
      {
        Outlier ("General",0.05);
      };
      Interval("Shermer interval",LnN(ln(25),ln(2)));
      Date("Shermer Date Est.");
    };
    Boundary("Shermer end");
  };
};
```

C.4.22 Sommers

```
Plot("Sommers Village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("Sommers occupation")
  {
    Boundary("Sommers begin");
    Phase("Sommers dates")
    {
      Phase("Inside fortifications")
      {
        Phase("XU17")
        {
          R_Date("UGAMS-43176, XU17, Floor, Collagen", 903, 18)
          {
            Outlier ("General",0.05);
          };
          R_Date("UGAMS-43177, XU17, F46, Collagen", 859, 18)
          {
            Outlier ("General",0.05);
          };
        };
      };
      Sequence("XU18")
      {
        After()
        {
          R_Date("Beta-1901, XU18 House Post", 1080, 60);
          R_Date("Beta-1902, XU18 House Post", 1240, 70);
          R_Date("Beta-1903, XU18 House Post", 1090, 60);
        };
        Boundary("XU18 begin");
        Phase("XU18")
        {
          R_Date("UGAMS-43080, XU18, F59, Collagen", 900, 20)
          {
            Outlier ("General",0.05);
          };
          R_Date("UGAMS-43081, XU18, F69, Collagen", 880, 20)
          {
            Outlier ("General",0.05);
          };
          R_Date("UGAMS-43178, XU18, F56, Collagen", 835, 18)
          {
            Outlier ("General",0.05);
          };
          R_Date("SMU-2736, XU18, house fill, Grass", 972, 73)
          {
            Outlier ("General",0.05);
          };
          R_Date("ETH-10419, XU18, floor fill, Maize", 835, 50)
          {
```

```

    Outlier ("General",0.05);
};
};
Boundary("XU18 end");
};
Interval("Inside Fortifications interval");
Date("Inside fortifications Date Est.");
};
Phase("Outside fortifications")
{
Phase("XU21")
{
R_Date("UGAMS-43075, XU21, F33, Collagen", 870, 20)
{
Outlier ("General",0.05);
};
R_Date("UGAMS-43077, XU21, F41, Collagen", 870, 19)
{
Outlier ("General",0.05);
};
R_Date("UGAMS-43085, XU21, F33, Collagen", 860, 20)
{
Outlier ("General",0.05);
};
};
};
Sequence("XU70")
{
After()
{
R_Date("Beta1904, XU70 House Post", 1420, 70);
R_Date("Beta1905, XU70 House Post", 1280, 60);
R_Date("Beta1906, XU70 House Post", 950, 60);
};
Boundary("XU70 begin");
Phase("XU70")
{
R_Date("UGAMS-43072, XU70, F88, Collagen", 870, 20)
{
Outlier ("General",0.05);
};
R_Date("UGAMS-43076, XU70, F95, Collagen", 890, 20)
{
Outlier ("General",0.05);
};
R_Date("ETH-11073, XU70 entrance, 3.5-4.0 ft sd, Maize", 940, 60)
{
Outlier ("General",0.05);
};
};
};
Boundary("XU70 end");
};

```

```

Phase("XU75")
{
  R_Date("UGAMS-43086, XU75, Floor, Collagen", 910, 20)
  {
    Outlier ("General",0.05);
  };
};
Interval("Outside Fortifications interval");
Date("Outside fortifications Date Est.");
};
Sequence("XU85")
{
  Phase("base of disch")
  {
    R_Date("UGAMS-43071, XU85 (Bottom Fort. Ditch), F133, Collagen", 920, 20)
    {
      Outlier ("General",0.05);
    };
    R_Date("UGAMS-43079, XU85 (Bottom Fort. Ditch), F133, Collagen", 880, 20)
    {
      Outlier ("General",0.05);
    };
  };
};
Phase("6'")
{
  R_Date("UGAMS-43073, XU85 (6' BS Fort. Ditch), F133, Collagen", 890, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-43074, XU85 (6' BS Fort. Ditch), F133, Collagen", 880, 20)
  {
    Outlier ("General",0.05);
  };
};
Phase("5.5-6'")
{
  R_Date("UGAMS-43082, XU85 (5.5-6' BS Fort. Ditch), F133, Collagen", 900, 20)
  {
    Outlier ("General",0.05);
  };
  R_Date("UGAMS-43083, XU85 (5.5-6' BS Fort. Ditch), F133, Collagen", 900, 20)
  {
    Outlier ("General",0.05);
  };
};
Phase("5-5.5'")
{
  R_Date("UGAMS-43078, XU85 (5-5.5' BS Fort. Ditch), F134, Collagen", 870, 20)
  {
    Outlier ("General",0.05);
  };
};

```

```
R_Date("UGAMS-43084, XU85 (5-5.5' BS Fort. Ditch), F134, Collagen", 860, 21)
{
  Outlier ("General",0.05);
};
};
Interval("Sommers interval");
Date("Sommers Date Est.");
};
Boundary("Sommers end");
};
Difference("Difference inside outside", "Outside fortifications Date Est.", "Inside
fortifications Date Est.");
};
```

C.4.23 South Cannonball

Plot("South Cannonball village")

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("South Cannonball occupation")
  {
    Boundary("South Cannonball begin");
    Phase("South Cannonball dates")
    {
      R_Date("WIS-1011, F93, Post 3, Uncarbonized Wood", 760, 70)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1098, F93, Post 1, Uncarbonized Wood", 750, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1100, F74, Uncarbonized Wood", 740, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1110, F7, Post 75, Uncarbonized Wood", 680, 70)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1106, F5, Post 79, Uncarbonized Wood", 660, 70)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1105, F7, Post 33, Uncarbonized Wood", 630, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1104, F16, Post 1, Uncarbonized Wood", 600, 70)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1097, F16, Post 50, Uncarbonized Wood", 570, 70)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1103, F15, Post 27, Uncarbonized Wood", 560, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("WIS-1102, F13, Post 29, Uncarbonized Wood", 510, 70)
      {
        Outlier ("General",0.05);
      };
      Interval("South Cannonball interval",LnN(ln(50),ln(2)));
      Date("South Cannonball Date Est.");
    }
  }
}
```

```
};  
Boundary("South Cannonball end");  
};  
};
```

C.4.24 Stony Point

```
Plot("Stony Point village")
{
  Sequence("Stony Point occupation")
  {
    Boundary("Stony Point begin");
    Phase("Stony Point dates")
    {
      R_Date("UCR-2314, HA, Charcoal", 685, 60);
      R_Date("UCR-2315, HA, Charcoal", 840, 50);
      Interval("Stony Point interval",LnN(ln(50),ln(2)));
      Date("Stony Point Date Est.");
    };
    Boundary("Stony Point end");
    Before("intrusive")
    {
      R_Date("GX-13406, Charcoal", 95, 75);
    };
  };
};
```

C.4.25 Swanson

```
Plot("Swanson village")
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Swanson occupation")
  {
    Boundary("Swanson begin");
    Phase("Swanson dates")
    {
      R_Date("WIS-553, H2, Post C, uncharred wood", 810, 55)
      {
        Outlier(1);
      };
      R_Date("WIS-554, ST.T, No 1, uncharred wood", 810, 60)
      {
        Outlier(1);
      };
      R_Date("WIS-651, H1, Post 2", 955, 60)
      {
        Outlier(1);
      };
      R_Date("WIS-660, H2, Post C", 935, 55)
      {
        Outlier(1);
      };
      Interval("Swanson interval",LnN(ln(50),ln(2)));
      Date("Swanson Date Est.");
    };
    Boundary("Swanson end");
  };
};
```

C.4.26 Travis I

```
Plot("Travis I village")
{
  Sequence("Travis I occupation")
  {
    Boundary("Travis I begin");
    Phase("Travis I dates")
    {
      R_Date("WIS-1709, F36", 780, 70);
      R_Date("WIS-1710, F18", 780, 70);
      Interval("Travis I interval", LnN(ln(25), ln(2)));
      Date("Travis I Date Est.");
    };
    Boundary("Travis I end");
  };
};
```

C.4.27 Vanderbilt

```
Plot("Vanderbilt village")
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("Vanderbilt occupation")
  {
    Boundary("Vanderbilt begin");
    Phase("Vanderbilt dates")
    {
      R_Date("DRI-3113, F6, Charcoal", 673, 44)
      {
        Outlier(1);
      };
      R_Date("ETH-16069, F6, Maize", 745, 65);
      R_Date("ETH-16070, H11, Charcoal", 750, 65)
      {
        Outlier(1);
      };
      Interval("Vanderbilt interval",LnN(ln(25),ln(2)));
      Date("Vanderbilt Date Est.");
    };
    Boundary("Vanderbilt end");
  };
};
```

C.4.28 White Buffalo Robe

```
Plot("White Buffalo Robe village")
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence("White Buffalo Robe occupation")
  {
    Boundary("White Buffalo Robe begin");
    Phase("White Buffalo Robe dates")
    {
      R_Date("SMU-796, H1, F144", 580, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-724, H1, F118", 692, 59)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-794, H1, F121", 742, 60)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-729, H6, F38", 608, 52)
      {
        Outlier ("General",0.05);
      };
      R_Date("SMU-732, H8, F240", 703, 63)
      {
        Outlier ("General",0.05);
      };
      Interval("White Buffalo Robe interval",LnN(ln(25),ln(2)));
      Date("White Buffalo Robe Date Est.");
    };
    Boundary("White Buffalo Robe end");
  };
};
```

C.4.29 32MO291

Plot(32MO129)

```
{
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence("32MO129 occupation")
  {
    Boundary("32MO129 begin");
    Phase("32MO129")
    {
      R_Date("ETH-18092, F25, Maize Cupule, AMS", 425, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-18093, F25, Maize Cupule, AMS", 520, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-18094, F35, Maize Kernel, AMS", 430, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-18095, F35, Unid. Seed, AMS", 425, 55)
      {
        Outlier ("General",0.05);
      };
      R_Date("DRI-3375, F35, Unid. Wood charcoal, Conv", 505, 69)
      {
        Outlier(1);
      };
      R_Date("ETH-18096, F40, Maize Kernel, AMS", 420, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-18097, F40, Bean Seed, AMS", 480, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("DRI-3376, F40, Unid. Wood charcoal, Conv", 545, 53)
      {
        Outlier(1);
      };
      R_Date("ETH-18098, F41, Maize Kernel, AMS", 405, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("ETH-18099, F41, Maize Kernel, AMS", 375, 50)
      {
        Outlier ("General",0.05);
      };
      R_Date("DRI-3377, F41, Unid. Wood charcoal, Conv", 603, 92)
```

```

{
  Outlier(1);
};
R_Date("ETH-18100, F50, Bean Seed, AMS", 565, 50)
{
  Outlier ("General",0.05);
};
R_Date("ETH-18101, F50, Bean Seed, AMS", 390, 50)
{
  Outlier ("General",0.05);
};
R_Date("DRI-3378, F50, Unid. Wood charcoal, Conv", 480, 62)
{
  Outlier(1);
};
R_Date("ETH-18102, F58, Bean Seed, AMS", 430, 50)
{
  Outlier ("General",0.05);
};
R_Date("DRI-3379, F58, Unid. Wood charcoal, Conv", 524, 54)
{
  Outlier(1);
};
R_Date("DRI-3380, F60, Unid. Wood charcoal, Conv", 604, 58)
{
  Outlier(1);
};
R_Date("ETH-18104, F76, Maize Kernel, AMS", 350, 50)
{
  Outlier ("General",0.05);
};
R_Date("ETH-18105, F76, Maize Kernel, AMS", 505, 50)
{
  Outlier ("General",0.05);
};
R_Date("DRI-3381, F76, Unid. Wood charcoal, Conv", 859, 58)
{
  Outlier(1);
};
Interval("32MO129 interval",LnN(ln(50),ln(2)));
Date("32MO129 Date Est.");
};
Boundary("32MO129 end");
};
};

```

C.5 Difference Models

C.5.1 Arzberger vs. Alberts Creek

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Alberts Creek")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Alberts Creek")
    {
      Boundary("Alberts Creek begin");
      Phase("Alberts Creek occupation")
      {
        R_Date("UGAMS-46696, Collagen", 620, 20);
        R_Date("UGAMS-46697, Collagen", 600, 20);
        R_Date("UGAMS-46698, Collagen", 560, 25);
        Interval("Alberts Creek interval",LnN(ln(25),ln(2)));
        Date("Alberts Creek date");
      };
      Boundary("Alberts Creek end");
    };
  };
  Difference("begin-begin", "Alberts Creek begin", "Arzberger begin");
  Difference("end-begin", "Alberts Creek end", "Arzberger begin");
  Difference("begin-end", "Alberts Creek begin", "Arzberger end");
}
```

```
Difference("end-end", "Alberts Creek end", "Arzberger end");  
Difference("date-date", "Alberts Creek date", "Arzberger date");  
Difference("date-begin", "Alberts Creek date", "Arzberger begin");  
Difference("date-end", "Alberts Creek date", "Arzberger end");  
Difference("begin-date", "Alberts Creek begin", "Arzberger date");  
Difference("end-date", "Alberts Creek end", "Arzberger date");  
};
```

C.5.2 Arzberger vs. Antelope Dreamer

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Antelope Dreamer")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Antelope Dreamer Village")
    {
      Boundary("Antelope Dreamer begin");
      Phase("Antelope Dreamer")
      {
        R_Date("UCR2308, H11, F107, Maize", 660, 50);
        R_Date("UCR2309, H11, F107, Maize", 735, 50);
        R_Date("UCR2310, H11, F107, Maize", 720, 50);
        R_Date("UCR2311, H15, F100, Chrcl", 870, 90)
        {
          Outlier(1);
        };
        R_Date("UCR2312, H15, F103, Chrcl", 800, 90)
        {
          Outlier(1);
        };
        R_Date("UCR2313, H15, F101, Chrcl", 820, 90)
        {
          Outlier(1);
        };
      };
    };
  };
}
```

```

};
R_Date("OS-85448, midden, Twigs", 765, 25);
Interval("Antelope Dreamer interval", LnN(ln(25), ln(2)));
Date("Antelope Dreamer date");
};
Boundary("Antelope Dreamer end");
};
};
Difference("begin-begin", "Antelope Dreamer begin", "Arzberger begin");
Difference("end-begin", "Antelope Dreamer end", "Arzberger begin");
Difference("begin-end", "Antelope Dreamer begin", "Arzberger end");
Difference("end-end", "Antelope Dreamer end", "Arzberger end");
Difference("date-date", "Antelope Dreamer date", "Arzberger date");
Difference("date-begin", "Antelope Dreamer date", "Arzberger begin");
Difference("date-end", "Antelope Dreamer date", "Arzberger end");
Difference("begin-date", "Antelope Dreamer begin", "Arzberger date");
Difference("end-date", "Antelope Dreamer end", "Arzberger date");
};

```

C.5.3 Arzberger vs.Cattle Oiler

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Cattle Oiler")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Cattle Oiler village")
    {
      Boundary("Cattle Oiler early begins");
      Phase("Cattle Oiler early")
      {
        R_Date("UGAMS45201, H1, F88, Collagen", 870, 20);
        R_Date("UGAMS45207, H1, F88, Collagen", 860, 20);
        R_Date("UGAMS43184, H1, Floor, Collagen", 865, 18);
        R_Date("UGAMS43185, H2, F54, Collagen", 866, 18);
        R_Date("UGAMS43191, H2, F55, Collagen", 876, 18);
        R_Date("UGAMS45192, H2, F54, Collagen", 860, 20);
        R_Date("UGAMS45195, H2, Floor, Collagen", 910, 20);
        R_Date("UGAMS45196, H2, F43, Collagen", 840, 20);
        R_Date("UGAMS45200, H2, F43, Collagen", 850, 20);
        R_Date("UGAMS45198, H3, F49, Collagen", 850, 20);
        R_Date("UGAMS43189, H3, Floor, Collagen", 897, 18);
        R_Date("UGAMS43183, F71 Pit outside H3, Collagen", 884, 20);
        R_Date("UGAMS45199, H4, F64, Collagen", 870, 20);
        R_Date("UGAMS45203, H4, F64, Collagen", 870, 35);
      }
    }
  }
}
```

```

R_Date("UGAMS45193, H5, F137, Collagen", 860, 20);
R_Date("UGAMS45204, H5, Floor F124, Collagen", 910, 25);
R_Date("UGAMS45206, H5, Floor F124, Collagen", 860, 20);
R_Date("UGAMS45190, H6, F135, Collagen", 881, 18);
R_Date("UGAMS45194, H6, F145, Collagen", 870, 20);
R_Date("UGAMS45208, H6, Floor F130, Collagen", 870, 20);
Interval("Cattle Oiler early interval",LnN(ln(25),ln(2)));
Date("Cattle Oiler early date est.");
};
Boundary("Cattle Oiler early end");
Interval("early to late occupations interval");
Boundary("Cattle Oiler late begin");
Phase("H7 - Cattle Oiler late")
{
  R_Date("UGAMS-43101, H7, F27, Collagen", 600, 20);
  R_Date("UGAMS-43102, H7, F27, Collagen", 630, 20);
  R_Date("UGAMS-45197, H7, F17, Collagen", 610, 20);
  R_Date("UGAMS-45202, H7, F32, Collagen", 630, 20);
  R_Date("UGAMS-45205, H7, F24, Collagen", 610, 20);
  R_Date("UGAMS-45209, H7, F17, Collagen", 590, 30);
  R_Date("ETH-11040, F98, Grass", 690, 60);
  Interval("Cattle Oiler late interval",LnN(ln(25),ln(2)));
  Date("Cattle Oiler late date");
};
Boundary("Cattle Oiler late end");
};
};
Difference("begin-begin", "Cattle Oiler late begin", "Arzberger begin");
Difference("end-begin", "Cattle Oiler late end", "Arzberger begin");
Difference("begin-end", "Cattle Oiler late begin", "Arzberger end");
Difference("end-end", "Cattle Oiler late end", "Arzberger end");
Difference("date", "Cattle Oiler late date", "Arzberger date");
Difference("date-begin", "Cattle Oiler late date", "Arzberger begin");
Difference("date-end", "Cattle Oiler late date", "Arzberger end");
Difference("begin-date", "Cattle Oiler late begin", "Arzberger date");
Difference("end-date", "Cattle Oiler late end", "Arzberger date");
};

```

C.5.4 Arzberger vs. Cheyenne River

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Cheyenne River")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Cheyenne River village")
    {
      Boundary("Cheyenne River begin");
      Phase("Cheyenne River")
      {
        R_Date("UGAMS46679, House (F34), Floor, Collagen", 590, 20);
        R_Date("ETH-10413, House (F34), cache 2, Bark", 675, 50);
        R_Date("UGAMS46680, House (F5), Floor, Collagen", 630, 20);
        R_Date("UGAMS46670, F34, House Post, Charcoal", 800, 20)
        {
          Outlier(1);
        };
        R_Date("M-840, F34, F103, Charcoal", 650, 105)
        {
          Outlier(1);
        };
        R_Date("I-581, F34, F103, Post, Charcoal", 775, 129)
        {
          Outlier(1);
        };
      };
    };
  };
}
```

```
};
Interval("Cheyenne River interval",LnN(ln(25),ln(2)));
Date("Cheyenne River date");
};
Boundary("Cheyenne River end");
};
};
Difference("begin-begin", "Cheyenne River begin", "Arzberger begin");
Difference("end-begin", "Cheyenne River end", "Arzberger begin");
Difference("begin-end", "Cheyenne River begin", "Arzberger end");
Difference("end-end", "Cheyenne River end", "Arzberger end");
Difference("date", "Cheyenne River date", "Arzberger date");
Difference("date-begin", "Cheyenne River date", "Arzberger begin");
Difference("date-end", "Cheyenne River date", "Arzberger end");
Difference("begin-date", "Cheyenne River begin", "Arzberger date");
Difference("end-date", "Cheyenne River end", "Arzberger date");
};
```

C.5.5 Arzberger vs. Durkin

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Durkin")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Durkin village")
    {
      Boundary("Durkin begin");
      Phase("Durkin")
      {
        R_Date("UGAMS-45846, H3, house post", 850, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46648, H3, house post", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-45845, H6, house post", 880, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46650, H6, house post", 870, 20)
        {
```

```

    Outlier(1);
};
R_Date("UGAMS-46683, H5, house post", 930, 50)
{
    Outlier(1);
};
R_Date("UGAMS-46649, H5, house post", 760, 20)
{
    Outlier(1);
};
R_Date("UGAMS-41525, H3, floor, Clgn", 640, 20);
R_Date("UGAMS-41527, H5, floor, Clgn", 660, 20);
R_Date("UGAMS-41523, H6, Bark", 640, 20);
R_Date("UGAMS-41524, H3, floor, Clgn", 670, 20);
R_Date("WIS-746, H5 floor, chrcl", 655, 60)
{
    Outlier(1);
};
R_Date("WIS-743, H6 floor, chrcl", 640, 55)
{
    Outlier(1);
};
Interval("Durkin interval",LnN(ln(25),ln(2)));
Date("Durkin date");
};
Boundary("Durkin end");
};
};
Difference("begin-begin", "Durkin begin", "Arzberger begin");
Difference("end-begin", "Durkin end", "Arzberger begin");
Difference("begin-end", "Durkin begin", "Arzberger end");
Difference("end-end", "Durkin end", "Arzberger end");
Difference("date", "Durkin date", "Arzberger date");
Difference("date-begin", "Durkin date", "Arzberger begin");
Difference("date-end", "Durkin date", "Arzberger end");
Difference("begin-date", "Durkin begin", "Arzberger date");
Difference("end-date", "Durkin end", "Arzberger date");
};

```

C.5.6 Arzberger vs. Indian Creek

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Indian Creek Early")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Indian Creek occupation")
    {
      Boundary("Indian Creek Early begin");
      Phase("Indian Creek")
      {
        R_Date("UGAMS-46700, Collagen", 620, 20);
        R_Date("UGAMS-46701, Collagen", 670, 25);
        R_Date("UGAMS-46702, Collagen", 540, 25);
        R_Date("UGAMS-46703, Collagen", 590, 25);
        R_Date("UGAMS-46704, Collagen", 590, 20);
        R_Date("UGAMS-46705, Collagen", 580, 20);
        R_Date("UGAMS-46706, Collagen", 690, 25);
        R_Date("UGAMS-46707, Collagen", 660, 25);
        Interval("Indian Creek Early interval",LnN(ln(25),ln(2)));
        Date("Indian Creek Early date");
      };
      Boundary("Indian Creek Early end");
      Interval("Early to Late interval");
      Boundary("Indian Creek Late begin");
    };
  };
}
```

```

Phase("Indian Creek Late")
{
  R_Date("I-18,039, F43", 330, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,040, F30", 450, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,041, F7", 300, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,042, F5", 330, 86)
  {
    Outlier(1);
  };
  Interval("Indian Creek Late interval",LnN(ln(25),ln(2)));
  Date("Indian Creek Late date");
};
Boundary("Indian Creek Late end");
};
};
Difference("begin-begin", "Indian Creek Early begin", "Arzberger begin");
Difference("end-begin", "Indian Creek Early end", "Arzberger begin");
Difference("begin-end", "Indian Creek Early begin", "Arzberger end");
Difference("end-end", "Indian Creek Early end", "Arzberger end");
Difference("date", "Indian Creek Early date", "Arzberger date");
Difference("date-begin", "Indian Creek Early date", "Arzberger begin");
Difference("date-end", "Indian Creek Early date", "Arzberger end");
Difference("begin-date", "Indian Creek Early begin", "Arzberger date");
Difference("end-date", "Indian Creek Early end", "Arzberger date");
};

```

C.5.7 Arzberger vs. Jiggs Thompson

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Jiggs Thompson")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Village occupation")
    {
      Boundary("Jiggs Thompson begin");
      Phase("Jiggs Thompson")
      {
        R_Date("I-1186, N/A", 670, 124);
        R_Date("I-1187, N/A", 670, 124);
        R_Date("ETH-11041, X-4 Midden", 770, 60);
        Interval("Jiggs interval",LnN(ln(25),ln(2)));
        Date("Jiggs date");
      };
      Boundary("Jiggs Thompson end");
    };
  };
  Difference("begin-begin", "Jiggs Thompson begin", "Arzberger begin");
  Difference("end-begin", "Jiggs Thompson end", "Arzberger begin");
  Difference("begin-end", "Jiggs Thompson begin", "Arzberger end");
  Difference("end-end", "Jiggs Thompson end", "Arzberger end");
  Difference("date", "Jiggs date", "Arzberger date");
}
```

```
Difference("date-begin", "Jiggs date", "Arzberger begin");  
Difference("date-end", "Jiggs date", "Arzberger end");  
Difference("begin-date", "Jiggs Thompson begin", "Arzberger date");  
Difference("end-date", "Jiggs Thompson end", "Arzberger date");  
};
```

Arzberger vs. Ketchen

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Ketchen")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Ketchen village")
    {
      Boundary("Ketchen begin");
      Phase("Ketchen")
      {
        R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20);
        R_Date("WIS-759, F3, P14", 830, 68);
        R_Date("WIS-762, F17, 157B", 725, 59);
        R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20);
        Interval("Ketchen interval",LnN(ln(25),ln(2)));
        Date("Ketchen date");
      };
      Boundary("Ketchen end");
    };
  };
  Difference("begin-begin", "Ketchen begin", "Arzberger begin");
  Difference("end-begin", "Ketchen end", "Arzberger begin");
  Difference("begin-end", "Ketchen begin", "Arzberger end");
  Difference("end-end", "Ketchen end", "Arzberger end");
}
```

```
Difference("date", "Ketchen date", "Arzberger date");  
Difference("date-begin", "Ketchen date", "Arzberger begin");  
Difference("date-end", "Ketchen date", "Arzberger end");  
Difference("begin-date", "Ketchen begin", "Arzberger date");  
Difference("end-date", "Ketchen end", "Arzberger date");  
};
```

C.5.8 Arzberger vs. Stony Point

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Alberts Creek")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Stony Point Occupation")
    {
      Boundary("Stony Point begin");
      Phase("Stony Point")
      {
        R_Date("UCR-2314, HA, Charcoal", 685, 60);
        R_Date("UCR-2315, HA, Charcoal", 840, 50);
        Interval("Stony Point interval",LnN(ln(50),ln(2)));
        Date("Stony Point date");
      };
      Boundary("Stony Point end");
    };
  };
  Difference("begin-begin", "Stony Point begin", "Arzberger begin");
  Difference("end-begin", "Stony Point end", "Arzberger begin");
  Difference("begin-end", "Stony Point begin", "Arzberger end");
  Difference("end-end", "Stony Point end", "Arzberger end");
  Difference("date-date", "Stony Point date", "Arzberger date");
  Difference("date-begin", "Stony Point date", "Arzberger begin");
}
```

```
Difference("date-end", "Stony Point date", "Arzberger end");  
Difference("begin-date", "Stony Point begin", "Arzberger date");  
Difference("end-date", "Stony Point end", "Arzberger date");  
};
```

C.5.9 Arzberger vs. Sully School

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Sully School")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Sully School Village")
    {
      Boundary("Sully School begin");
      Phase("Sully School")
      {
        R_Date("UGAMS-46686, F4, Floor (F54?), Collagen", 550, 25);
        R_Date("UGAMS-46687, F4, C1, Collagen", 670, 25);
        R_Date("UGAMS-46688, F4, C1, Collagen", 620, 20);
        R_Date("UGAMS-46689, F5, C4, Collagen", 650, 25);
        R_Date("UGAMS-46690, F5, C4, Collagen", 640, 25);
        R_Date("UGAMS-46691, F5, C4, Collagen", 640, 25);
        R_Date("UGAMS-46692, F5, C4, Collagen", 750, 20);
        R_Date("UGAMS-46693, F5, C8, Collagen", 740, 20);
        R_Date("UGAMS-46694, F5, C8, Collagen", 710, 20);
        R_Date("UGAMS-46695, F23, C1, Collagen", 630, 20);
        Interval("Sully School interval",LnN(ln(50),ln(2)));
        Date("Sully School date");
      };
      Boundary("Sully School end");
    };
  };
}
```

```
};  
};  
Difference("begin-begin", "Sully School begin", "Arzberger begin");  
Difference("end-begin", "Sully School end", "Arzberger begin");  
Difference("begin-end", "Sully School begin", "Arzberger end");  
Difference("end-end", "Sully School end", "Arzberger end");  
Difference("date", "Sully School date", "Arzberger date");  
Difference("date-begin", "Sully School date", "Arzberger begin");  
Difference("date-end", "Sully School date", "Arzberger end");  
Difference("begin-date", "Sully School begin", "Arzberger date");  
Difference("end-date", "Sully School end", "Arzberger date");  
};
```

C.5.10 Black Partizan Early vs. Alberts Creek

Plot()

```
{
Phase("Black Partizan Early v. Alberts Creek")
{
Sequence("Black Partizan village")
{
Boundary("Black Partizan Early begin");
Phase("Black Partizan early w/in fortification")
{
R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early date");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
Sequence("Alberts Creek")
{
Boundary("Alberts Creek begin");
Phase("Alberts Creek occupation")
{
R_Date("UGAMS-46696, Collagen", 620, 20);
R_Date("UGAMS-46697, Collagen", 600, 20);
R_Date("UGAMS-46698, Collagen", 560, 25);
Interval("Alberts Creek interval",LnN(ln(25),ln(2)));
Date("Alberts Creek date");
};
Boundary("Alberts Creek end");
};
};
Difference("begin-begin", "Alberts Creek begin", "Black Partizan Early begin");
Difference("end-begin", "Alberts Creek end", "Black Partizan Early begin");
Difference("begin-end", "Alberts Creek begin", "Black Partizan Early end");
```

```
Difference("end-end", "Alberts Creek end", "Black Partizan Early end");
Difference("date", "Alberts Creek date", "Black Partizan Early date");
Difference("date-begin", "Alberts Creek date", "Black Partizan Early begin");
Difference("date-end", "Alberts Creek date", "Black Partizan Early end");
Difference("begin-date", "Alberts Creek begin", "Black Partizan Early date");
Difference("end-date", "Alberts Creek end", "Black Partizan Early date");
};
```

C.5.11 Black Partizan Early vs. Antelope Dreamer

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Black Partizan Early v. Antelope Dreamer")
  {
    Sequence("Black Partizan village")
    {
      Boundary("Black Partizan Early begin");
      Phase("Black Partizan early w/in fortification")
      {
        R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
        R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
        R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
        R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
        R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
        R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
        R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
        R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
        R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
        Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Early date");
      };
      Boundary("Black Partizan Early end");
      Interval("Interval early to late occupations");
      Boundary("Black Partizan Late occupation begin");
      Phase("House 2")
      {
        R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
        R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
        Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Late date");
      };
      Boundary("Black Partizan Late end");
    };
    Sequence("Antelope Dreamer village")
    {
      Boundary("Antelope Dreamer begin");
      Phase("Antelope Dreamer")
      {
        R_Date("UCR2308, H11, F107, Maize", 660, 50);
        R_Date("UCR2309, H11, F107, Maize", 735, 50);
        R_Date("UCR2310, H11, F107, Maize", 720, 50);
        R_Date("UCR2311, H15, F100, Chrcl", 870, 90)
        {
          Outlier(1);
        };
        R_Date("UCR2312, H15, F103, Chrcl", 800, 90)
        {
          Outlier(1);
        };
      };
    };
  };
}
```

```

R_Date("UCR2313, H15, F101, Chrcl", 820, 90)
{
  Outlier(1);
};
R_Date("OS-85448, midden, Twigs", 765, 25);
Interval("Antelope Dreamer interval", LnN(Ln(25), Ln(2)));
Date("Antelope Dreamer date");
};
Boundary("Antelope Dreamer end");
};
};
Difference("begin-begin", "Antelope Dreamer begin", "Black Partizan Early begin");
Difference("end-begin", "Antelope Dreamer end", "Black Partizan Early begin");
Difference("begin-end", "Antelope Dreamer begin", "Black Partizan Early end");
Difference("end-end", "Antelope Dreamer end", "Black Partizan Early end");
Difference("date", "Antelope Dreamer date", "Black Partizan Early date");
Difference("date-begin", "Antelope Dreamer date", "Black Partizan Early begin");
Difference("date-end", "Antelope Dreamer date", "Black Partizan Early end");
Difference("begin-date", "Antelope Dreamer begin", "Black Partizan Early date");
Difference("end-date", "Antelope Dreamer end", "Black Partizan Early date");
};

```

C.5.12 Black Partizan Early vs.Cattle Oiler

```
Plot()
{
Phase("Black Partizan Early v. Cattle Oiler late")
{
Sequence("Black Partizan village")
{
Boundary("Black Partizan Early begin");
Phase("Black Partizan early w/in fortification")
{
R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early date");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
Sequence("Cattle Oiler village")
{
Boundary("Cattle Oiler early begins");
Phase("Cattle Oiler early")
{
R_Date("UGAMS45201, H1, F88, Collagen", 870, 20);
R_Date("UGAMS45207, H1, F88, Collagen", 860, 20);
R_Date("UGAMS43184, H1, Floor, Collagen", 865, 18);
R_Date("UGAMS43185, H2, F54, Collagen", 866, 18);
R_Date("UGAMS43191, H2, F55, Collagen", 876, 18);
R_Date("UGAMS45192, H2, F54, Collagen", 860, 20);
R_Date("UGAMS45195, H2, Floor, Collagen", 910, 20);
R_Date("UGAMS45196, H2, F43, Collagen", 840, 20);
R_Date("UGAMS45200, H2, F43, Collagen", 850, 20);
R_Date("UGAMS45198, H3, F49, Collagen", 850, 20);
R_Date("UGAMS43189, H3, Floor, Collagen", 897, 18);
R_Date("UGAMS43183, F71 Pit outside H3, Collagen", 884, 20);
```

```

R_Date("UGAMS45199, H4, F64, Collagen", 870, 20);
R_Date("UGAMS45203, H4, F64, Collagen", 870, 35);
R_Date("UGAMS45193, H5, F137, Collagen", 860, 20);
R_Date("UGAMS45204, H5, Floor F124, Collagen", 910, 25);
R_Date("UGAMS45206, H5, Floor F124, Collagen", 860, 20);
R_Date("UGAMS45190, H6, F135, Collagen", 881, 18);
R_Date("UGAMS45194, H6, F145, Collagen", 870, 20);
R_Date("UGAMS45208, H6, Floor F130, Collagen", 870, 20);
Interval("Cattle Oiler early interval",LnN(ln(25),ln(2)));
Date("Cattle Oiler early date est.");
};
Boundary("Cattle Oiler early end");
Interval("early to late occupations interval");
Boundary("Cattle Oiler late begin");
Phase("H7 - Cattle Oiler late")
{
  R_Date("UGAMS-43101, H7, F27, Collagen", 600, 20);
  R_Date("UGAMS-43102, H7, F27, Collagen", 630, 20);
  R_Date("UGAMS-45197, H7, F17, Collagen", 610, 20);
  R_Date("UGAMS-45202, H7, F32, Collagen", 630, 20);
  R_Date("UGAMS-45205, H7, F24, Collagen", 610, 20);
  R_Date("UGAMS-45209, H7, F17, Collagen", 590, 30);
  R_Date("ETH-11040, F98, Grass", 690, 60);
  Interval("Cattle Oiler late interval",LnN(ln(25),ln(2)));
  Date("Cattle Oiler late date");
};
Boundary("Cattle Oiler late end");
};
};
Difference("begin-begin", "Cattle Oiler late begin", "Black Partizan Early begin");
Difference("end-begin", "Cattle Oiler late end", "Black Partizan Early begin");
Difference("begin-end", "Cattle Oiler late begin", "Black Partizan Early end");
Difference("end-end", "Cattle Oiler late end", "Black Partizan Early end");
Difference("date", "Cattle Oiler late date", "Black Partizan Early date");
Difference("date-begin", "Cattle Oiler late date", "Black Partizan Early begin");
Difference("date-end", "Cattle Oiler late date", "Black Partizan Early end");
Difference("begin-date", "Cattle Oiler late begin", "Black Partizan Early date");
Difference("end-date", "Cattle Oiler late end", "Black Partizan Early date");
};

```

C.5.13 Black Partizan Early vs. Cheyenne River

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Black Partizan Early v. Cheyenne River")
  {
    Sequence("Black Partizan village")
    {
      Boundary("Black Partizan Early begin");
      Phase("Black Partizan early w/in fortification")
      {
        R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
        R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
        R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
        R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
        R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
        R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
        R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
        R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
        R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
        Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Early date");
      };
      Boundary("Black Partizan Early end");
      Interval("Interval early to late occupations");
      Boundary("Black Partizan Late occupation begin");
      Phase("House 2")
      {
        R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
        R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
        Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Late date");
      };
      Boundary("Black Partizan Late end");
    };
    Sequence("Cheyenne River village")
    {
      Boundary("Cheyenne River begin");
      Phase("Cheyenne River")
      {
        R_Date("UGAMS46679, House (F34), Floor, Collagen", 590, 20);
        R_Date("ETH-10413, House (F34), cache 2, Bark", 675, 50);
        R_Date("UGAMS46680, House (F5), Floor, Collagen", 630, 20);
        R_Date("UGAMS46670, F34, House Post, Charcoal", 800, 20)
        {
          Outlier(1);
        };
        R_Date("M-840, F34, F103, Charcoal", 650, 105)
        {
          Outlier(1);
        };
      };
    };
  };
};
```

```

R_Date("I-581, F34, F103, Post, Charcoal", 775, 129)
{
  Outlier(1);
};
Interval("Cheyenne River interval",LnN(ln(25),ln(2)));
Date("Cheyenne River date");
};
Boundary("Cheyenne River end");
};
};
Difference("begin-begin", "Cheyenne River begin", "Black Partizan Early begin");
Difference("end-begin", "Cheyenne River end", "Black Partizan Early begin");
Difference("begin-end", "Cheyenne River begin", "Black Partizan Early end");
Difference("end-end", "Cheyenne River end", "Black Partizan Early end");
Difference("date", "Cheyenne River date", "Black Partizan Early date");
Difference("date-begin", "Cheyenne River date", "Black Partizan Early begin");
Difference("date-end", "Cheyenne River date", "Black Partizan Early end");
Difference("begin-date", "Cheyenne River begin", "Black Partizan Early date");
Difference("end-date", "Cheyenne River end", "Black Partizan Early date");
};

```

C.5.14 Black Partizan Early vs. Durkin

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Black Partizan Early v. Durkin")
  {
    Sequence("Black Partizan village")
    {
      Boundary("Black Partizan Early begin");
      Phase("Black Partizan early w/in fortification")
      {
        R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
        R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
        R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
        R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
        R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
        R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
        R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
        R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
        R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
        Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Early date");
      };
      Boundary("Black Partizan Early end");
      Interval("Interval early to late occupations");
      Boundary("Black Partizan Late occupation begin");
      Phase("House 2")
      {
        R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
        R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
        Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Late date");
      };
      Boundary("Black Partizan Late end");
    };
    Sequence("Durkin village")
    {
      Boundary("Durkin begin");
      Phase("Durkin")
      {
        R_Date("UGAMS-45846, H3, house post", 850, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46648, H3, house post", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-45845, H6, house post", 880, 20)
        {
          Outlier(1);
        };
      };
    };
  };
}
```

```

};
R_Date("UGAMS-46650, H6, house post", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46683, H5, house post", 930, 50)
{
  Outlier(1);
};
R_Date("UGAMS-46649, H5, house post", 760, 20)
{
  Outlier(1);
};
R_Date("UGAMS-41525, H3, floor, Clgn", 640, 20);
R_Date("UGAMS-41527, H5, floor, Clgn", 660, 20);
R_Date("UGAMS-41523, H6, Bark", 640, 20);
R_Date("UGAMS-41524, H3, floor, Clgn", 670, 20);
R_Date("WIS-746, H5 floor, chrcl", 655, 60)
{
  Outlier(1);
};
R_Date("WIS-743, H6 floor, chrcl", 640, 55)
{
  Outlier(1);
};
Interval("Durkin interval", LnN(ln(25), ln(2)));
Date("Durkin date");
};
Boundary("Durkin end");
};
};
Difference("begin-begin", "Durkin begin", "Black Partizan Early begin");
Difference("end-begin", "Durkin end", "Black Partizan Early begin");
Difference("begin-end", "Durkin begin", "Black Partizan Early end");
Difference("end-end", "Durkin end", "Black Partizan Early end");
Difference("date", "Durkin date", "Black Partizan Early date");
Difference("date-begin", "Durkin date", "Black Partizan Early begin");
Difference("date-end", "Durkin date", "Black Partizan Early end");
Difference("begin-date", "Durkin begin", "Black Partizan Early date");
Difference("end-date", "Durkin end", "Black Partizan Early date");
};

```

C.5.15 Black Partizan Early vs. Indian Creek

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Black Partizan Early v. Indian Creek Early")
  {
    Sequence("Black Partizan village")
    {
      Boundary("Black Partizan Early begin");
      Phase("Black Partizan early w/in fortification")
      {
        R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
        R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
        R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
        R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
        R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
        R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
        R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
        R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
        R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
        Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Early date");
      };
      Boundary("Black Partizan Early end");
      Interval("Interval early to late occupations");
      Boundary("Black Partizan Late occupation begin");
      Phase("House 2")
      {
        R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
        R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
        Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Late date");
      };
      Boundary("Black Partizan Late end");
    };
  };
  Sequence("Indian Creek occupation")
  {
    Boundary("Indian Creek Early begin");
    Phase("Indian Creek")
    {
      R_Date("UGAMS-46700, Collagen", 620, 20);
      R_Date("UGAMS-46701, Collagen", 670, 25);
      R_Date("UGAMS-46702, Collagen", 540, 25);
      R_Date("UGAMS-46703, Collagen", 590, 25);
      R_Date("UGAMS-46704, Collagen", 590, 20);
      R_Date("UGAMS-46705, Collagen", 580, 20);
      R_Date("UGAMS-46706, Collagen", 690, 25);
      R_Date("UGAMS-46707, Collagen", 660, 25);
      Interval("Indian Creek Early interval",LnN(ln(25),ln(2)));
      Date("Indian Creek Early date");
    };
  };
};
```

```

Boundary("Indian Creek Early end");
Interval("Early to Late interval");
Boundary("Indian Creek Late begin");
Phase("Indian Creek Late")
{
  R_Date("I-18,039, F43", 330, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,040, F30", 450, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,041, F7", 300, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,042, F5", 330, 86)
  {
    Outlier(1);
  };
  Interval("Indian Creek Late interval",LnN(ln(25),ln(2)));
  Date("Indian Creek Late date");
};
Boundary("Indian Creek Late end");
};
};
Difference("begin-begin", "Indian Creek Early begin", "Black Partizan Early begin");
Difference("end-begin", "Indian Creek Early end", "Black Partizan Early begin");
Difference("begin-end", "Indian Creek Early begin", "Black Partizan Early end");
Difference("end-end", "Indian Creek Early end", "Black Partizan Early end");
Difference("date", "Indian Creek Early date", "Black Partizan Early date");
Difference("date-begin", "Indian Creek Early date", "Black Partizan Early begin");
Difference("date-end", "Indian Creek Early date", "Black Partizan Early end");
Difference("begin-date", "Indian Creek Early begin", "Black Partizan Early date");
Difference("end-date", "Indian Creek Early end", "Black Partizan Early date");
};

```

C.5.16 Black Partizan Early vs. Jiggs Thompson

```
Plot()
{
Phase("Black Partizan Early v. Jiggs Thompson")
{
Sequence("Black Partizan village")
{
Boundary("Black Partizan Early begin");
Phase("Black Partizan early w/in fortification")
{
R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early date");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
Sequence("Jiggs Thompson village")
{
Boundary("Jiggs Thompson begin");
Phase("Jiggs Thompson")
{
R_Date("I-1186, N/A", 670, 124);
R_Date("I-1187, N/A", 670, 124);
R_Date("ETH-11041, X-4 Midden", 770, 60);
Interval("Jiggs interval",LnN(ln(25),ln(2)));
Date("Jiggs date");
};
Boundary("Jiggs Thompson end");
};
};
Difference("begin-begin", "Jiggs Thompson begin", "Black Partizan Early begin");
Difference("end-begin", "Jiggs Thompson end", "Black Partizan Early begin");
Difference("begin-end", "Jiggs Thompson begin", "Black Partizan Early end");
```

```
Difference("end-end", "Jiggs Thompson end", "Black Partizan Early end");  
Difference("date", "Jiggs date", "Black Partizan Early date");  
Difference("date-begin", "Jiggs date", "Black Partizan Early begin");  
Difference("date-end", "Jiggs date", "Black Partizan Early end");  
Difference("begin-date", "Jiggs Thompson begin", "Black Partizan Early date");  
Difference("end-date", "Jiggs Thompson end", "Black Partizan Early date");  
};
```

C.5.17 Black Partizan Early vs. Ketchen

```
Plot()
{
Phase("Black Partizan Early v. Ketchen")
{
Sequence("Black Partizan village")
{
Boundary("Black Partizan Early begin");
Phase("Black Partizan early w/in fortification")
{
R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early date");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
Sequence("Ketchen village")
{
Boundary("Ketchen begin");
Phase("Ketchen")
{
R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20);
R_Date("WIS-759, F3, P14", 830, 68);
R_Date("WIS-762, F17, 157B", 725, 59);
R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20);
Interval("Ketchen interval",LnN(ln(25),ln(2)));
Date("Ketchen date");
};
Boundary("Ketchen end");
};
};
Difference("begin-begin", "Ketchen begin", "Black Partizan Early begin");
Difference("end-begin", "Ketchen end", "Black Partizan Early begin");
```

```
Difference("begin-end", "Ketchen begin", "Black Partizan Early end");
Difference("end-end", "Ketchen end", "Black Partizan Early end");
Difference("date", "Ketchen date", "Black Partizan Early date");
Difference("date-begin", "Ketchen date", "Black Partizan Early begin");
Difference("date-end", "Ketchen date", "Black Partizan Early end");
Difference("begin-date", "Ketchen begin", "Black Partizan Early date");
Difference("end-date", "Ketchen end", "Black Partizan Early date");
};
```

C.5.18 Black Partizan Early vs. Stony Point

```
Plot()
{
Phase("Black Partizan Early v. Alberts Creek")
{
Sequence("Black Partizan village")
{
Boundary("Black Partizan Early begin");
Phase("Black Partizan early w/in fortification")
{
R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early date");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
Sequence("Stony Point Occupation")
{
Boundary("Stony Point begin");
Phase("Stony Point")
{
R_Date("UCR-2314, HA, Charcoal", 685, 60);
R_Date("UCR-2315, HA, Charcoal", 840, 50);
Interval("Stony Point interval",LnN(ln(50),ln(2)));
Date("Stony Point date");
};
Boundary("Stony Point end");
};
};
Difference("begin-begin", "Stony Point begin", "Black Partizan Early begin");
Difference("end-begin", "Stony Point end", "Black Partizan Early begin");
Difference("begin-end", "Stony Point begin", "Black Partizan Early end");
Difference("end-end", "Stony Point end", "Black Partizan Early end");
```

```
Difference("date", "Stony Point date", "Black Partizan Early date");  
Difference("date-begin", "Stony Point date", "Black Partizan Early begin");  
Difference("date-end", "Stony Point date", "Black Partizan Early end");  
Difference("begin-date", "Stony Point begin", "Black Partizan Early date");  
Difference("end-date", "Stony Point end", "Black Partizan Early date");  
};
```

C.5.19 Black Partizan Early vs. Sully School

```
Plot()
{
Phase("Black Partizan Early v. Sully School")
{
Sequence("Black Partizan village")
{
Boundary("Black Partizan Early begin");
Phase("Black Partizan early w/in fortification")
{
R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
Date("Black Partizan Early date");
};
Boundary("Black Partizan Early end");
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
Interval("Black Partizan Late interval",LnN(ln(50),ln(2)));
Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
Sequence("Sully School Village")
{
Boundary("Sully School begin");
Phase("Sully School")
{
R_Date("UGAMS-46686, F4, Floor (F54?), Collagen", 550, 25);
R_Date("UGAMS-46687, F4, C1, Collagen", 670, 25);
R_Date("UGAMS-46688, F4, C1, Collagen", 620, 20);
R_Date("UGAMS-46689, F5, C4, Collagen", 650, 25);
R_Date("UGAMS-46690, F5, C4, Collagen", 640, 25);
R_Date("UGAMS-46691, F5, C4, Collagen", 640, 25);
R_Date("UGAMS-46692, F5, C4, Collagen", 750, 20);
R_Date("UGAMS-46693, F5, C8, Collagen", 740, 20);
R_Date("UGAMS-46694, F5, C8, Collagen", 710, 20);
R_Date("UGAMS-46695, F23, C1, Collagen", 630, 20);
Interval("Sully School interval",LnN(ln(50),ln(2)));
Date("Sully School date");
};
};
};
};
};
```

```
};  
Boundary("Sully School end");  
};  
};  
Difference("begin-begin", "Sully School begin", "Black Partizan Early begin");  
Difference("end-begin", "Sully School end", "Black Partizan Early begin");  
Difference("begin-end", "Sully School begin", "Black Partizan Early end");  
Difference("end-end", "Sully School end", "Black Partizan Early end");  
Difference("date", "Sully School date", "Black Partizan Early date");  
Difference("date-begin", "Sully School date", "Black Partizan Early begin");  
Difference("date-end", "Sully School date", "Black Partizan Early end");  
Difference("begin-date", "Sully School begin", "Black Partizan Early date");  
Difference("end-date", "Sully School end", "Black Partizan Early date");  
};
```

C.5.20 Crow Creek Late vs. Alberts Creek

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Alberts Creek")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);
}

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Alberts Creek")
{
  Boundary("Alberts Creek begin");
  Phase("Alberts Creek occupation")
  {
    R_Date("UGAMS-46696, Collagen", 620, 20);
    R_Date("UGAMS-46697, Collagen", 600, 20);
    R_Date("UGAMS-46698, Collagen", 560, 25);
    Interval("Alberts Creek interval",LnN(ln(25),ln(2)));
    Date("Alberts Creek date");
  };
  Boundary("Alberts Creek end");
};
};
Difference("begin-begin", "Alberts Creek begin", "Crow Creek Late begin");
Difference("end-begin", "Alberts Creek end", "Crow Creek Late begin");
Difference("begin-end", "Alberts Creek begin", "Crow Creek Late end");
Difference("end-end", "Alberts Creek end", "Crow Creek Late end");

```

```
Difference("date", "Alberts Creek date", "Crow Creek Late date");  
Difference("date-begin", "Alberts Creek date", "Crow Creek Late begin");  
Difference("date-end", "Alberts Creek date", "Crow Creek Late end");  
Difference("begin-date", "Alberts Creek begin", "Crow Creek Late date");  
Difference("end-date", "Alberts Creek end", "Crow Creek Late date");  
};
```

C.5.21 Crow Creek Late vs. Antelope Dreamer

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Antelope Dreamer")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);
}

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Antelope Dreamer Village")
{
  Boundary("Antelope Dreamer begin");
  Phase("Antelope Dreamer")
  {
    R_Date("UCR2308, H11, F107, Maize", 660, 50);
    R_Date("UCR2309, H11, F107, Maize", 735, 50);
    R_Date("UCR2310, H11, F107, Maize", 720, 50);
    R_Date("UCR2311, H15, F100, Chrcl", 870, 90)
    {
      Outlier(1);
    };
    R_Date("UCR2312, H15, F103, Chrcl", 800, 90)
    {
      Outlier(1);
    };
    R_Date("UCR2313, H15, F101, Chrcl", 820, 90)
    {

```

```

    Outlier(1);
};
R_Date("OS-85448, midden, Twigs", 765, 25);
Interval("Antelope Dreamer interval", LnN(ln(25), ln(2)));
Date("Antelope Dreamer date");
};
Boundary("Antelope Dreamer end");
};
};
Difference("begin-begin", "Antelope Dreamer begin", "Crow Creek Late begin");
Difference("end-begin", "Antelope Dreamer end", "Crow Creek Late begin");
Difference("begin-end", "Antelope Dreamer begin", "Crow Creek Late end");
Difference("end-end", "Antelope Dreamer end", "Crow Creek Late end");
Difference("date", "Antelope Dreamer date", "Crow Creek Late date");
Difference("date-begin", "Antelope Dreamer date", "Crow Creek Late begin");
Difference("date-end", "Antelope Dreamer date", "Crow Creek Late end");
Difference("begin-date", "Antelope Dreamer begin", "Crow Creek Late date");
Difference("end-date", "Antelope Dreamer end", "Crow Creek Late date");
};

```

C.5.22 Crow Creek Late vs.Cattle Oiler

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Cattle Oiler")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Cattle Oiler village")
{
  Boundary("Cattle Oiler early begins");
  Phase("Cattle Oiler early")
  {
    R_Date("UGAMS45201, H1, F88, Collagen", 870, 20);
    R_Date("UGAMS45207, H1, F88, Collagen", 860, 20);
    R_Date("UGAMS43184, H1, Floor, Collagen", 865, 18);
    R_Date("UGAMS43185, H2, F54, Collagen", 866, 18);
    R_Date("UGAMS43191, H2, F55, Collagen", 876, 18);
    R_Date("UGAMS45192, H2, F54, Collagen", 860, 20);
    R_Date("UGAMS45195, H2, Floor, Collagen", 910, 20);
    R_Date("UGAMS45196, H2, F43, Collagen", 840, 20);
    R_Date("UGAMS45200, H2, F43, Collagen", 850, 20);
    R_Date("UGAMS45198, H3, F49, Collagen", 850, 20);
    R_Date("UGAMS43189, H3, Floor, Collagen", 897, 18);
    R_Date("UGAMS43183, F71 Pit outside H3, Collagen", 884, 20);
    R_Date("UGAMS45199, H4, F64, Collagen", 870, 20);

```

```

R_Date("UGAMS45203, H4, F64, Collagen", 870, 35);
R_Date("UGAMS45193, H5, F137, Collagen", 860, 20);
R_Date("UGAMS45204, H5, Floor F124, Collagen", 910, 25);
R_Date("UGAMS45206, H5, Floor F124, Collagen", 860, 20);
R_Date("UGAMS45190, H6, F135, Collagen", 881, 18);
R_Date("UGAMS45194, H6, F145, Collagen", 870, 20);
R_Date("UGAMS45208, H6, Floor F130, Collagen", 870, 20);
Interval("Cattle Oiler early interval",LnN(In(25),In(2)));
Date("Cattle Oiler early date est.");
};
Boundary("Cattle Oiler early end");
Interval("early to late occupations interval");
Boundary("Cattle Oiler late begin");
Phase("H7 - Cattle Oiler late")
{
R_Date("UGAMS-43101, H7, F27, Collagen", 600, 20);
R_Date("UGAMS-43102, H7, F27, Collagen", 630, 20);
R_Date("UGAMS-45197, H7, F17, Collagen", 610, 20);
R_Date("UGAMS-45202, H7, F32, Collagen", 630, 20);
R_Date("UGAMS-45205, H7, F24, Collagen", 610, 20);
R_Date("UGAMS-45209, H7, F17, Collagen", 590, 30);
R_Date("ETH-11040, F98, Grass", 690 ,60);
Interval("Cattle Oiler late interval",LnN(In(25),In(2)));
Date("Cattle Oiler late date");
};
Boundary("Cattle Oiler late end");
};
};
Difference("begin-begin", "Cattle Oiler late begin", "Crow Creek Late begin");
Difference("end-begin", "Cattle Oiler late end", "Crow Creek Late begin");
Difference("begin-end", "Cattle Oiler late begin", "Crow Creek Late end");
Difference("end-end", "Cattle Oiler late end", "Crow Creek Late end");
Difference("date", "Cattle Oiler late date", "Crow Creek Late date");
Difference("date-begin", "Cattle Oiler late date", "Crow Creek Late begin");
Difference("date-end", "Cattle Oiler late date", "Crow Creek Late end");
Difference("begin-date", "Cattle Oiler late begin", "Crow Creek Late date");
Difference("end-date", "Cattle Oiler late end", "Crow Creek Late date");
};

```

C.5.23 Crow Creek Late vs. Cheyenne River

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Cheyenne River")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Cheyenne River village")
{
  Boundary("Cheyenne River begin");
  Phase("Cheyenne River")
  {
    R_Date("UGAMS46679, House (F34), Floor, Collagen", 590, 20);
    R_Date("ETH-10413, House (F34), cache 2, Bark", 675, 50);
    R_Date("UGAMS46680, House (F5), Floor, Collagen", 630, 20);
    R_Date("UGAMS46670, F34, House Post, Charcoal", 800, 20)
    {
      Outlier(1);
    };
    R_Date("M-840, F34, F103, Charcoal", 650, 105)
    {
      Outlier(1);
    };
    R_Date("I-581, F34, F103, Post, Charcoal", 775, 129)
    {

```

```

    Outlier(1);
  };
  Interval("Cheyenne River interval",LnN(ln(25),ln(2)));
  Date("Cheyenne River date");
};
Boundary("Cheyenne River end");
};
};
Difference("begin-begin", "Cheyenne River begin", "Crow Creek Late begin");
Difference("end-begin", "Cheyenne River end", "Crow Creek Late begin");
Difference("begin-end", "Cheyenne River begin", "Crow Creek Late end");
Difference("end-end", "Cheyenne River end", "Crow Creek Late end");
Difference("date", "Cheyenne River date", "Crow Creek Late date");
Difference("date-begin", "Cheyenne River date", "Crow Creek Late begin");
Difference("date-end", "Cheyenne River date", "Crow Creek Late end");
Difference("begin-date", "Cheyenne River begin", "Crow Creek Late date");
Difference("end-date", "Cheyenne River end", "Crow Creek Late date");
};

```

C.5.24 Crow Creek Late vs. Durkin

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Durkin")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)
```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Durkin village")
{
  After("House Posts")
  {
    R_Date("UGAMS-45846, H3, house post", 850, 20);
    R_Date("UGAMS-46648, H3, house post", 930, 20);
    R_Date("UGAMS-45845, H6, house post", 880, 20);
    R_Date("UGAMS-46650, H6, house post", 870, 20);
    R_Date("UGAMS-46683, H5, house post", 930, 50);
    R_Date("UGAMS-46649, H5, house post", 760, 20);
  };
  Boundary("Durkin begin");
  Phase("Durkin")
  {
    R_Date("UGAMS-41525, H3, floor, Clgn", 640, 20);
    R_Date("UGAMS-41527, H5, floor, Clgn", 660, 20);
    R_Date("UGAMS-41523, H6, Bark", 640, 20);
    R_Date("UGAMS-41524, H3, floor, Clgn", 670, 20);
  }
}

```

```

R_Date("WIS-746, H5 floor, chrcl", 655, 60)
{
  Outlier(1);
};
R_Date("WIS-743, H6 floor, chrcl", 640, 55)
{
  Outlier(1);
};
Interval("Durkin interval",LnN(ln(25),ln(2)));
Date("Durkin date");
};
Boundary("Durkin end");
};
};
Difference("begin-begin", "Durkin begin", "Crow Creek Late begin");
Difference("end-begin", "Durkin end", "Crow Creek Late begin");
Difference("begin-end", "Durkin begin", "Crow Creek Late end");
Difference("end-end", "Durkin end", "Crow Creek Late end");
Difference("date", "Durkin date", "Crow Creek Late date");
Difference("date-begin", "Durkin date", "Crow Creek Late begin");
Difference("date-end", "Durkin date", "Crow Creek Late end");
Difference("begin-date", "Durkin begin", "Crow Creek Late date");
Difference("end-date", "Durkin end", "Crow Creek Late date");
};

```

C.5.25 Crow Creek Late vs. Indian Creek

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Indian Creek Early")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);
}

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Indian Creek occupation")
{
  Boundary("Indian Creek Early begin");
  Phase("Indian Creek")
  {
    R_Date("UGAMS-46700, Collagen", 620, 20);
    R_Date("UGAMS-46701, Collagen", 670, 25);
    R_Date("UGAMS-46702, Collagen", 540, 25);
    R_Date("UGAMS-46703, Collagen", 590, 25);
    R_Date("UGAMS-46704, Collagen", 590, 20);
    R_Date("UGAMS-46705, Collagen", 580, 20);
    R_Date("UGAMS-46706, Collagen", 690, 25);
    R_Date("UGAMS-46707, Collagen", 660, 25);
    Interval("Indian Creek Early interval",LnN(ln(25),ln(2)));
    Date("Indian Creek Early date");
  };
  Boundary("Indian Creek Early end");
  Interval("Early to Late interval");
};

```

```

Boundary("Indian Creek Late begin");
Phase("Indian Creek Late")
{
  R_Date("I-18,039, F43", 330, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,040, F30", 450, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,041, F7", 300, 86)
  {
    Outlier(1);
  };
  R_Date("I-18,042, F5", 330, 86)
  {
    Outlier(1);
  };
  Interval("Indian Creek Late interval",LnN(ln(25),ln(2)));
  Date("Indian Creek Late date");
};
Boundary("Indian Creek Late end");
};
Difference("begin-begin", "Indian Creek Early begin", "Crow Creek Late begin");
Difference("end-begin", "Indian Creek Early end", "Crow Creek Late begin");
Difference("begin-end", "Indian Creek Early begin", "Crow Creek Late end");
Difference("end-end", "Indian Creek Early end", "Crow Creek Late end");
Difference("date", "Indian Creek Early date", "Crow Creek Late date");
Difference("date-begin", "Indian Creek Early date", "Crow Creek Late begin");
Difference("date-end", "Indian Creek Early date", "Crow Creek Late end");
Difference("begin-date", "Indian Creek Early begin", "Crow Creek Late date");
Difference("end-date", "Indian Creek Early end", "Crow Creek Late date");
};

```

C.5.26 Crow Creek Late vs. Jiggs Thompson

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Jiggs Thompson")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Village occupation")
{
  Boundary("Jiggs Thompson begin");
  Phase("Jiggs Thompson")
  {
    R_Date("I-1186, N/A", 670, 124);
    R_Date("I-1187, N/A", 670, 124);
    R_Date("ETH-11041, X-4 Midden", 770, 60);
    Interval("Jiggs interval",LnN(ln(25),ln(2)));
    Date("Jiggs date");
  };
  Boundary("Jiggs Thompson end");
};
};
Difference("begin-begin", "Jiggs Thompson begin", "Crow Creek Late begin");
Difference("end-begin", "Jiggs Thompson end", "Crow Creek Late begin");
Difference("begin-end", "Jiggs Thompson begin", "Crow Creek Late end");
Difference("end-end", "Jiggs Thompson end", "Crow Creek Late end");

```

```
Difference("date", "Jiggs date", "Crow Creek Late date");  
Difference("date-begin", "Jiggs date", "Crow Creek Late begin");  
Difference("date-end", "Jiggs date", "Crow Creek Late end");  
Difference("begin-date", "Jiggs Thompson begin", "Crow Creek Late date");  
Difference("end-date", "Jiggs Thompson end", "Crow Creek Late date");  
};
```

C.5.27 Crow Creek Late vs. Ketchen

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Ketchen")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Ketchen village")
{
  Boundary("Ketchen begin");
  Phase("Ketchen")
  {
    R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20);
    R_Date("WIS-759, F3, P14", 830, 68);
    R_Date("WIS-762, F17, 157B", 725, 59);
    R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20);
    Interval("Ketchen interval", LnN(ln(25),ln(2)));
    Date("Ketchen date");
  };
  Boundary("Ketchen end");
};
};
Difference("begin-begin", "Ketchen begin", "Crow Creek Late begin");
Difference("end-begin", "Ketchen end", "Crow Creek Late begin");
Difference("begin-end", "Ketchen begin", "Crow Creek Late end");

```

```
Difference("end-end", "Ketchen end", "Crow Creek Late end");  
Difference("date", "Ketchen date", "Crow Creek Late date");  
Difference("date-begin", "Ketchen date", "Crow Creek Late begin");  
Difference("date-end", "Ketchen date", "Crow Creek Late end");  
Difference("begin-date", "Ketchen begin", "Crow Creek Late date");  
Difference("end-date", "Ketchen end", "Crow Creek Late date");  
};
```

C.5.28 Crow Creek Late vs. Stony Point

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Alberts Creek")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)

```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Stony Point Occupation")
{
  Boundary("Stony Point begin");
  Phase("Stony Point")
  {
    R_Date("UCR-2314, HA, Charcoal", 685, 60);
    R_Date("UCR-2315, HA, Charcoal", 840, 50);
    Interval("Stony Point interval",LnN(ln(50),ln(2)));
    Date("Stony Point date");
  };
  Boundary("Stony Point end");
};
};
Difference("begin-begin", "Stony Point begin", "Crow Creek Late begin");
Difference("end-begin", "Stony Point end", "Crow Creek Late begin");
Difference("begin-end", "Stony Point begin", "Crow Creek Late end");
Difference("end-end", "Stony Point end", "Crow Creek Late end");
Difference("date", "Stony Point date", "Crow Creek Late date");

```

```
Difference("date-begin", "Stony Point date", "Crow Creek Late begin");  
Difference("date-end", "Stony Point date", "Crow Creek Late end");  
Difference("begin-date", "Stony Point begin", "Crow Creek Late date");  
Difference("end-date", "Stony Point end", "Crow Creek Late date");  
};
```

C.5.29 Crow Creek Late vs. Sully School

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Sully School")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)
```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Sully School Village")
{
  Boundary("Sully School begin");
  Phase("Sully School")
  {
    R_Date("UGAMS-46686, F4, Floor (F54?), Collagen", 550, 25);
    R_Date("UGAMS-46687, F4, C1, Collagen", 670, 25);
    R_Date("UGAMS-46688, F4, C1, Collagen", 620, 20);
    R_Date("UGAMS-46689, F5, C4, Collagen", 650, 25);
    R_Date("UGAMS-46690, F5, C4, Collagen", 640, 25);
    R_Date("UGAMS-46691, F5, C4, Collagen", 640, 25);
    R_Date("UGAMS-46692, F5, C4, Collagen", 750, 20);
    R_Date("UGAMS-46693, F5, C8, Collagen", 740, 20);
    R_Date("UGAMS-46694, F5, C8, Collagen", 710, 20);
    R_Date("UGAMS-46695, F23, C1, Collagen", 630, 20);
    Interval("Sully School interval",LnN(ln(50),ln(2)));
    Date("Sully School date");
  };
};

```

```
Boundary("Sully School end");
};
};
Difference("begin-begin", "Sully School begin", "Crow Creek Late begin");
Difference("end-begin", "Sully School end", "Crow Creek Late begin");
Difference("begin-end", "Sully School begin", "Crow Creek Late end");
Difference("end-end", "Sully School end", "Crow Creek Late end");
Difference("date", "Sully School date", "Crow Creek Late date");
Difference("date-begin", "Sully School date", "Crow Creek Late begin");
Difference("date-end", "Sully School date", "Crow Creek Late end");
Difference("begin-date", "Sully School begin", "Crow Creek Late date");
Difference("end-date", "Sully School end", "Crow Creek Late date");
};
```

C.5.30 Whistling Elk vs. Alberts Creek

Plot()

```
{
Phase("Whistling Elk v. Alberts Creek")
{
Sequence("Whistling Elk village")
{
Boundary("Whistling Elk begin");
Phase("Whistling Elk Houses 1, 2, and central lodge")
{
R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
R_Date("UGAMS43174, Big House, Collagen", 612, 18);
R_Date("UGAMS43175, Big House, Collagen", 609, 18);
R_Date("UCR2035, H2, Maize,", 650, 60);
R_Date("UCR2036, H2, Maize", 550, 70);
R_Date("UCR2037, H2, Maize", 710, 70);
Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
Date("Whistling Elk date");
};
Boundary("Whistling Elk end");
};
Sequence("Alberts Creek")
{
Boundary("Alberts Creek begin");
Phase("Alberts Creek occupation")
{
R_Date("UGAMS-46696, Collagen", 620, 20);
R_Date("UGAMS-46697, Collagen", 600, 20);
R_Date("UGAMS-46698, Collagen", 560, 25);
Interval("Alberts Creek interval",LnN(ln(25),ln(2)));
Date("Alberts Creek date");
};
Boundary("Alberts Creek end");
};
};
Difference("begin-begin", "Alberts Creek begin", "Whistling Elk begin");
Difference("end-begin", "Alberts Creek end", "Whistling Elk begin");
Difference("begin-end", "Alberts Creek begin", "Whistling Elk end");
Difference("end-end", "Alberts Creek end", "Whistling Elk end");
Difference("date", "Alberts Creek date", "Whistling Elk date");
Difference("date-begin", "Alberts Creek date", "Whistling Elk begin");
Difference("date-end", "Alberts Creek date", "Whistling Elk end");
Difference("begin-date", "Alberts Creek begin", "Whistling Elk date");
Difference("end-date", "Alberts Creek end", "Whistling Elk date");
};
};
```

C.5.31 Whistling Elk vs. Antelope Dreamer

```

Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Whistling Elk v. Antelope Dreamer")
  {
    Sequence("Whistling Elk village")
    {
      Boundary("Whistling Elk begin");
      Phase("Whistling Elk Houses 1, 2, and central lodge")
      {
        R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
        R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
        R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
        R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
        R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
        R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
        R_Date("UGAMS43174, Big House, Collagen", 612, 18);
        R_Date("UGAMS43175, Big House, Collagen", 609, 18);
        R_Date("UCR2035, H2, Maize,", 650, 60);
        R_Date("UCR2036, H2, Maize", 550, 70);
        R_Date("UCR2037, H2, Maize", 710, 70);
        Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
        Date("Whistling Elk date");
      };
      Boundary("Whistling Elk end");
    };
    Sequence("Antelope Dreamer village")
    {
      Boundary("Antelope Dreamer begin");
      Phase("Antelope Dreamer")
      {
        R_Date("UCR2308, H11, F107, Maize", 660, 50);
        R_Date("UCR2309, H11, F107, Maize", 735, 50);
        R_Date("UCR2310, H11, F107, Maize", 720, 50);
        R_Date("UCR2311, H15, F100, Chrcl", 870, 90)
        {
          Outlier(1);
        };
        R_Date("UCR2312, H15, F103, Chrcl", 800, 90)
        {
          Outlier(1);
        };
        R_Date("UCR2313, H15, F101, Chrcl", 820, 90)
        {
          Outlier(1);
        };
        R_Date("OS-85448, midden, Twigs", 765, 25);
        Interval("Antelope Dreamer interval",LnN(ln(25),ln(2)));
        Date("Antelope Dreamer date");
      };
      Boundary("Antelope Dreamer end");
    };
  };
}

```

```
};  
};  
Difference("begin-begin", "Antelope Dreamer begin", "Whistling Elk begin");  
Difference("end-begin", "Antelope Dreamer end", "Whistling Elk begin");  
Difference("begin-end", "Antelope Dreamer begin", "Whistling Elk end");  
Difference("end-end", "Antelope Dreamer end", "Whistling Elk end");  
Difference("date", "Antelope Dreamer date", "Whistling Elk date");  
Difference("date-begin", "Antelope Dreamer date", "Whistling Elk begin");  
Difference("date-end", "Antelope Dreamer date", "Whistling Elk end");  
Difference("begin-date", "Antelope Dreamer begin", "Whistling Elk date");  
Difference("end-date", "Antelope Dreamer end", "Whistling Elk date");  
};
```

C.5.32 Whistling Elk vs. Cattle Oiler

Plot()

```
{
Phase("Whistling Elk v. Cattle Oiler Late")
{
Sequence("Whistling Elk village")
{
Boundary("Whistling Elk begin");
Phase("Whistling Elk Houses 1, 2, and central lodge")
{
R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
R_Date("UGAMS43174, Big House, Collagen", 612, 18);
R_Date("UGAMS43175, Big House, Collagen", 609, 18);
R_Date("UCR2035, H2, Maize", 650, 60);
R_Date("UCR2036, H2, Maize", 550, 70);
R_Date("UCR2037, H2, Maize", 710, 70);
Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
Date("Whistling Elk date");
};
Boundary("Whistling Elk end");
};
Sequence("Cattle Oiler village")
{
Boundary("Cattle Oiler early begin");
Phase("Cattle Oiler early")
{
R_Date("UGAMS45201, H1, F88, Collagen", 870, 20);
R_Date("UGAMS45207, H1, F88, Collagen", 860, 20);
R_Date("UGAMS43184, H1, Floor, Collagen", 865, 18);
R_Date("UGAMS43185, H2, F54, Collagen", 866, 18);
R_Date("UGAMS43191, H2, F55, Collagen", 876, 18);
R_Date("UGAMS45192, H2, F54, Collagen", 860, 20);
R_Date("UGAMS45195, H2, Floor, Collagen", 910, 20);
R_Date("UGAMS45196, H2, F43, Collagen", 840, 20);
R_Date("UGAMS45200, H2, F43, Collagen", 850, 20);
R_Date("UGAMS45198, H3, F49, Collagen", 850, 20);
R_Date("UGAMS43189, H3, Floor, Collagen", 897, 18);
R_Date("UGAMS43183, F71 Pit outside H3, Collagen", 884, 20);
R_Date("UGAMS45199, H4, F64, Collagen", 870, 20);
R_Date("UGAMS45203, H4, F64, Collagen", 870, 35);
R_Date("UGAMS45193, H5, F137, Collagen", 860, 20);
R_Date("UGAMS45204, H5, Floor F124, Collagen", 910, 25);
R_Date("UGAMS45206, H5, Floor F124, Collagen", 860, 20);
R_Date("UGAMS45190, H6, F135, Collagen", 881, 18);
R_Date("UGAMS45194, H6, F145, Collagen", 870, 20);
R_Date("UGAMS45208, H6, Floor F130, Collagen", 870, 20);
};
};
};
};
```

```

Interval("Cattle Oiler early interval",LnN(ln(25),ln(2)));
Date("Cattle Oiler early date est.");
};
Boundary("Cattle Oiler early end");
Interval("early to late occupations interval");
Boundary("Cattle Oiler late begin");
Phase("H7 - Cattle Oiler late")
{
R_Date("UGAMS-43101, H7, F27, Collagen", 600, 20);
R_Date("UGAMS-43102, H7, F27, Collagen", 630, 20);
R_Date("UGAMS-45197, H7, F17, Collagen", 610, 20);
R_Date("UGAMS-45202, H7, F32, Collagen", 630, 20);
R_Date("UGAMS-45205, H7, F24, Collagen", 610, 20);
R_Date("UGAMS-45209, H7, F17, Collagen", 590, 30);
R_Date("ETH-11040, F98, Grass", 690, 60);
Interval("Cattle Oiler late interval",LnN(ln(25),ln(2)));
Date("Cattle Oiler late date");
};
Boundary("Cattle Oiler late end");
};
};
Difference("begin-begin", "Cattle Oiler late begin", "Whistling Elk begin");
Difference("end-begin", "Cattle Oiler late end", "Whistling Elk begin");
Difference("begin-end", "Cattle Oiler late begin", "Whistling Elk end");
Difference("end-end", "Cattle Oiler late end", "Whistling Elk end");
Difference("date", "Cattle Oiler late date", "Whistling Elk date");
Difference("date-begin", "Cattle Oiler late date", "Whistling Elk begin");
Difference("date-end", "Cattle Oiler late date", "Whistling Elk end");
Difference("begin-date", "Cattle Oiler late begin", "Whistling Elk date");
Difference("end-date", "Cattle Oiler late end", "Whistling Elk date");
};

```

C.5.33 Whistling Elk vs. Cheyenne River

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Whistling Elk v. Cheyenne River")
  {
    Sequence("Whistling Elk village")
    {
      Boundary("Whistling Elk begin");
      Phase("Whistling Elk Houses 1, 2, and central lodge")
      {
        R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
        R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
        R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
        R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
        R_Date("UGAMS43154, H2, F29, Maize", 613, 18);
        R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
        R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
        R_Date("UGAMS43174, Big House, Collagen", 612, 18);
        R_Date("UGAMS43175, Big House, Collagen", 609, 18);
        R_Date("UCR2035, H2, Maize,", 650, 60);
        R_Date("UCR2036, H2, Maize", 550, 70);
        R_Date("UCR2037, H2, Maize", 710, 70);
        Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
        Date("Whistling Elk date");
      };
      Boundary("Whistling Elk end");
    };
    Sequence("Cheyenne River village")
    {
      Boundary("Cheyenne River begin");
      Phase("Cheyenne River")
      {
        R_Date("UGAMS46679, House (F34), Floor, Collagen", 590, 20);
        R_Date("ETH-10413, House (F34), cache 2, Bark", 675, 50);
        R_Date("UGAMS46680, House (F5), Floor, Collagen", 630, 20);
        R_Date("UGAMS46670, F34, House Post, Charcoal", 800, 20)
        {
          Outlier(1);
        };
        R_Date("M-840, F34, F103, Charcoal", 650, 105)
        {
          Outlier(1);
        };
        R_Date("I-581, F34, F103, Post, Charcoal", 775, 129)
        {
          Outlier(1);
        };
        Interval("Cheyenne River interval",LnN(ln(25),ln(2)));
        Date("Cheyenne River date");
      };
    };
  };
};
```

```
Boundary("Cheyenne River end");
};
};
Difference("begin-begin", "Cheyenne River begin", "Whistling Elk begin");
Difference("end-begin", "Cheyenne River end", "Whistling Elk begin");
Difference("begin-end", "Cheyenne River begin", "Whistling Elk end");
Difference("end-end", "Cheyenne River end", "Whistling Elk end");
Difference("date", "Cheyenne River date", "Whistling Elk date");
Difference("date-begin", "Cheyenne River date", "Whistling Elk begin");
Difference("date-end", "Cheyenne River date", "Whistling Elk end");
Difference("begin-date", "Cheyenne River begin", "Whistling Elk date");
Difference("end-date", "Cheyenne River end", "Whistling Elk date");
};
```

C.5.34 Whistling Elk vs. Durkin

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Whistling Elk v. Durkin")
  {
    Sequence("Whistling Elk village")
    {
      Boundary("Whistling Elk begin");
      Phase("Whistling Elk Houses 1, 2, and central lodge")
      {
        R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
        R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
        R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
        R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
        R_Date("UGAMS43154, H2, F29, Maize", 613, 18);
        R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
        R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
        R_Date("UGAMS43174, Big House, Collagen", 612, 18);
        R_Date("UGAMS43175, Big House, Collagen", 609, 18);
        R_Date("UCR2035, H2, Maize,", 650, 60);
        R_Date("UCR2036, H2, Maize", 550, 70);
        R_Date("UCR2037, H2, Maize", 710, 70);
        Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
        Date("Whistling Elk date");
      };
      Boundary("Whistling Elk end");
    };
    Sequence("Durkin village")
    {
      Boundary("Durkin begin");
      Phase("Durkin")
      {
        R_Date("UGAMS-45846, H3, house post", 850, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46648, H3, house post", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-45845, H6, house post", 880, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46650, H6, house post", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46683, H5, house post", 930, 50)
        {
```

```

    Outlier(1);
  };
  R_Date("UGAMS-46649, H5, house post", 760, 20)
  {
    Outlier(1);
  };
  R_Date("UGAMS-41525, H3, floor, Clgn", 640, 20);
  R_Date("UGAMS-41527, H5, floor, Clgn", 660, 20);
  R_Date("UGAMS-41523, H6, Bark", 640, 20);
  R_Date("UGAMS-41524, H3, floor, Clgn", 670, 20);
  R_Date("WIS-746, H5 floor, chrcl", 655, 60)
  {
    Outlier(1);
  };
  R_Date("WIS-743, H6 floor, chrcl", 640, 55)
  {
    Outlier(1);
  };
  Interval("Durkin interval", LnN(ln(25), ln(2)));
  Date("Durkin date");
};
Boundary("Durkin end");
};
};
Difference("begin-begin", "Durkin begin", "Whistling Elk begin");
Difference("end-begin", "Durkin end", "Whistling Elk begin");
Difference("begin-end", "Durkin begin", "Whistling Elk end");
Difference("end-end", "Durkin end", "Whistling Elk end");
Difference("date", "Durkin date", "Whistling Elk date");
Difference("date-begin", "Durkin date", "Whistling Elk begin");
Difference("date-end", "Durkin date", "Whistling Elk end");
Difference("begin-date", "Durkin begin", "Whistling Elk date");
Difference("end-date", "Durkin end", "Whistling Elk date");
};

```

C.5.35 Whistling Elk vs. Indian Creek

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Whistling Elk v. Indian Creek Early")
  {
    Sequence("Whistling Elk village")
    {
      Boundary("Whistling Elk begin");
      Phase("Whistling Elk Houses 1, 2, and central lodge")
      {
        R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
        R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
        R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
        R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
        R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
        R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
        R_Date("UGAMS43174, Big House, Collagen", 612, 18);
        R_Date("UGAMS43175, Big House, Collagen", 609, 18);
        R_Date("UCR2035, H2, Maize,", 650, 60);
        R_Date("UCR2036, H2, Maize", 550, 70);
        R_Date("UCR2037, H2, Maize", 710, 70);
        Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
        Date("Whistling Elk date");
      };
      Boundary("Whistling Elk end");
    };
    Sequence("Indian Creek occupation")
    {
      Boundary("Indian Creek Early begin");
      Phase("Indian Creek")
      {
        R_Date("UGAMS-46700, Collagen", 620, 20);
        R_Date("UGAMS-46701, Collagen", 670, 25);
        R_Date("UGAMS-46702, Collagen", 540, 25);
        R_Date("UGAMS-46703, Collagen", 590, 25);
        R_Date("UGAMS-46704, Collagen", 590, 20);
        R_Date("UGAMS-46705, Collagen", 580, 20);
        R_Date("UGAMS-46706, Collagen", 690, 25);
        R_Date("UGAMS-46707, Collagen", 660, 25);
        Interval("Indian Creek Early interval",LnN(ln(25),ln(2)));
        Date("Indian Creek Early date");
      };
      Boundary("Indian Creek Early end");
      Interval("Early to Late interval");
      Boundary("Indian Creek Late begin");
      Phase("Indian Creek Late")
      {
        R_Date("I-18,039, F43", 330, 86)
        {
          Outlier(1);
        }
      }
    }
  }
}
```

```

};
R_Date("I-18,040, F30", 450, 86)
{
  Outlier(1);
};
R_Date("I-18,041, F7", 300, 86)
{
  Outlier(1);
};
R_Date("I-18,042, F5", 330, 86)
{
  Outlier(1);
};
Interval("Indian Creek Late interval",LnN(ln(25),ln(2)));
Date("Indian Creek Late date");
};
Boundary("Indian Creek Late end");
};
};
Difference("begin-begin", "Indian Creek Early begin", "Whistling Elk begin");
Difference("end-begin", "Indian Creek Early end", "Whistling Elk begin");
Difference("begin-end", "Indian Creek Early begin", "Whistling Elk end");
Difference("end-end", "Indian Creek Early end", "Whistling Elk end");
Difference("date", "Indian Creek Early date", "Whistling Elk date");
Difference("date-begin", "Indian Creek Early date", "Whistling Elk begin");
Difference("date-end", "Indian Creek Early date", "Whistling Elk end");
Difference("begin-date", "Indian Creek Early begin", "Whistling Elk date");
Difference("end-date", "Indian Creek Early end", "Whistling Elk date");
};

```

C.5.36 Whistling Elk vs. Jiggs Thompson

```
Plot()
{
Phase("Whistling Elk v. Jiggs Thompson")
{
Sequence("Whistling Elk village")
{
Boundary("Whistling Elk begin");
Phase("Whistling Elk Houses 1, 2, and central lodge")
{
R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
R_Date("UGAMS43154, H2, F29, Maize", 613, 18);
R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
R_Date("UGAMS43174, Big House, Collagen", 612, 18);
R_Date("UGAMS43175, Big House, Collagen", 609, 18);
R_Date("UCR2035, H2, Maize,", 650, 60);
R_Date("UCR2036, H2, Maize", 550, 70);
R_Date("UCR2037, H2, Maize", 710, 70);
Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
Date("Whistling Elk date");
};
Boundary("Whistling Elk end");
};
Sequence("Jiggs Thompson village")
{
Boundary("Jiggs Thompson begin");
Phase("Jiggs Thompson")
{
R_Date("I-1186, N/A", 670, 124);
R_Date("I-1187, N/A", 670, 124);
R_Date("ETH-11041, X-4 Midden", 770, 60);
Interval("Jiggs interval",LnN(ln(25),ln(2)));
Date("Jiggs date");
};
Boundary("Jiggs Thompson end");
};
};
Difference("begin-begin", "Jiggs Thompson begin", "Whistling Elk begin");
Difference("end-begin", "Jiggs Thompson end", "Whistling Elk begin");
Difference("begin-end", "Jiggs Thompson begin", "Whistling Elk end");
Difference("end-end", "Jiggs Thompson end", "Whistling Elk end");
Difference("date", "Jiggs date", "Whistling Elk date");
Difference("date-begin", "Jiggs date", "Whistling Elk begin");
Difference("date-end", "Jiggs date", "Whistling Elk end");
Difference("begin-date", "Jiggs Thompson begin", "Whistling Elk date");
Difference("end-date", "Jiggs Thompson end", "Whistling Elk date");
};
};
```

C.5.37 Whistling Elk vs. Ketchen

Plot()

```
{
Phase("Whistling Elk v. Ketchen")
{
Sequence("Whistling Elk village")
{
Boundary("Whistling Elk begin");
Phase("Whistling Elk Houses 1, 2, and central lodge")
{
R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
R_Date("UGAMS43154, H2, F29, Maize", 613, 18);
R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
R_Date("UGAMS43174, Big House, Collagen", 612, 18);
R_Date("UGAMS43175, Big House, Collagen", 609, 18);
R_Date("UCR2035, H2, Maize,", 650, 60);
R_Date("UCR2036, H2, Maize", 550, 70);
R_Date("UCR2037, H2, Maize", 710, 70);
Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
Date("Whistling Elk date");
};
Boundary("Whistling Elk end");
};
Sequence("Ketchen village")
{
Boundary("Ketchen begin");
Phase("Ketchen")
{
R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20);
R_Date("WIS-759, F3, P14", 830, 68);
R_Date("WIS-762, F17, 157B", 725, 59);
R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20);
Interval("Ketchen interval",LnN(ln(25),ln(2)));
Date("Ketchen date");
};
Boundary("Ketchen end");
};
};
Difference("begin-begin", "Ketchen begin", "Whistling Elk begin");
Difference("end-begin", "Ketchen end", "Whistling Elk begin");
Difference("begin-end", "Ketchen begin", "Whistling Elk end");
Difference("end-end", "Ketchen end", "Whistling Elk end");
Difference("date", "Ketchen date", "Whistling Elk date");
Difference("date-begin", "Ketchen date", "Whistling Elk begin");
Difference("date-end", "Ketchen date", "Whistling Elk end");
Difference("begin-date", "Ketchen begin", "Whistling Elk date");
```

```
Difference("end-date", "Ketchen end", "Whistling Elk date");  
};
```

C.5.38 Whistling Elk vs. Stony Point

```
Plot()
{
Phase("Whistling Elk v. Stony Point")
{
Sequence("Whistling Elk village")
{
Boundary("Whistling Elk begin");
Phase("Whistling Elk Houses 1, 2, and central lodge")
{
R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
R_Date("UGAMS43174, Big House, Collagen", 612, 18);
R_Date("UGAMS43175, Big House, Collagen", 609, 18);
R_Date("UCR2035, H2, Maize,", 650, 60);
R_Date("UCR2036, H2, Maize", 550, 70);
R_Date("UCR2037, H2, Maize", 710, 70);
Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
Date("Whistling Elk date");
};
Boundary("Whistling Elk end");
};
Sequence("Stony Point Occupation")
{
Boundary("Stony Point begin");
Phase("Stony Point")
{
R_Date("UCR-2314, HA, Charcoal", 685, 60);
R_Date("UCR-2315, HA, Charcoal", 840, 50);
Interval("Stony Point interval",LnN(ln(50),ln(2)));
Date("Stony Point date");
};
Boundary("Stony Point end");
};
};
Difference("begin-begin", "Stony Point begin", "Whistling Elk begin");
Difference("end-begin", "Stony Point end", "Whistling Elk begin");
Difference("begin-end", "Stony Point begin", "Whistling Elk end");
Difference("end-end", "Stony Point end", "Whistling Elk end");
Difference("date", "Stony Point date", "Whistling Elk date");
Difference("date-begin", "Stony Point date", "Whistling Elk begin");
Difference("date-end", "Stony Point date", "Whistling Elk end");
Difference("begin-date", "Stony Point begin", "Whistling Elk date");
Difference("end-date", "Stony Point end", "Whistling Elk date");
};
};
```

C.5.39 Whistling Elk vs. Sully School

```
Plot()
{
Phase("Whistling Elk v. Sully School")
{
Sequence("Whistling Elk village")
{
Boundary("Whistling Elk begin");
Phase("Whistling Elk Houses 1, 2, and central lodge")
{
R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
R_Date("UGAMS43174, Big House, Collagen", 612, 18);
R_Date("UGAMS43175, Big House, Collagen", 609, 18);
R_Date("UCR2035, H2, Maize,", 650, 60);
R_Date("UCR2036, H2, Maize", 550, 70);
R_Date("UCR2037, H2, Maize", 710, 70);
Interval("Whistling Elk interval",LnN(ln(25),ln(2)));
Date("Whistling Elk date");
};
Boundary("Whistling Elk end");
};
Sequence("Sully School Village")
{
Boundary("Sully School begin");
Phase("Sully School")
{
R_Date("UGAMS-46686, F4, Floor (F54?), Collagen", 550, 25);
R_Date("UGAMS-46687, F4, C1, Collagen", 670, 25);
R_Date("UGAMS-46688, F4, C1, Collagen", 620, 20);
R_Date("UGAMS-46689, F5, C4, Collagen", 650, 25);
R_Date("UGAMS-46690, F5, C4, Collagen", 640, 25);
R_Date("UGAMS-46691, F5, C4, Collagen", 640, 25);
R_Date("UGAMS-46692, F5, C4, Collagen", 750, 20);
R_Date("UGAMS-46693, F5, C8, Collagen", 740, 20);
R_Date("UGAMS-46694, F5, C8, Collagen", 710, 20);
R_Date("UGAMS-46695, F23, C1, Collagen", 630, 20);
Interval("Sully School interval",LnN(ln(50),ln(2)));
Date("Sully School date");
};
Boundary("Sully School end");
};
};
Difference("begin-begin", "Sully School begin", "Whistling Elk begin");
Difference("end-begin", "Sully School end", "Whistling Elk begin");
Difference("begin-end", "Sully School begin", "Whistling Elk end");
Difference("end-end", "Sully School end", "Whistling Elk end");
```

```
Difference("date", "Sully School date", "Whistling Elk date");  
Difference("date-begin", "Sully School date", "Whistling Elk begin");  
Difference("date-end", "Sully School date", "Whistling Elk end");  
Difference("begin-date", "Sully School begin", "Whistling Elk date");  
Difference("end-date", "Sully School end", "Whistling Elk date");  
};
```

C.6 Overlap Models Of Coalescent Villages

C.6.1 Arzberger and Black Partizan Overlap

```
Plot()
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Arzberger v. Alberts Creek")
  {
    Sequence("Arzberger Village")
    {
      Boundary("Arzberger begin");
      Phase("Arzberger")
      {
        R_Date("UGAMS43159, H3, F4, Collagen", 562, 20);
        R_Date("UGAMS43160, H4, F3, Collagen", 517, 20);
        R_Date("UGAMS43161, H2, F5, Collagen", 524, 20);
        R_Date("UGAMS43162, H3, Cache, Collagen", 545, 20);
        R_Date("UGAMS43163, H1, F9, Collagen", 547, 20);
        R_Date("UGAMS43164, H1, F10, Collagen", 554, 20);
        R_Date("UGAMS43165, H1, F10, Collagen", 523, 20);
        R_Date("UGAMS43166, H1, F9, Collagen", 559, 20);
        R_Date("M-1126a, X26, Bastion, Charcoal", 430, 105)
        {
          Outlier(1);
        };
        R_Date("M-1126, X28, Hearth", 500, 82)
        {
          Outlier(1);
        };
        Interval("Arzberger interval",LnN(ln(25),ln(2)));
        Date("Arzberger date");
      };
      Boundary("Arzberger end");
    };
    Sequence("Black Partizan village")
    {
      Boundary("Black Partizan Early begin");
      Phase("Black Partizan early w/in fortification")
      {
        R_Date("UGAMS-43146, H11, F15, Collagen", 460, 19);
        R_Date("UGAMS-43143, H11, F16, Collagen", 510, 19);
        R_Date("UGAMS-43141, H8, F7, Collagen", 650, 19);
        R_Date("UGAMS-43148, H8, F7, Collagen", 640, 19);
        R_Date("UGAMS-43142, H8, F5, Collagen", 600, 20);
        R_Date("UGAMS-43135, H8, Floor, Collagen", 650, 19);
        R_Date("UGAMS-43137, H8, F6, Collagen", 620, 19);
        R_Date("UGAMS-43138, H11, F18, Collagen", 560, 19);
        R_Date("UGAMS-43147, H11, F1, Collagen", 553, 18);
        Interval("Black Partizan Early interval",LnN(ln(50),ln(2)));
        Date("Black Partizan Early date");
      };
      Boundary("Black Partizan Early end");
    };
  };
}
```

```
Interval("Interval early to late occupations");
Boundary("Black Partizan Late occupation begin");
Phase("House 2")
{
  R_Date("UGAMS-43136, H2, F16, Collagen", 290, 19);
  R_Date("UGAMS-43144, H2, F12, Collagen", 300, 18);
  Interval("Black Partizan Late interval", LnN(ln(50), ln(2)));
  Date("Black Partizan Late date");
};
Boundary("Black Partizan Late end");
};
};
Order("Order")
{
};
};
```

C.6.2 Crow Creek Late and Whistling Elk

Plot()

```
{
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Phase("Crow Creek Late v. Whistling Elk")
  {
    Sequence("Crow Creek")
    {
      Boundary("Crow Creek Early begin");
      Phase("Crow Creek Early")
      {
        R_Date("UGAMS-46717, F52, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46720, F88, HVI, Collagen", 860, 25);
        R_Date("UGAMS-46743, F90, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46744, F52, HVI, Collagen", 910, 20);
        R_Date("UGAMS-46728, F195, HVII, Collagen", 910, 20);
        R_Date("UGAMS-46734, F2, P29, HI (below house floor), Collagen", 920, 20 );
        R_Date("UGAMS-46735, F2, P, HI (below house floor), Grass", 900, 20);
        R_Date("M-836, Charcoal", 900, 105)
        {
          Outlier(1);
        };
        R_Date("1-577, Charcoal", 850, 86)
        {
          Outlier(1);
        };
        R_Date("1-578, Charcoal", 900, 80)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46651, Post, Cat#40802B, Charcoal", 930, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46654, Post, Cat#40814, Charcoal", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46655, Post, Cat#n/a, Charcoal", 940, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46657, Post, Cat#40798, Wood", 870, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46660, Post, Cat#40810B, Wood", 890, 20)
        {
          Outlier(1);
        };
        R_Date("UGAMS-46662, Post, Cat#40802, Charcoal", 850, 20)
```

```

{
  Outlier(1);
};
R_Date("UGAMS-46663, Post, Cat#40814, Charcoal", 870, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46664, Post, F50, Charcoal", 860, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46666, Post, Cat#40806, Charcoal", 860, 20)
{
  Outlier(1);
};
Interval("Crow Creek Early interval");
Date("Crow Creek Early dates");
};
Boundary("Crow Creek Early end");
Before("HVII fill")
{
  R_Date("UGAMS-46726, F195, HVII, Collagen", 780, 20);
  R_Date("UGAMS-46727, F195, HVII, Collagen", 790, 25);
};
Interval("Interval between occupations");
After("Pre-date HI")
{
  R_Date("UGAMS-46733, F2, HI (pre-date), Collagen", 890, 20);
  R_Date("UGAMS-46736, F2, Floor & Below, HI, Collagen", 880, 20);
};
Boundary("Crow Creek Late begin");
Phase("Crow Creek Late")
{
  R_Date("UGAMS-46731, F2 (Floor, 48), HI, Collagen", 520, 25);
  R_Date("UGAMS-46737, F2, Floor, HI, Collagen", 630, 20);
  R_Date("UGAMS-46709, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46710, F18, HII, Collagen", 600, 25);
  R_Date("UGAMS-46711, F18, HII, Collagen", 580, 25);
  R_Date("UGAMS-46712, F19, HII (pre-date), Collagen", 620, 25);
  R_Date("UGAMS-46714, F23, HII, Collagen", 610, 20);
  R_Date("UGAMS-46715, F44, HII, Collagen", 530, 25);
  R_Date("UGAMS-46716, F43, HII, Collagen", 620, 20);
  R_Date("UGAMS-46738, F30, Posthole #59, HII, Collagen", 600, 20);
  R_Date("UGAMS-46739, F30, Posthole #59, HII, Collagen", 570, 20);
  R_Date("UGAMS-46745, F14, HII (post-date), Collagen", 540, 20);
  R_Date("UGAMS-46713, F21, HIII (post-date), Collagen", 510, 25);
  R_Date("UGAMS-46719, F61, HIII, Collagen", 560, 25);
  R_Date("UGAMS-46718, F61A, HIII (pre-date), Collagen", 510, 25);
  R_Date("UGAMS-46723, F133, HIV (post-date), Collagen", 620, 25);
  R_Date("UGAMS-46740, F100, Post #53, HIV, Collagen", 660, 20);
  R_Date("UGAMS-46741, F100, Post holes, HIV, Collagen", 610, 20);

```

```

R_Date("UGAMS-46724, F180, HV (pre-date), Collagen", 620, 25);
R_Date("UGAMS-46722, F115 (Post), HV, Collagen", 640, 20 );
R_Date("UGAMS-46742, F102, HVIII, Collagen", 700, 20);
R_Date("UGAMS-46725, F185 House J, Collagen", 610, 20);
R_Date("M-1079a, F 100, P 46, Charcoal", 560, 82)
{
  Outlier(1);
};
R_Date("UGAMS-41522, Post, Cat#40799C, Charcoal", 600, 20)
{
  Outlier(1);
};
R_Date("UGAMS-43100, Post, Cat#40799B, Charcoal", 610, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46652, Post Cat#40804B, Charcoal", 630, 20)
{
  Outlier(1);
};
R_Date("UGAMS-46656, Post Cat#40804, Charcoal", 500, 20)
{
  Outlier(1);
};
R_Date("WIS-1074, Outer Fort. Ditch, Charcoal", 610, 55)
{
  Outlier(1);
};
Interval("Crow Creek Late interval");
Date("Crow Creek Late date");
};
Boundary("Crow Creek Late end");
};
Sequence("Whistling Elk village")
{
  Boundary("Whistling Elk begin");
  Phase("Whistling Elk Houses 1, 2, and central lodge")
  {
    R_Date("UGAMS43149, H2, F23, Collagen", 580, 19);
    R_Date("UGAMS43151, H1, Rf/Flr, Maize", 619, 18);
    R_Date("UGAMS43152, H2, Rf/Flr, Maize", 616, 18);
    R_Date("UGAMS43153, H2, Rf/Flr, Maize", 605, 18);
    R_Date("UGAMS43154, H2, F29, Maize", 613, 18);
    R_Date("UGAMS43155, H1, Rf/Flr, Maize", 625, 18);
    R_Date("UGAMS43156, H1, Rf/Flr, Maize", 608, 18);
    R_Date("UGAMS43174, Big House, Collagen", 612, 18);
    R_Date("UGAMS43175, Big House, Collagen", 609, 18);
    R_Date("UCR2035, H2, Maize,", 650, 60);
    R_Date("UCR2036, H2, Maize", 550, 70);
    R_Date("UCR2037, H2, Maize", 710, 70);
    Interval("Whistling Elk interval",LnN(ln(25),ln(2)));

```

```
Date("Whistling Elk date");  
};  
Boundary("Whistling Elk end");  
};  
Order("Order")  
{  
};  
};
```

C.7 Extended Middle Missouri Village Orders

C.7.1 Travis I vs. Ketchen

Plot()

```
{
Phase("Arzberger v. Ketchen")
{
Sequence("Travis I")
{
Boundary("Travis I begin");
Phase("Village")
{
R_Date("WIS-1709, F36", 780, 70);
R_Date("WIS-1710, F18", 780, 70);
Interval("Travis I interval",LnN(ln(25),ln(2)));
Date("Travis I date");
};
Boundary("Travis I end");
};
Sequence("Ketchen village")
{
Boundary("Ketchen begin");
Phase("Ketchen")
{
R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20);
R_Date("WIS-759, F3, P14", 830, 68);
R_Date("WIS-762, F17, 157B", 725, 59);
R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20);
Interval("Ketchen interval",LnN(ln(25),ln(2)));
Date("Ketchen date");
};
Boundary("Ketchen end");
};
};
Order()
{
};
};
```

C.7.2 Travis I vs. Clark's Creek

Plot()

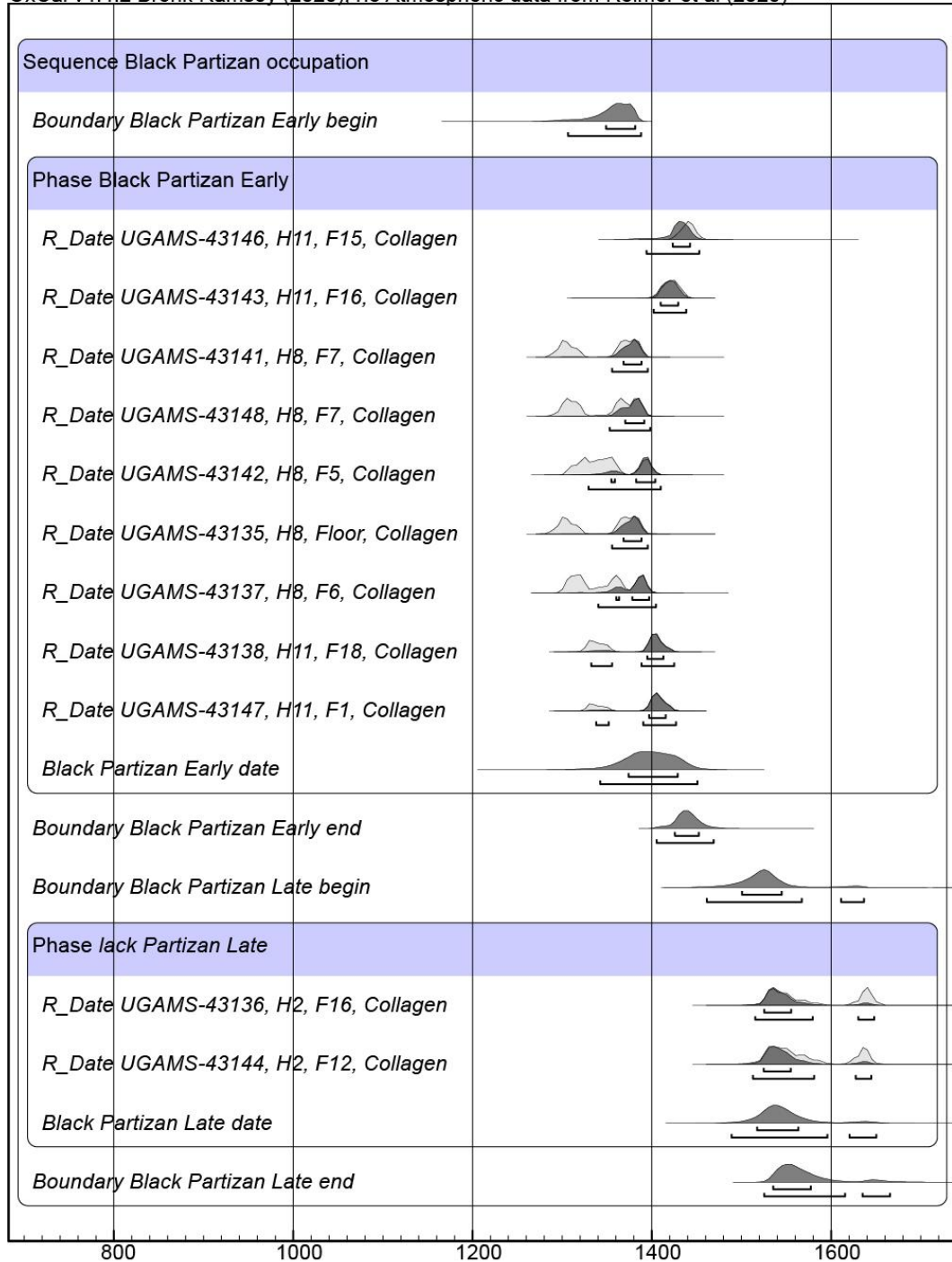
```
{
Phase("Arzberger v. Ketchen")
{
Sequence("Travis I")
{
Boundary("Travis I begin");
Phase("Village")
{
R_Date("WIS-1709, F36", 780, 70);
R_Date("WIS-1710, F18", 780, 70);
Interval("Travis I interval",LnN(ln(25),ln(2)));
Date("Travis I date");
};
Boundary("Travis I end");
};
Sequence("Ketchen village")
{
Boundary("Ketchen begin");
Phase("Ketchen")
{
R_Date("UGAMS-46685, XU11, F12, 2.0-2.5 BS", 730, 20);
R_Date("WIS-759, F3, P14", 830, 68);
R_Date("WIS-762, F17, 157B", 725, 59);
R_Date("UGAMS-46684, XU2, F3, Floor", 800, 20);
Interval("Ketchen interval",LnN(ln(25),ln(2)));
Date("Ketchen date");
};
Boundary("Ketchen end");
};
Sequence("Clark's Creek village")
{
Boundary("Clark's Creek begin");
Phase("Clark's Creek")
{
R_Date("M-2366, T1, F1", 670, 105);
R_Date("M-2367, T1, F1", 770, 115);
R_Date("SMU-1286, T1, F1", 750, 59);
Interval("Clark's Creek interval",LnN(ln(25),ln(2)));
Date("Clark's Creek date");
};
Boundary("Clark's Creek end");
};
};
Order()
{
};
};
};
```

Appendix D: Results of Bayesian Models

D.1 Multi-occupation Sites

D.1.1 Black Partizan

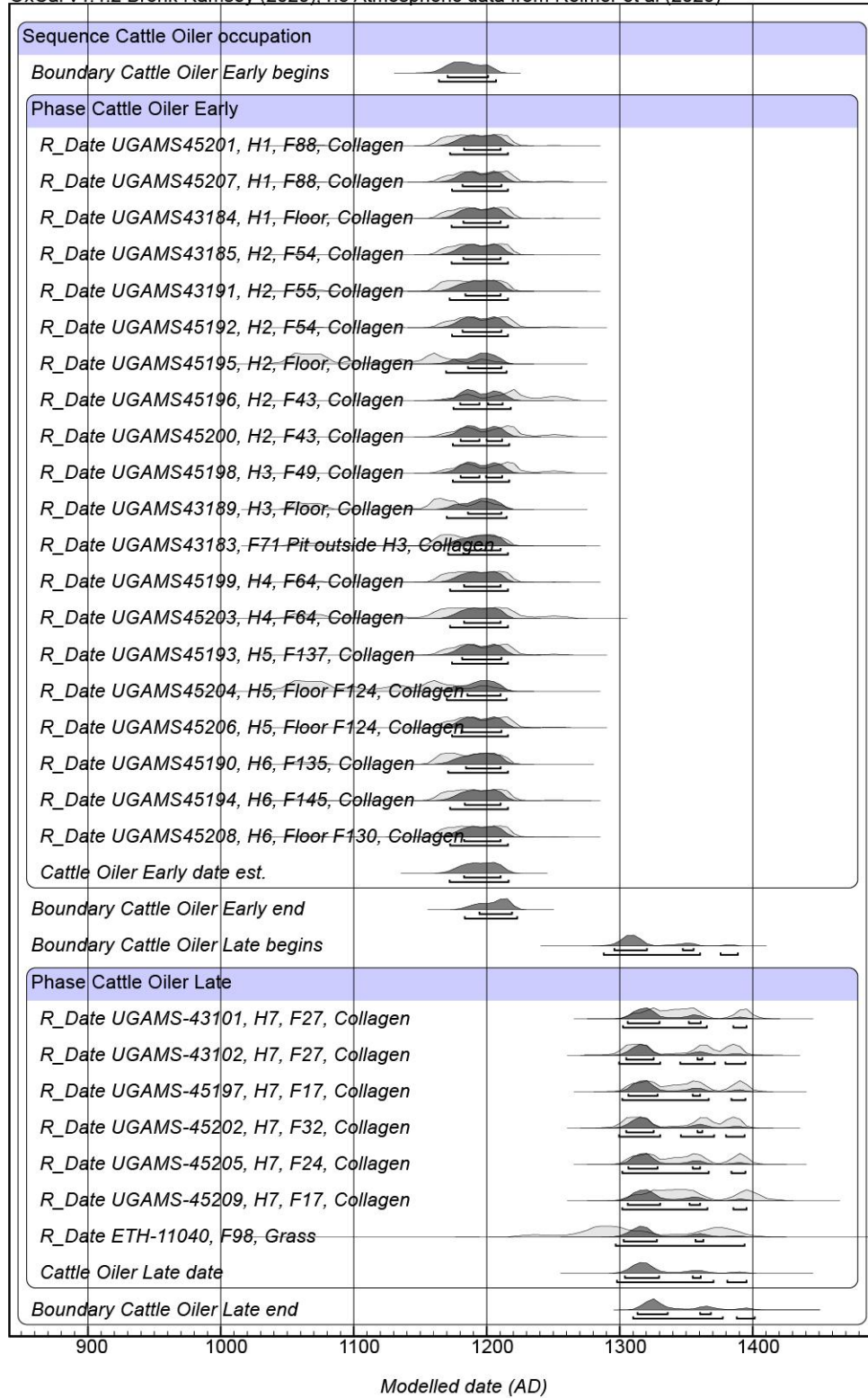
OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



Modelled date (AD)

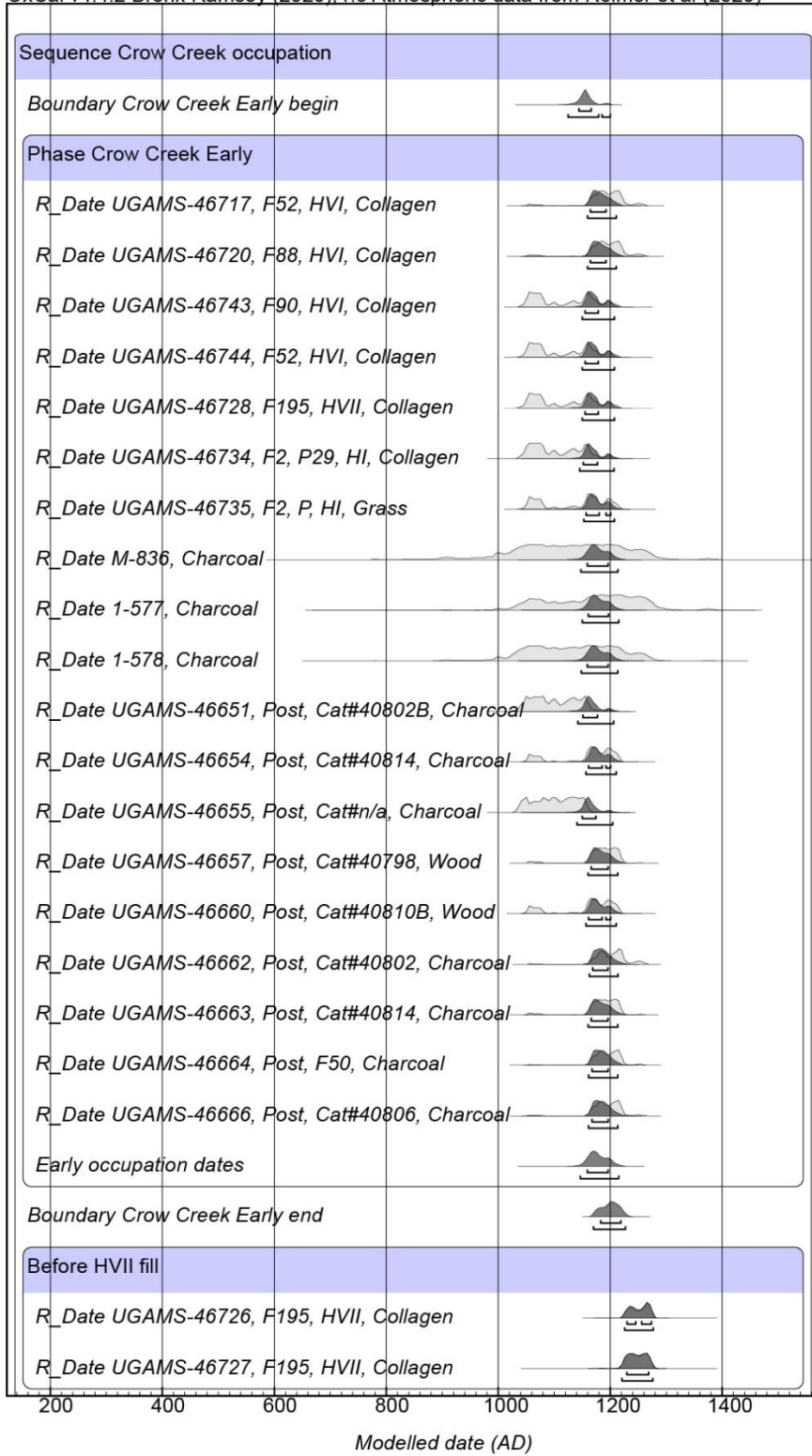
C.1.2 Cattle Oiler

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



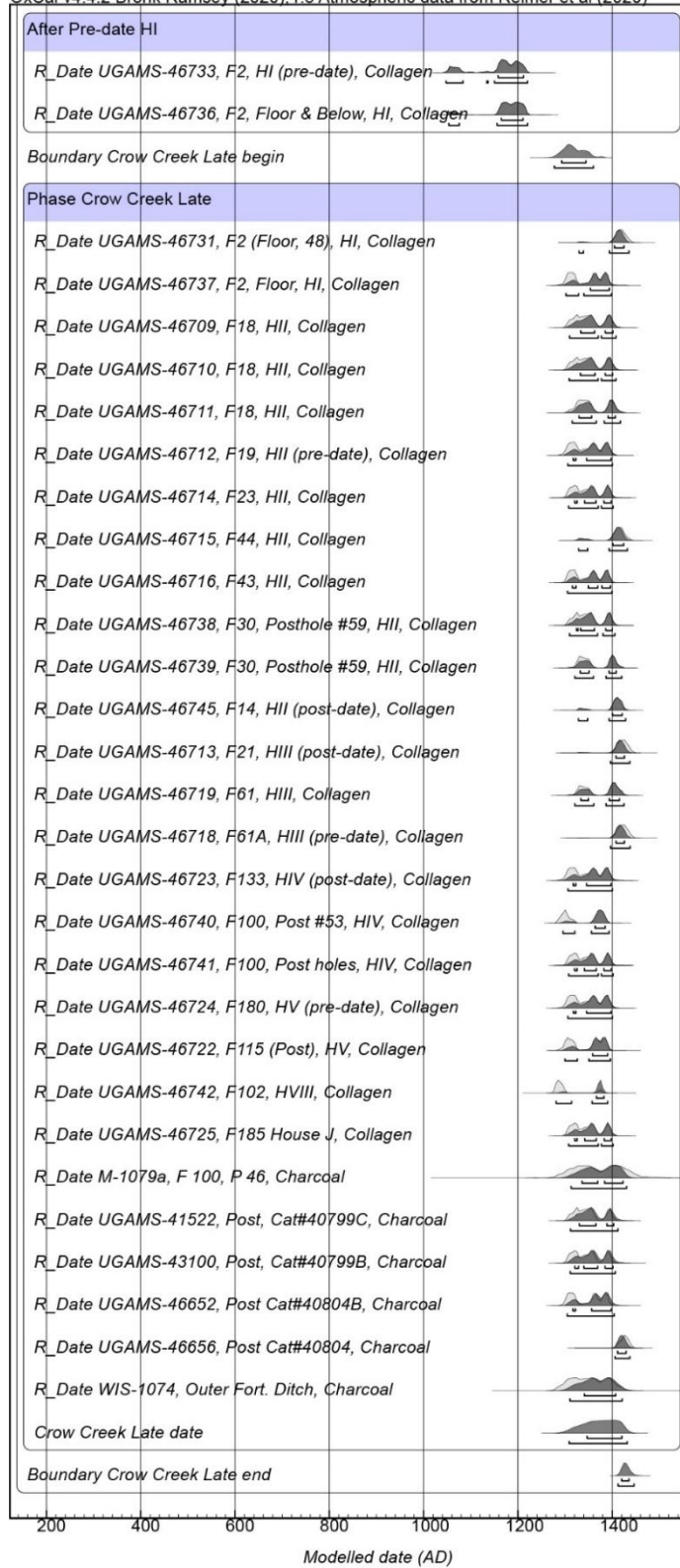
D.1.3.1 Crow Creek (early occupation section of model)

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



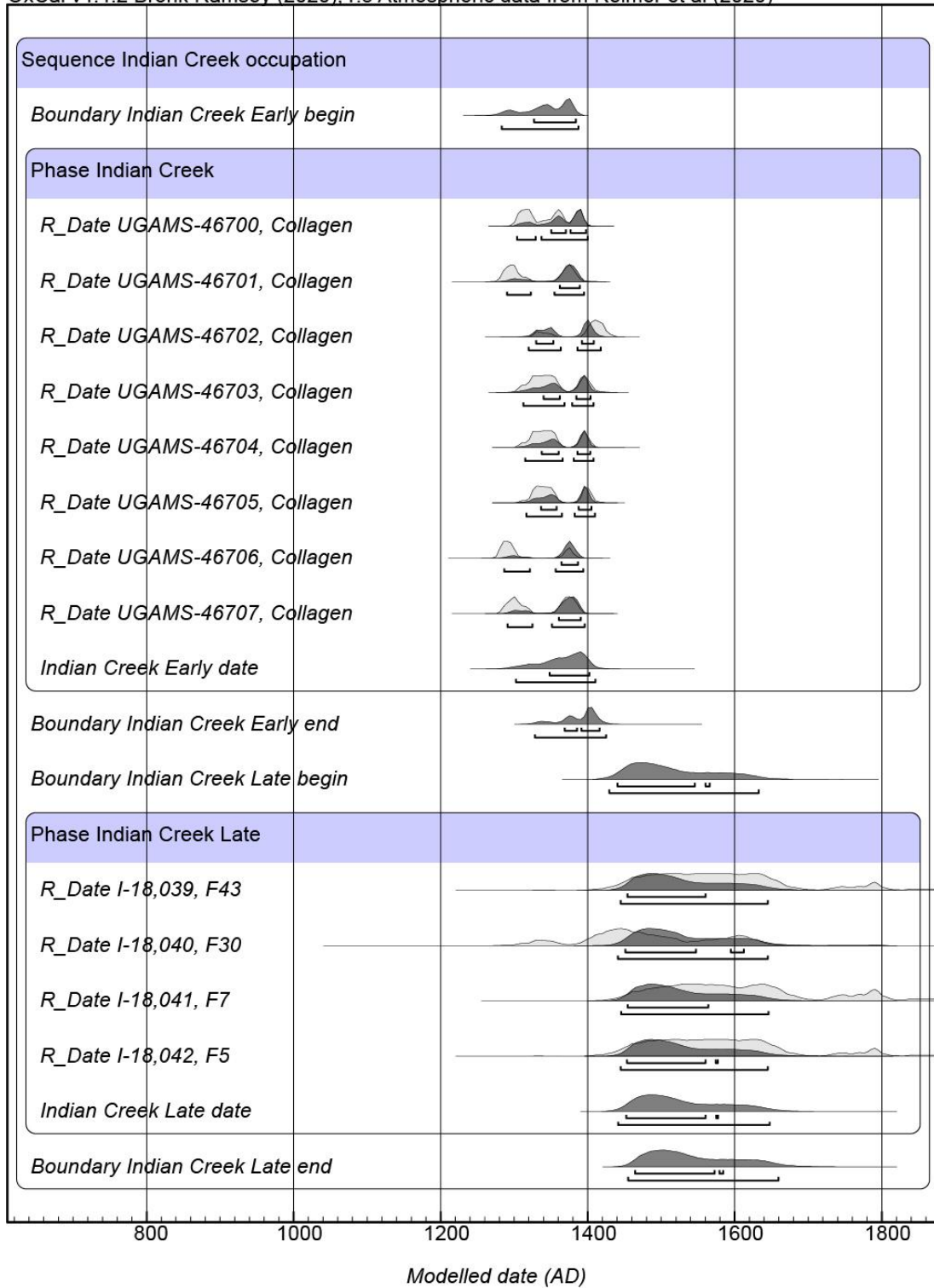
D.1.3.2 Crow Creek cont. (late occupation section of model)

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



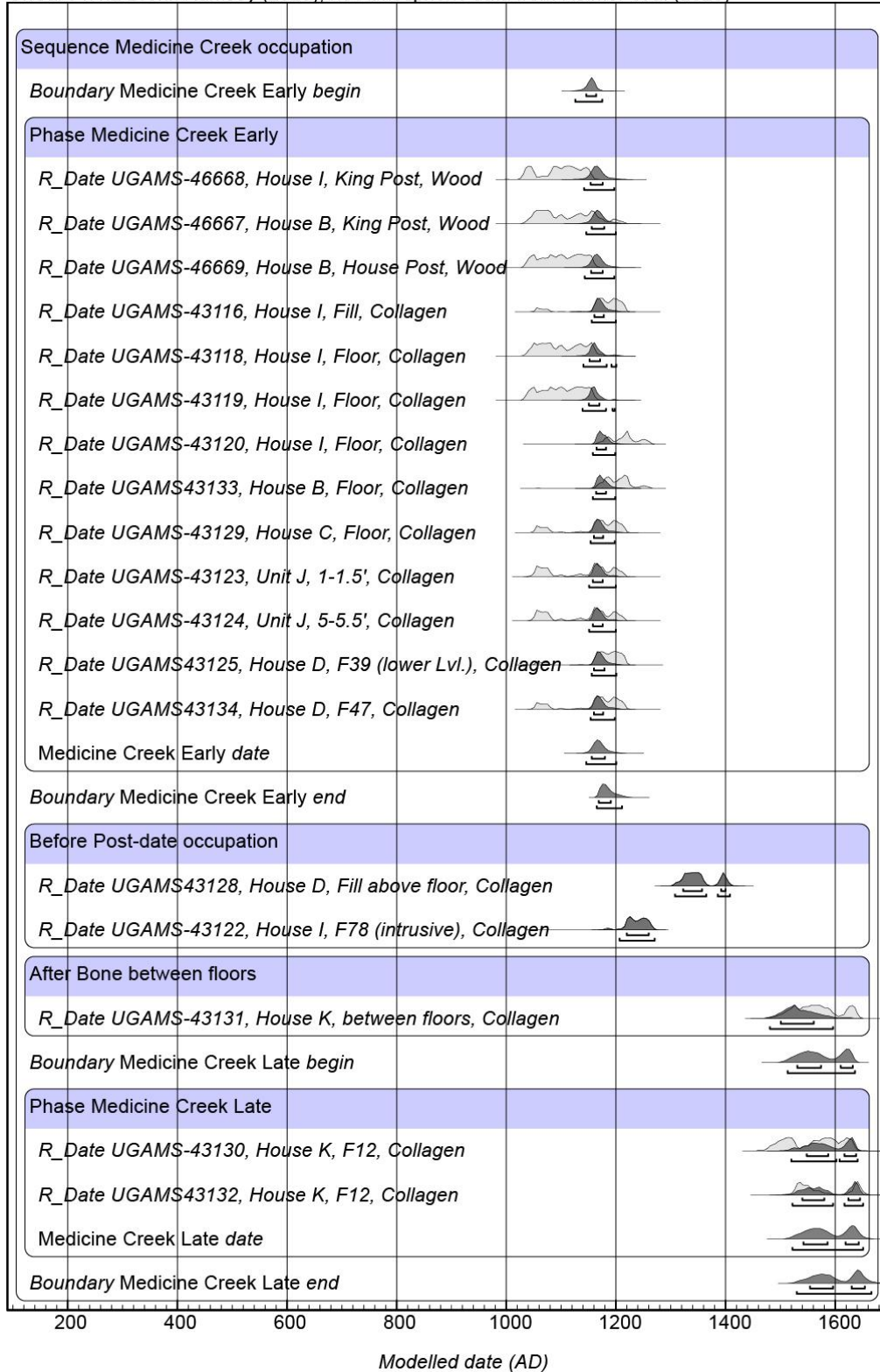
D.1.4 Indian Creek

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



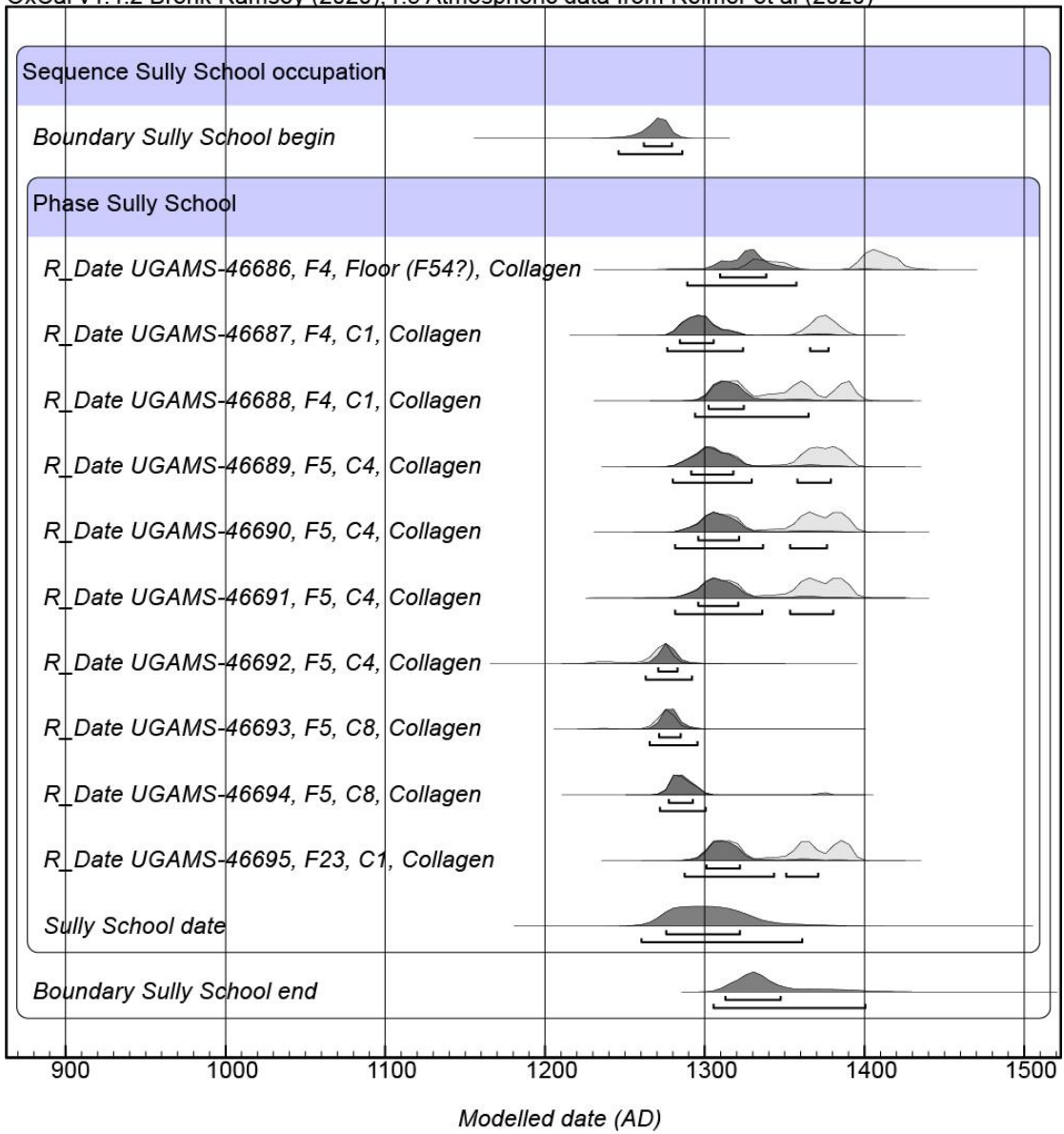
D.1.5 Medicine Creek

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



C.1.6 Sully School

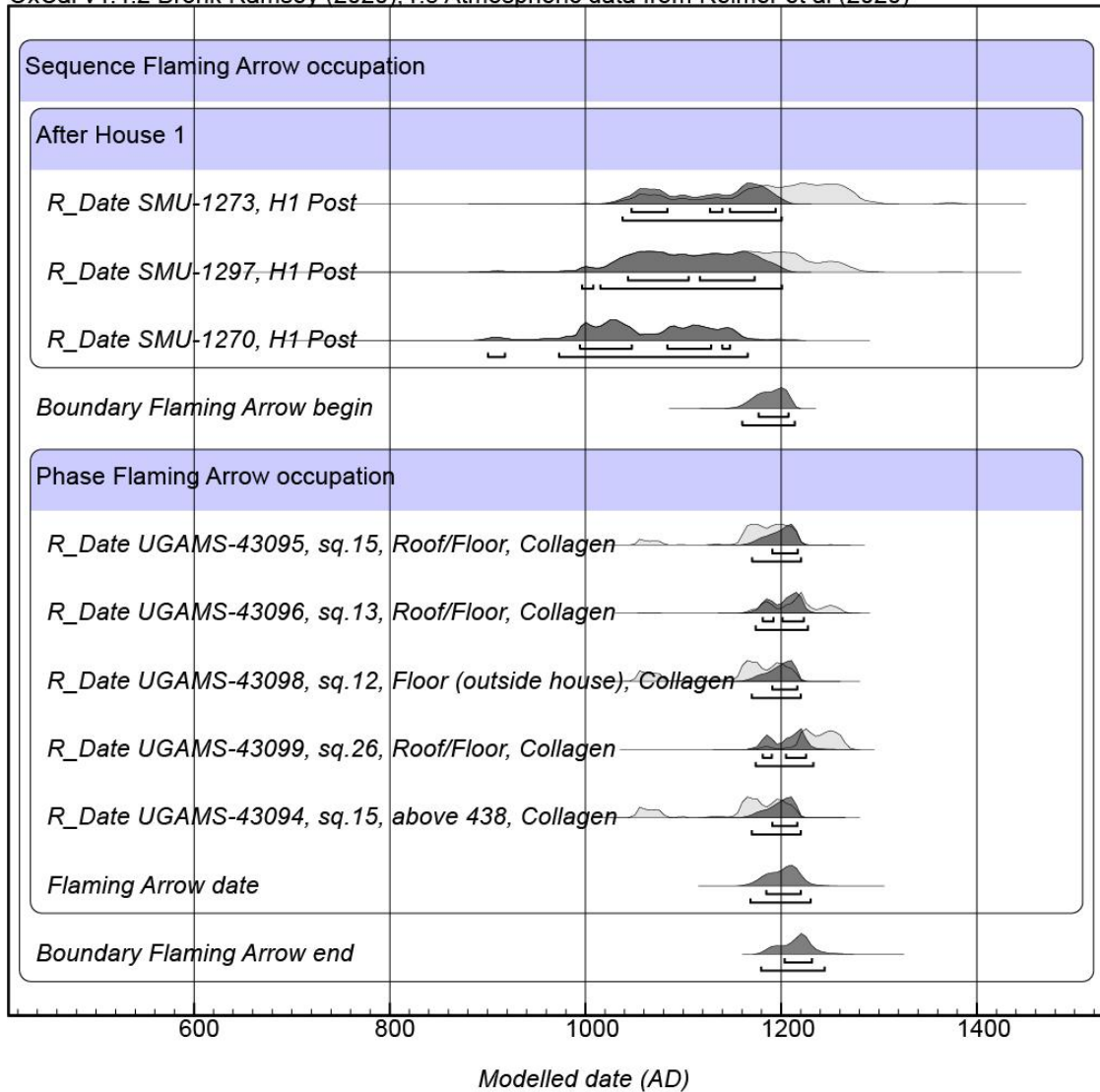
OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



D.2 Woodland Villages

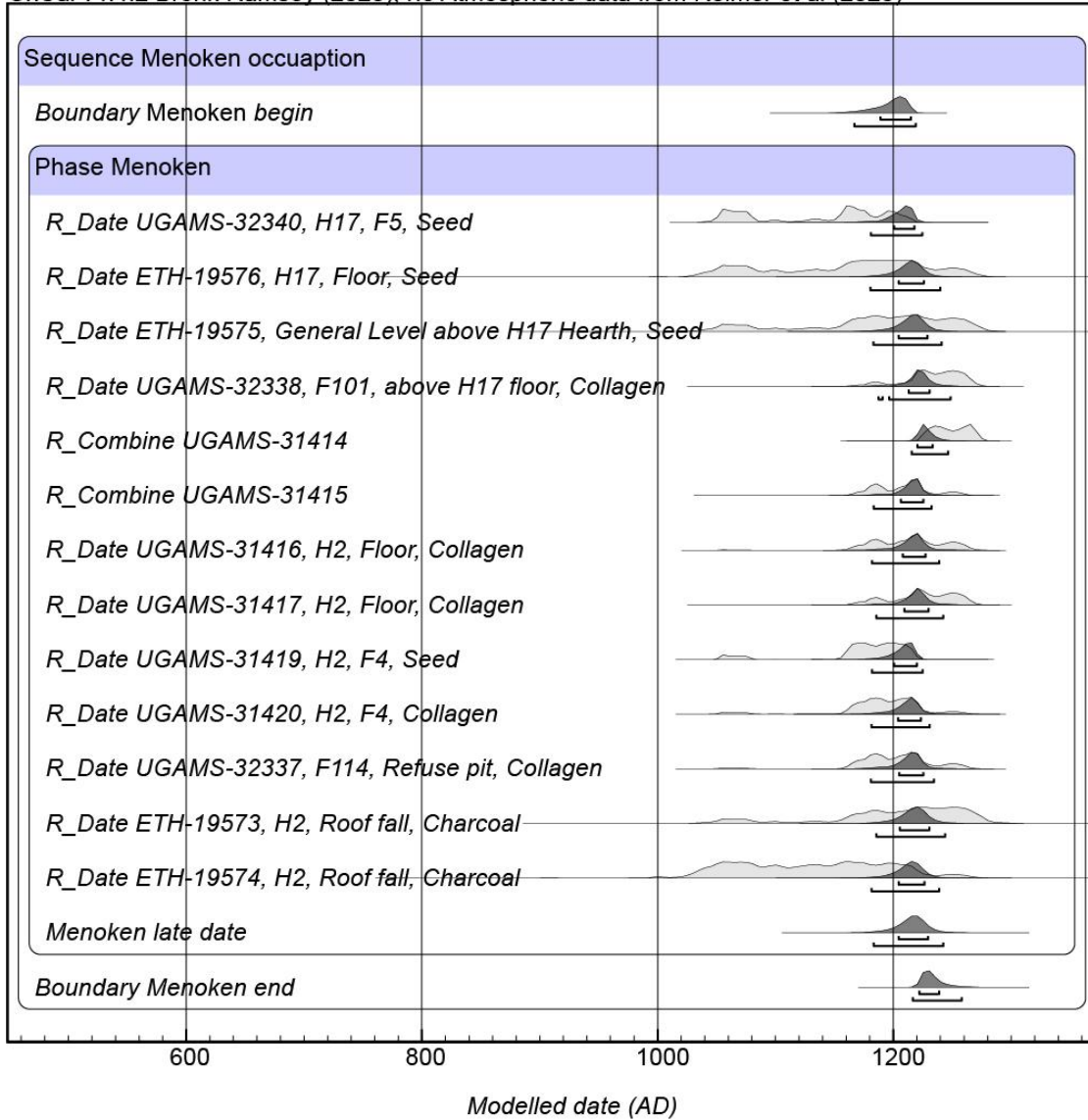
D.2.1 Flaming Arrow

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



C.2.2 Menoken

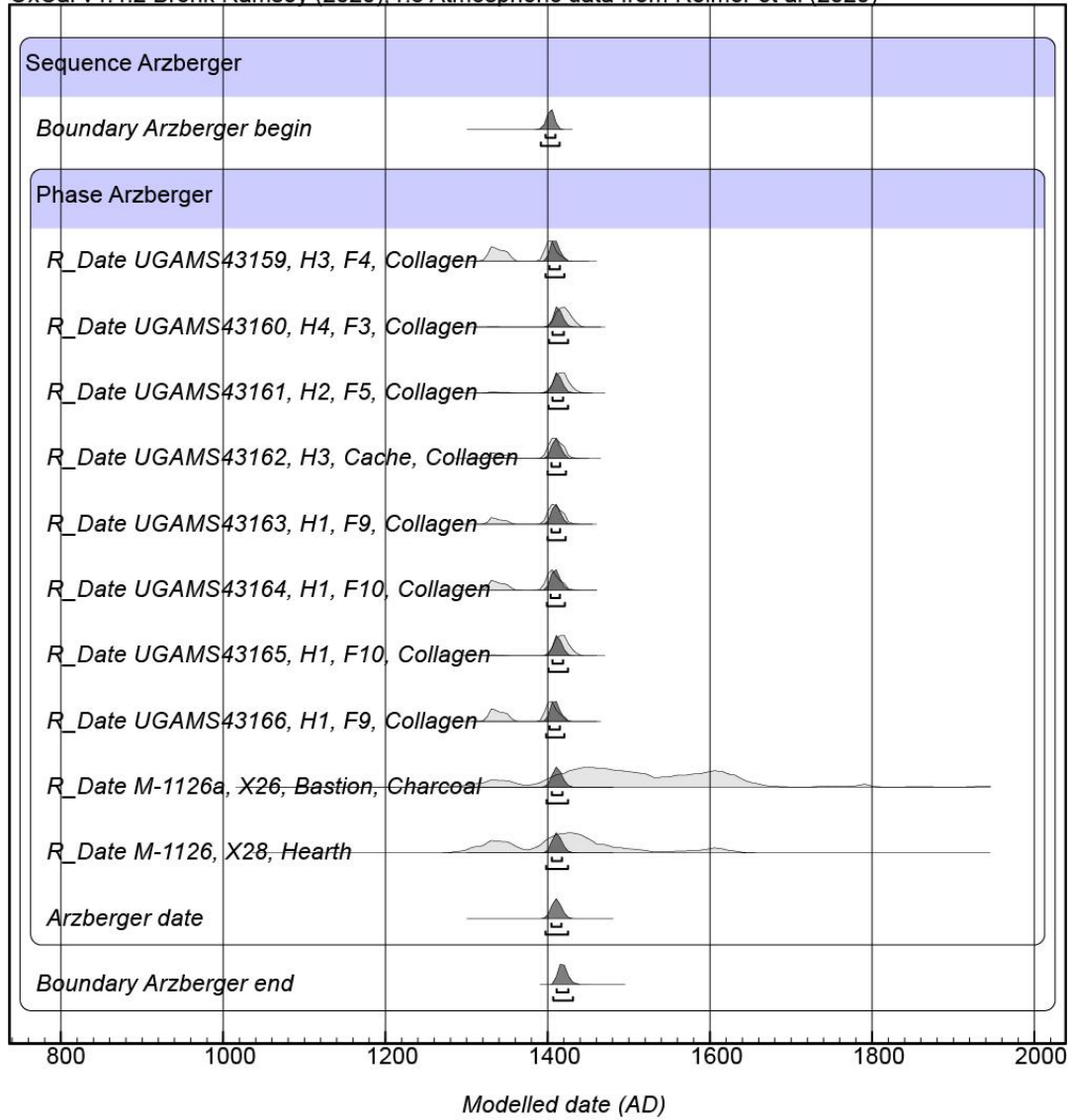
OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



D.3 Coalescent Village Models

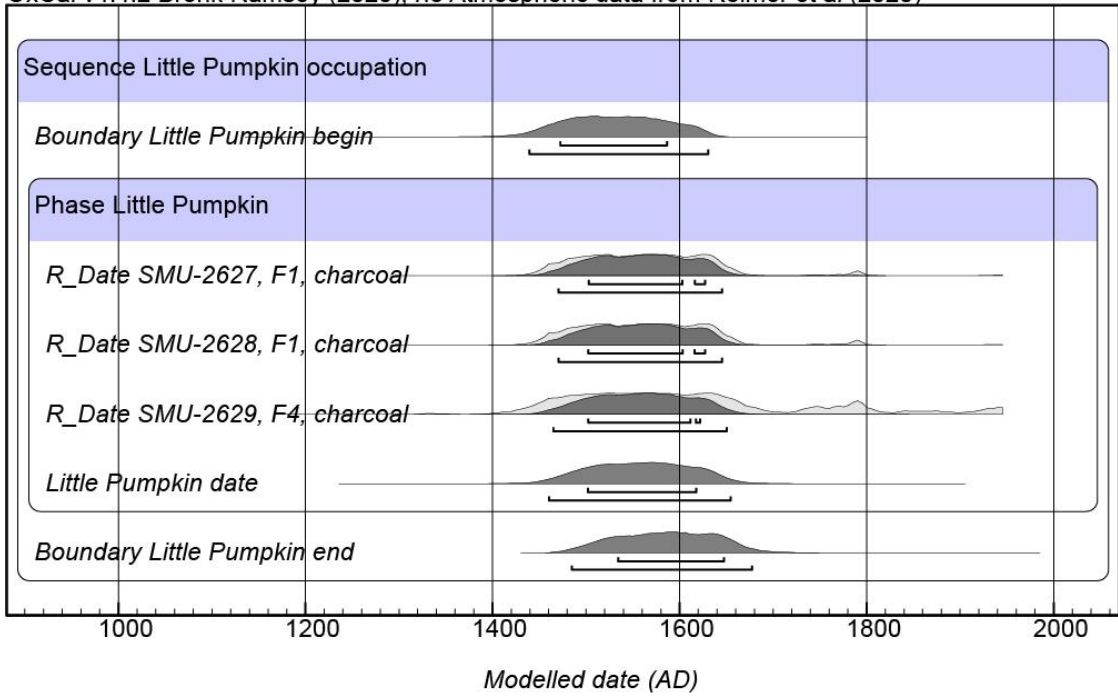
D.3.1 Arzberger

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



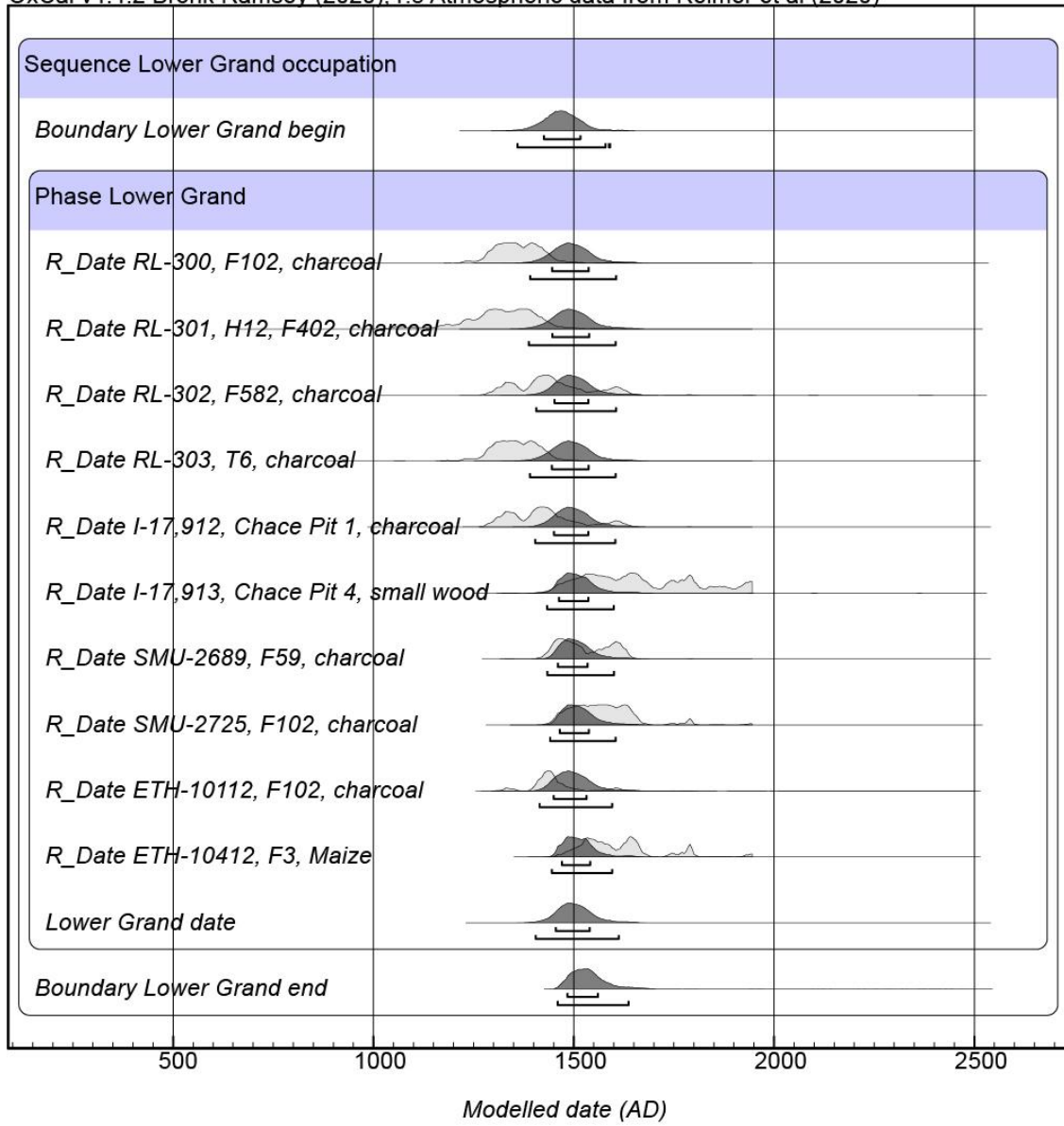
D.3.2 Little Pumpkin

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



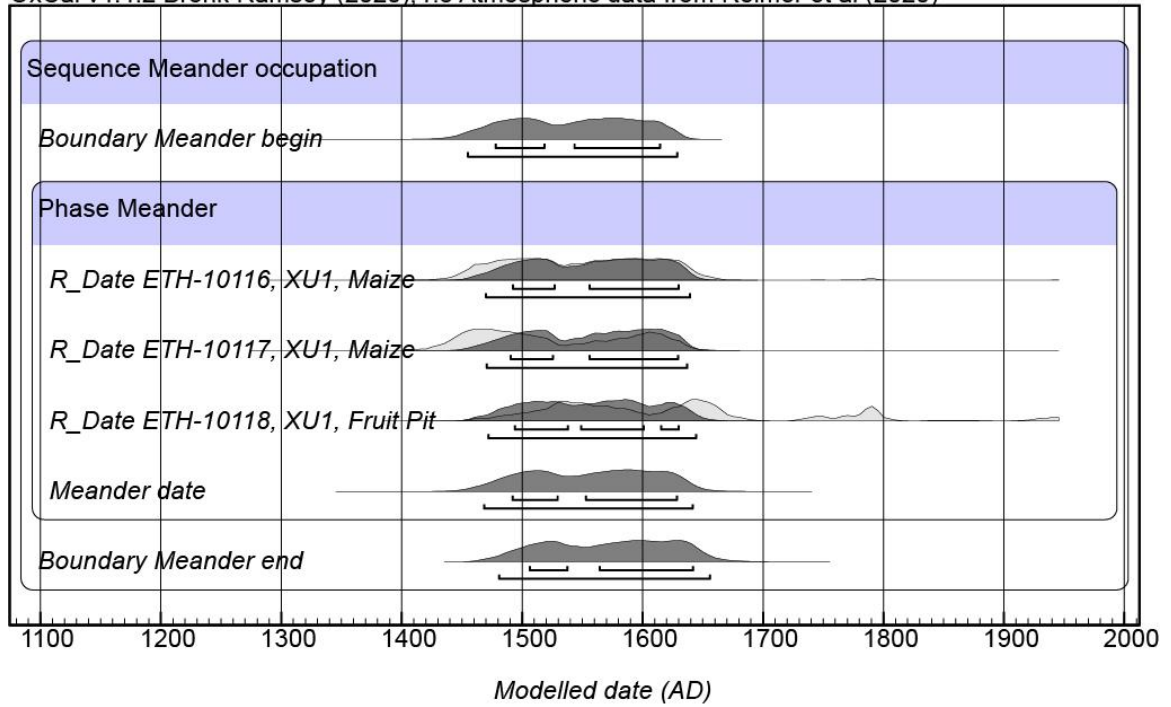
D.3.3 Lower Grand

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



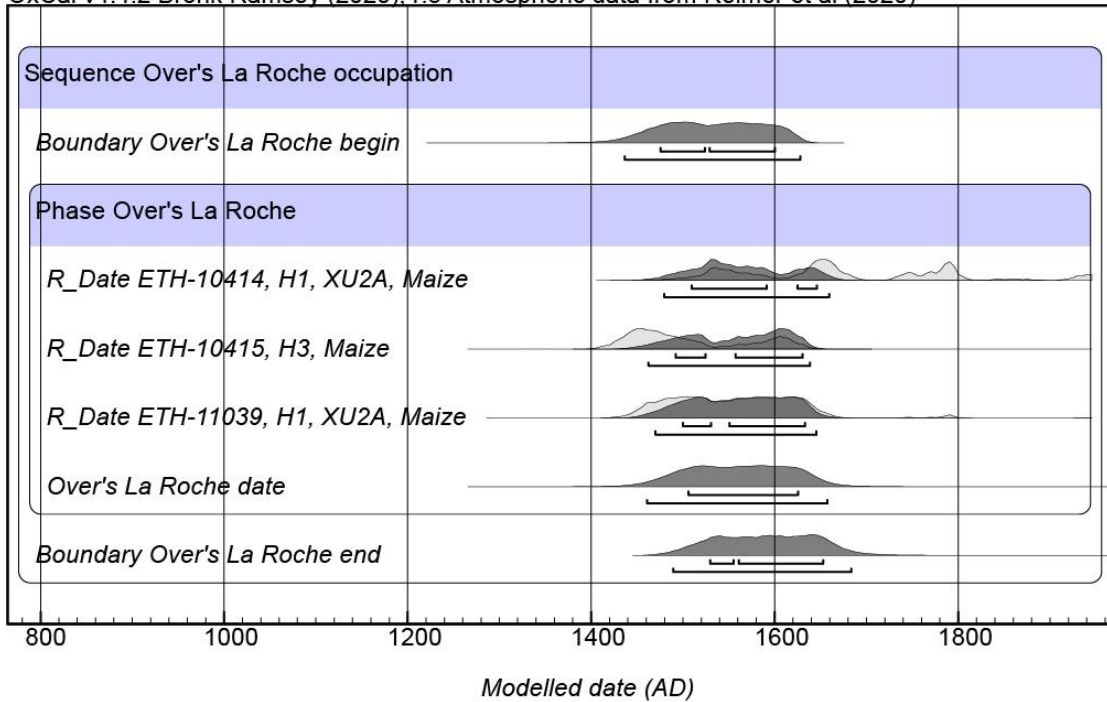
D.3.4 Meander

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



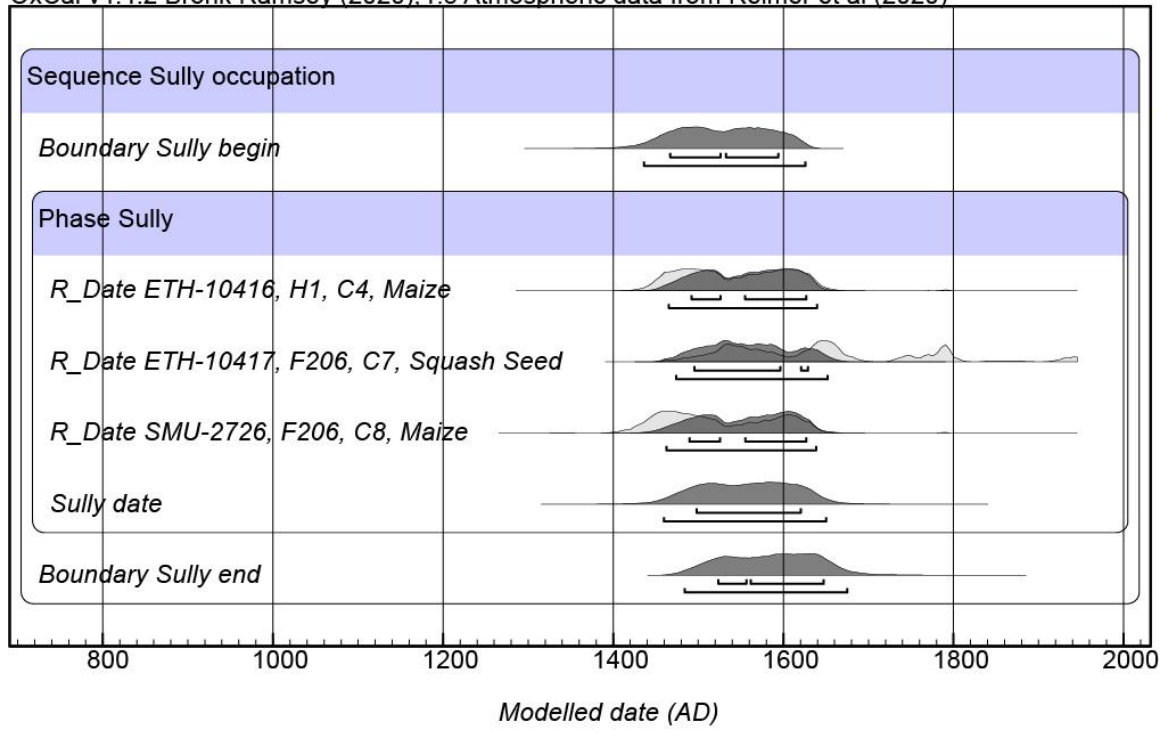
D.3.5 Over's La Roche

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



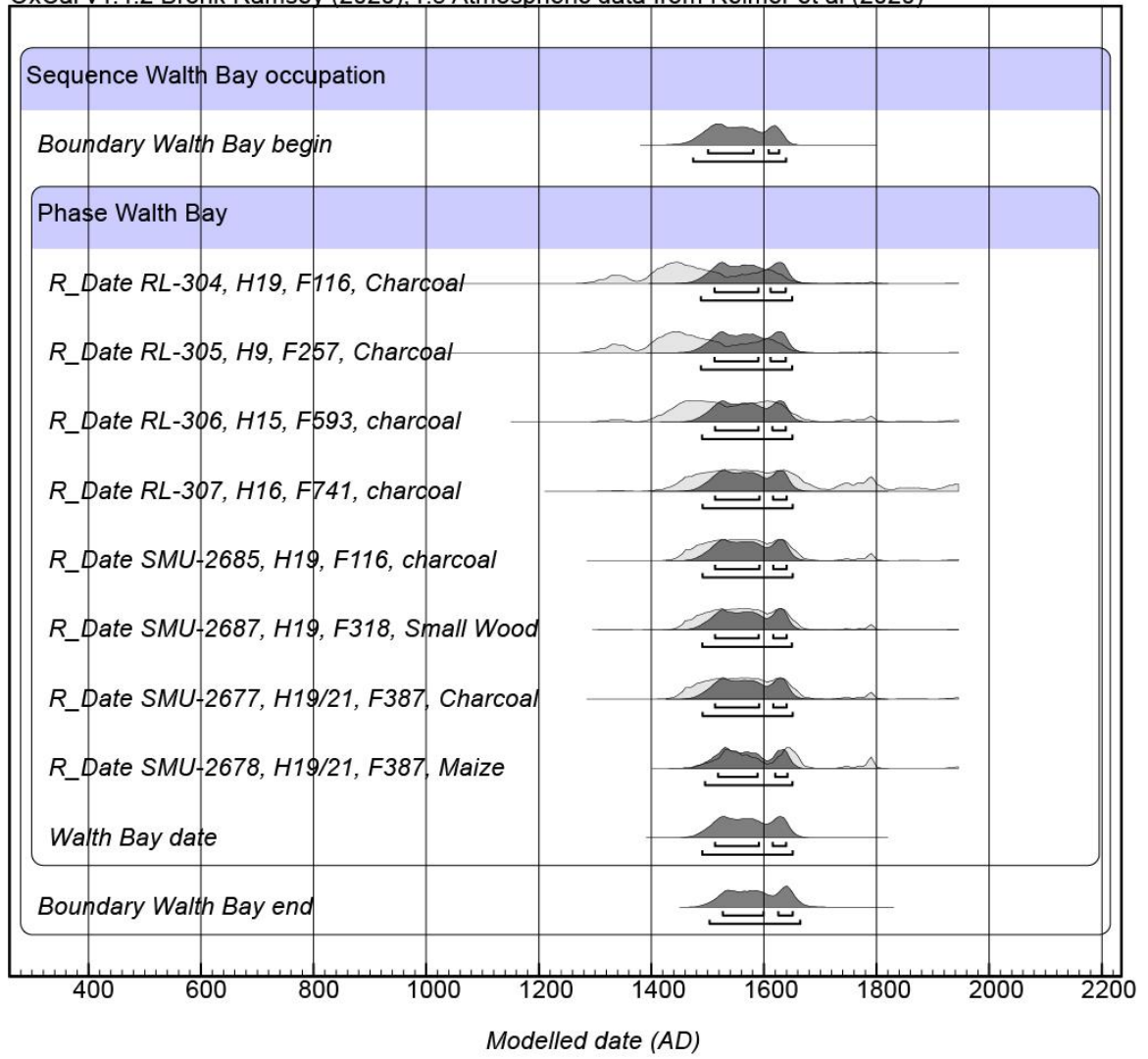
D.3.6 Sully

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



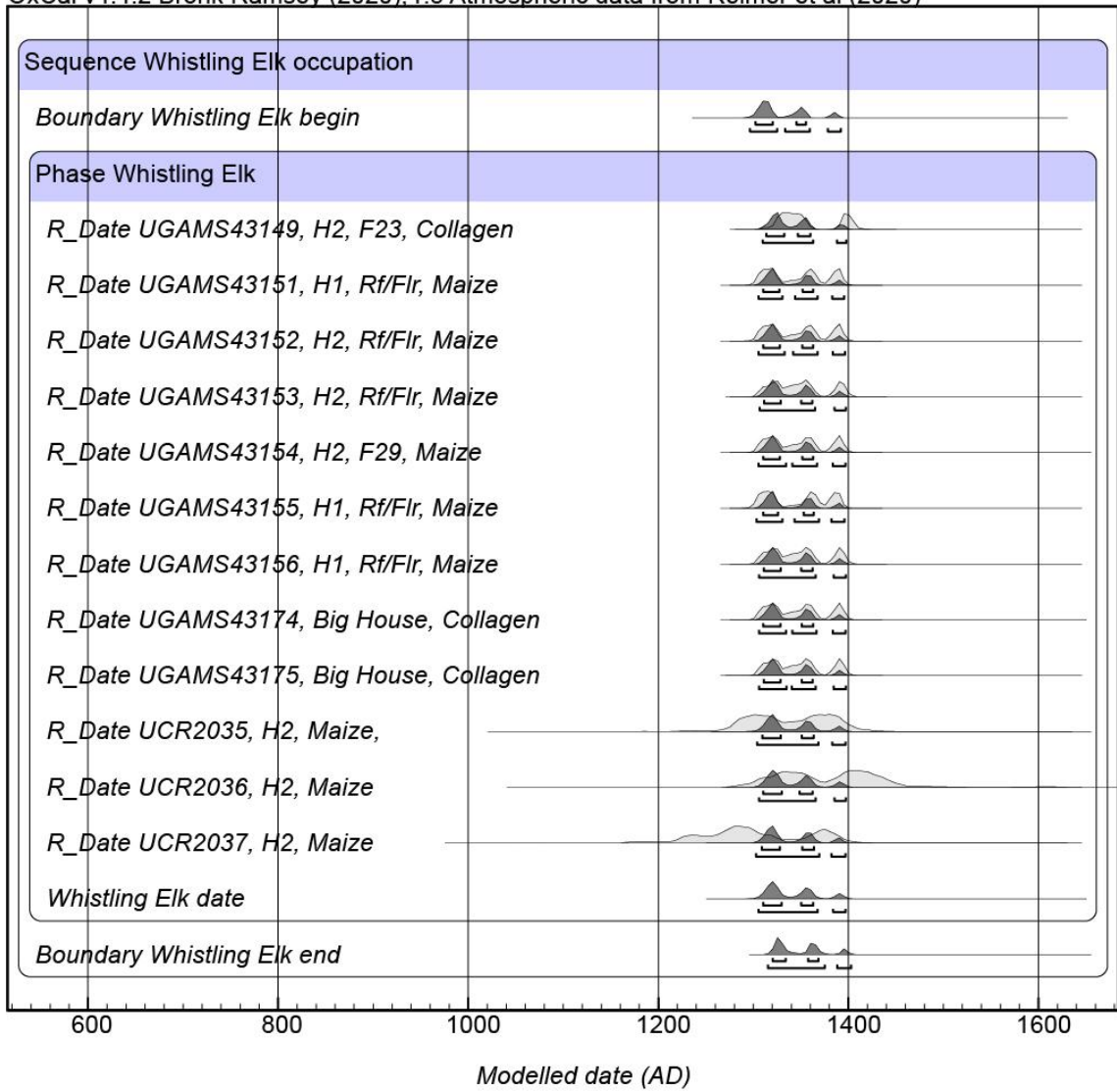
D.3.7 Walth Bay

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



D.3.8 Whistling Elk

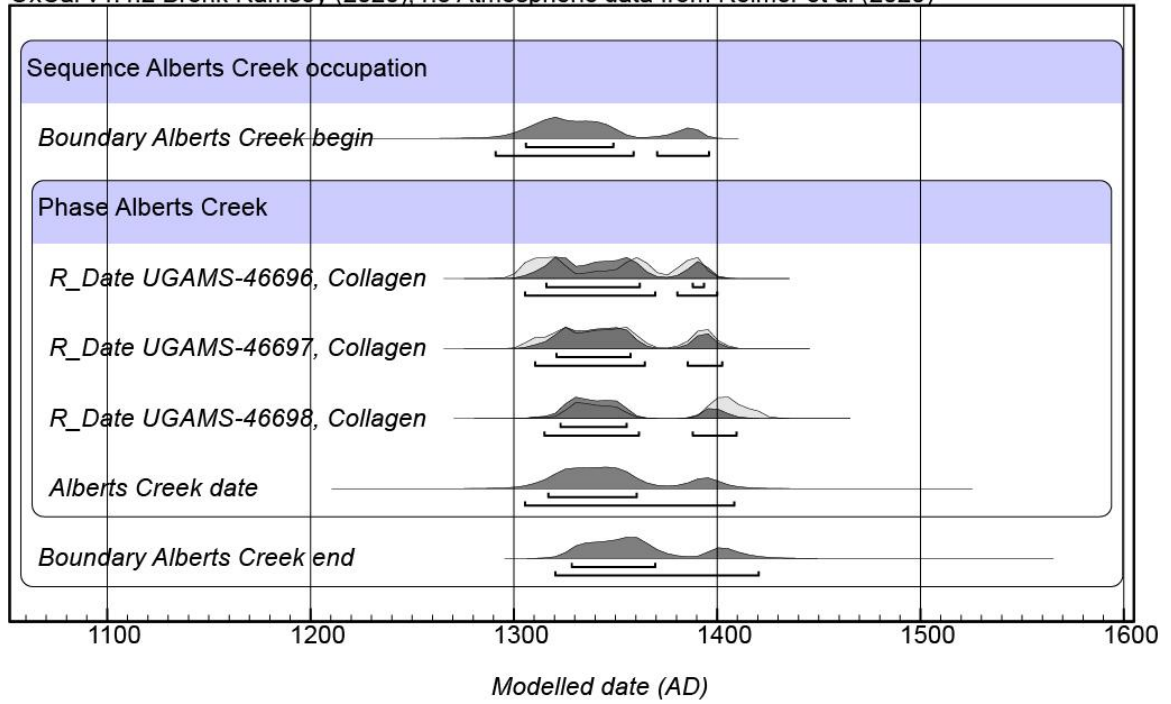
OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



D.4 Middle Missouri Village Models

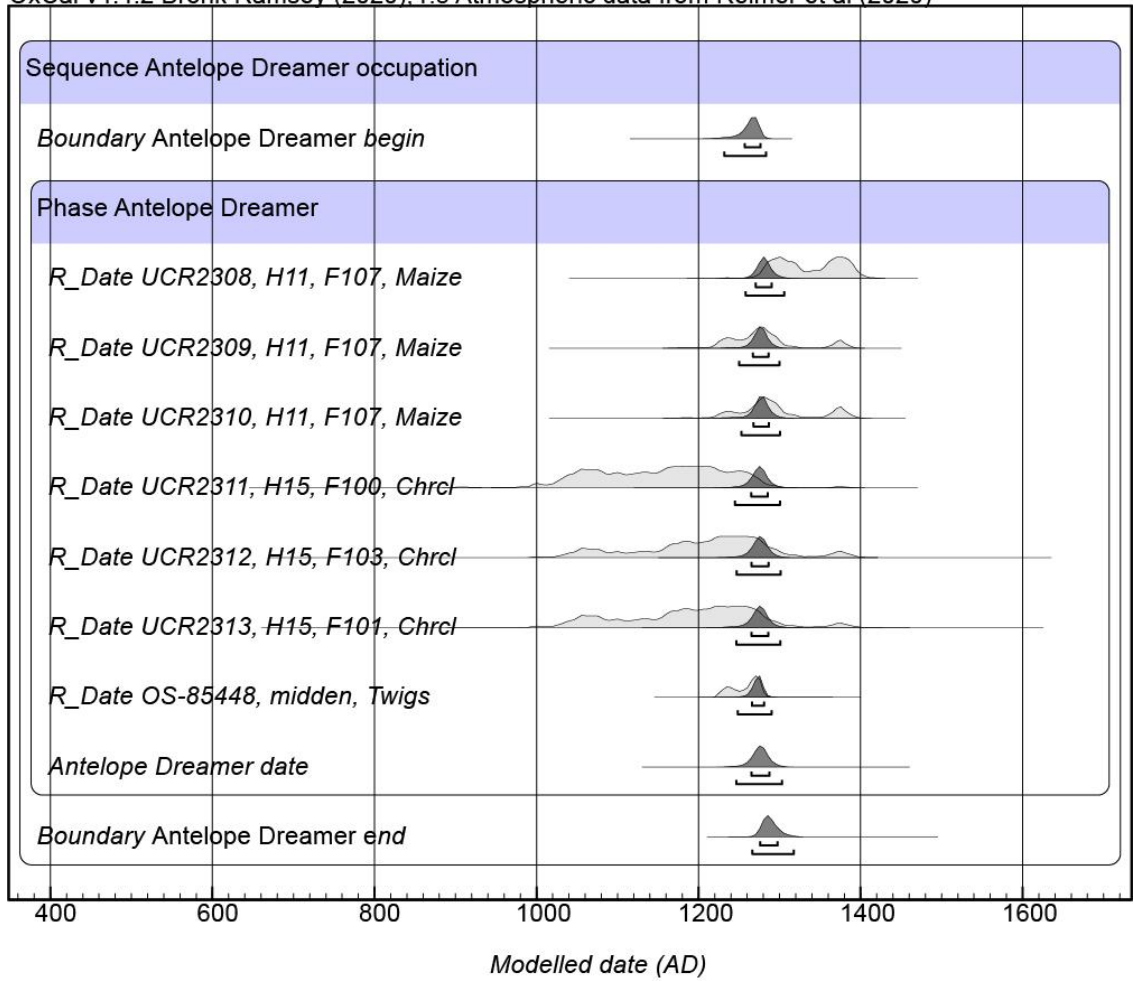
D.4.1 Alberts Creek

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



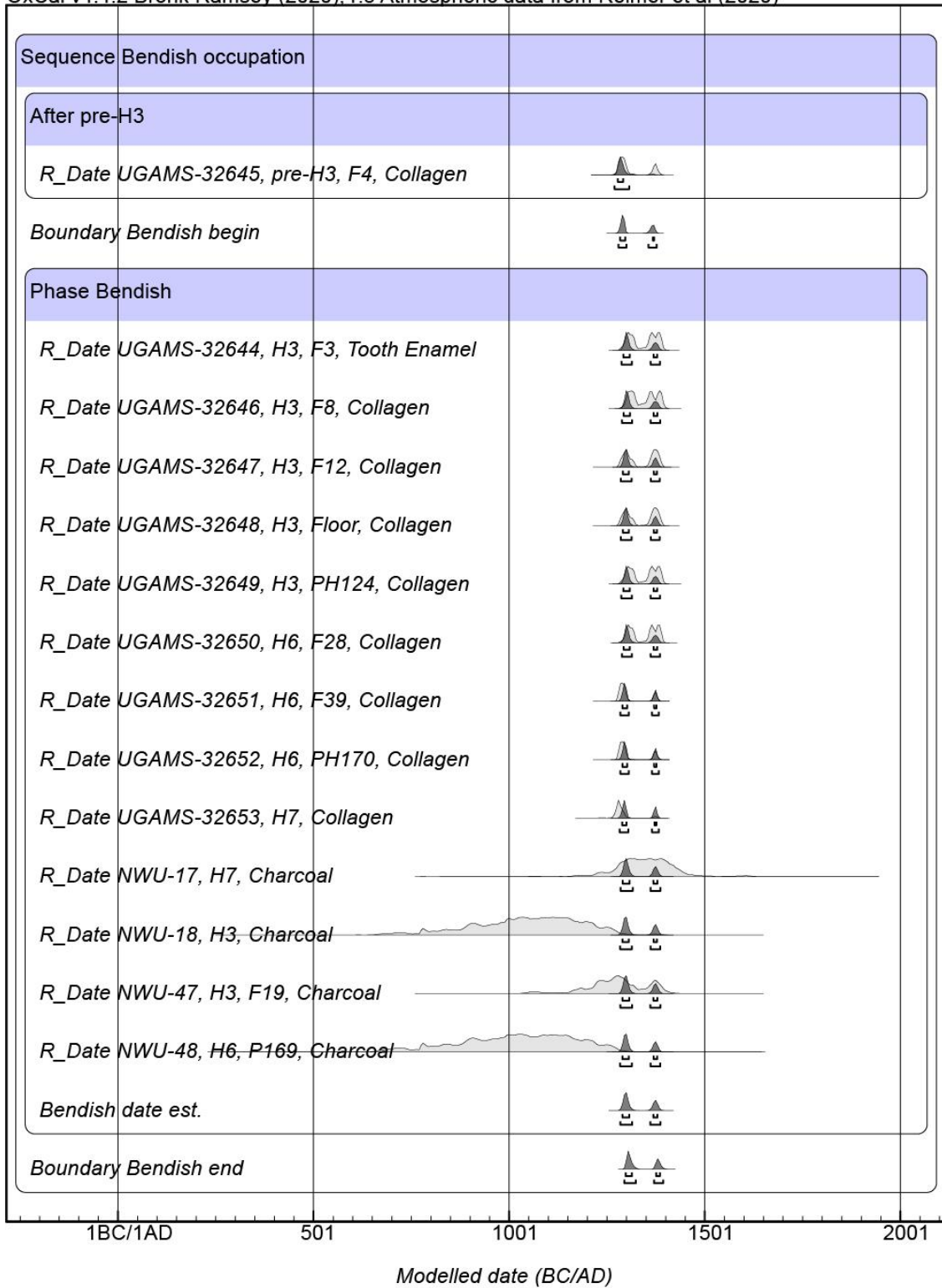
D.4.2 Antelope Dreamer

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



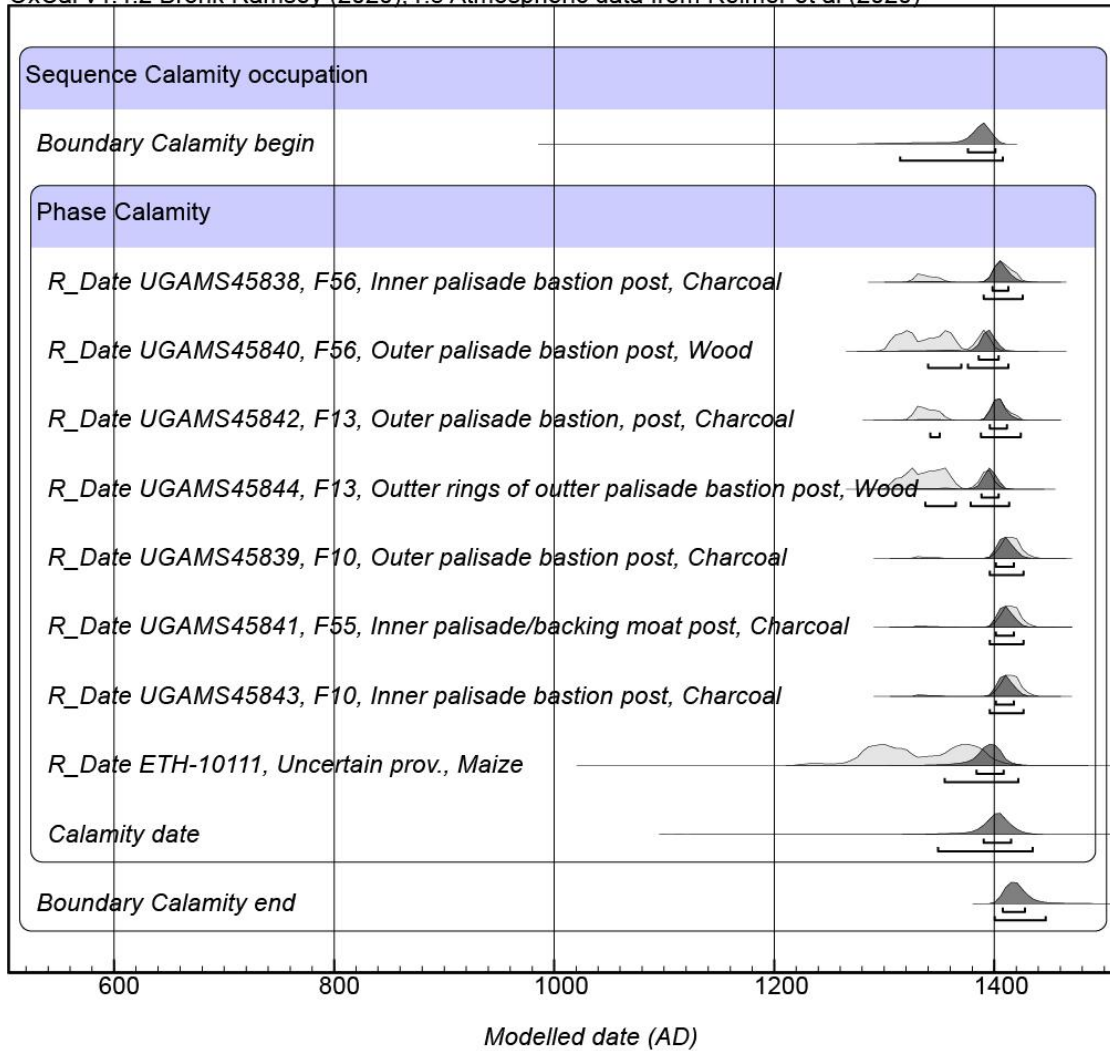
D.4.3 Bendish

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



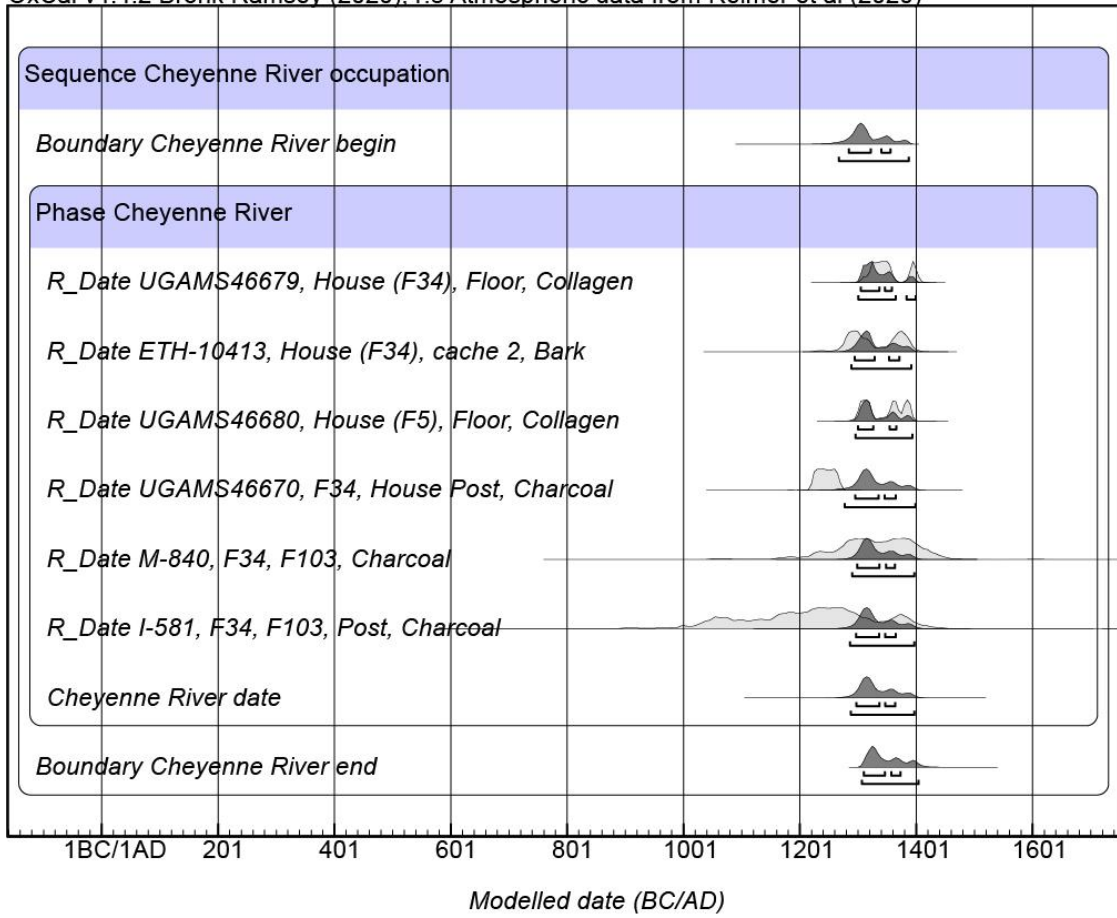
D.4.4 Calamity

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



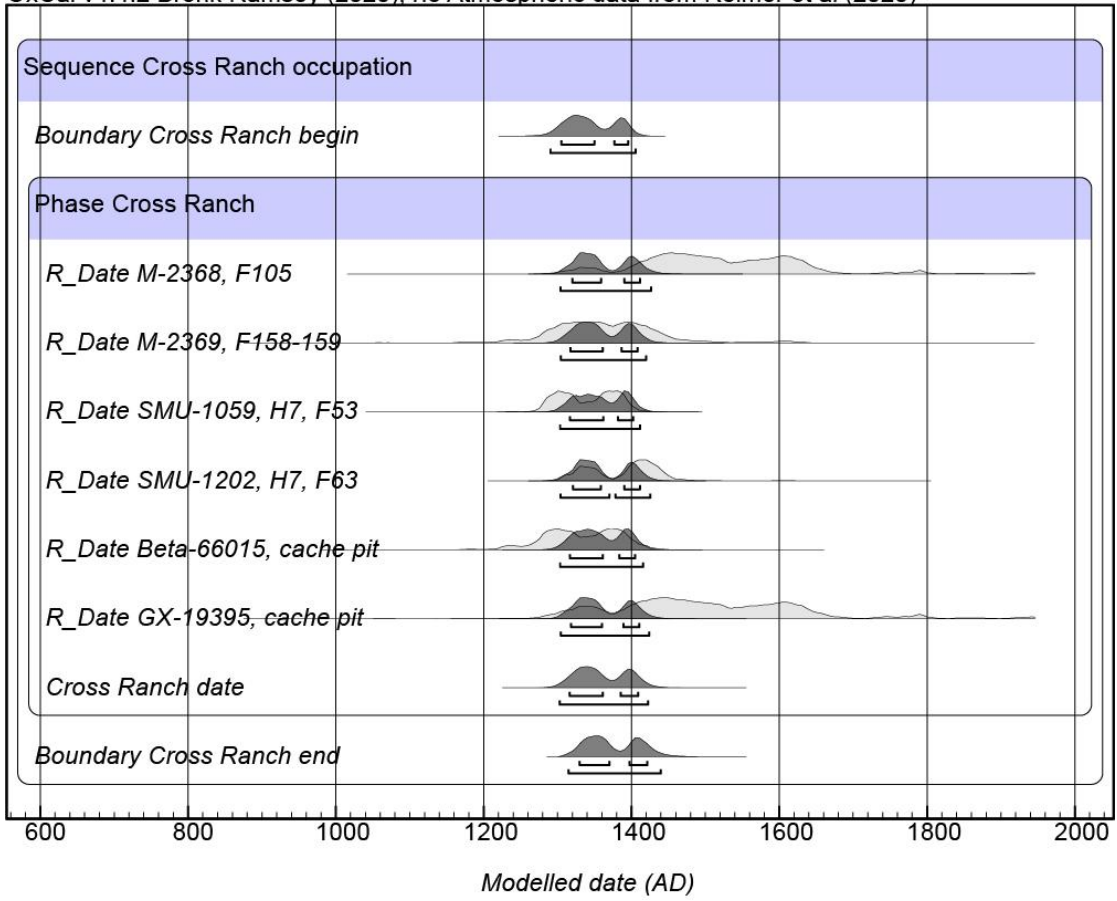
D.4.5 Cheyenne River

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



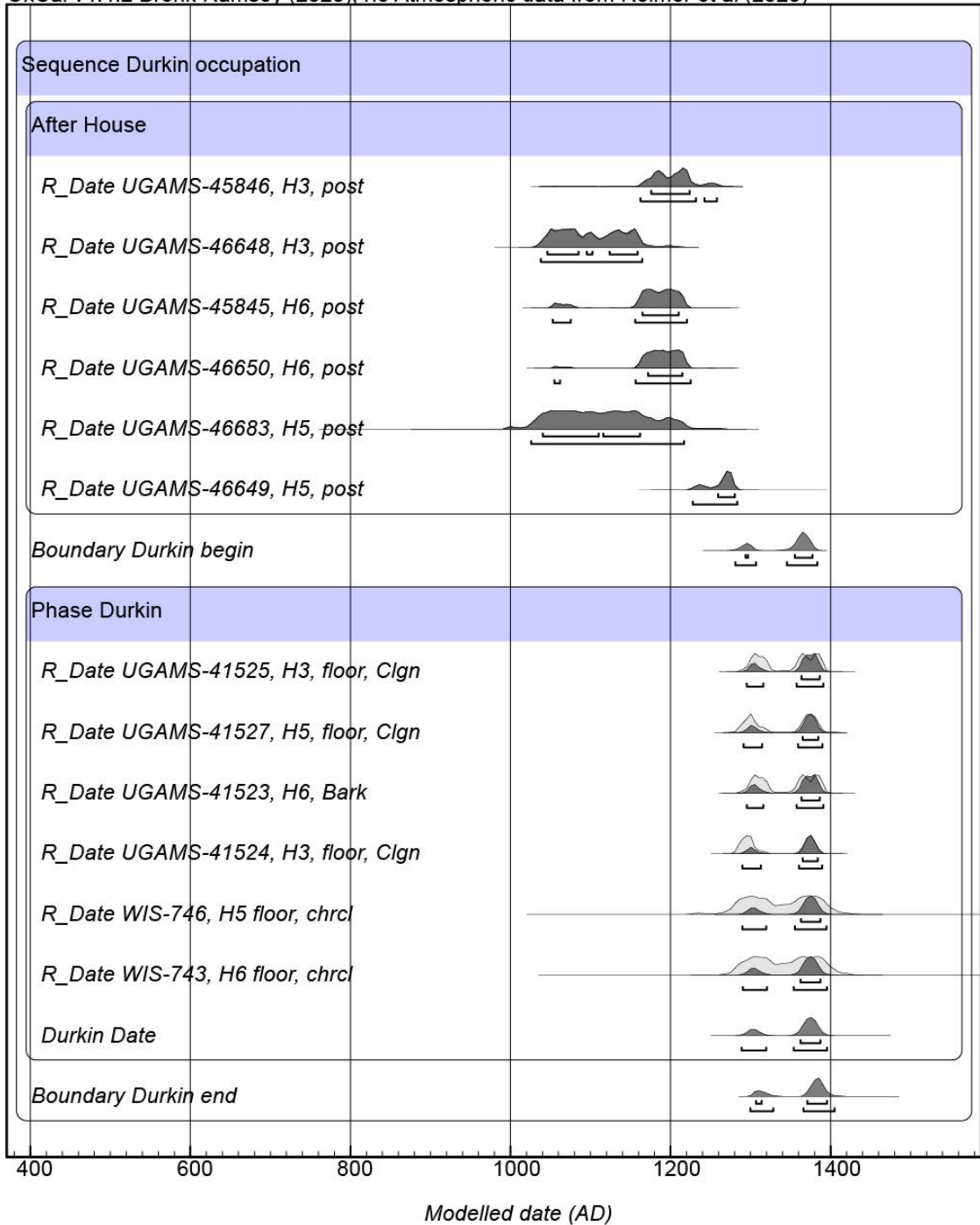
D.4.6 Cross Ranch

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



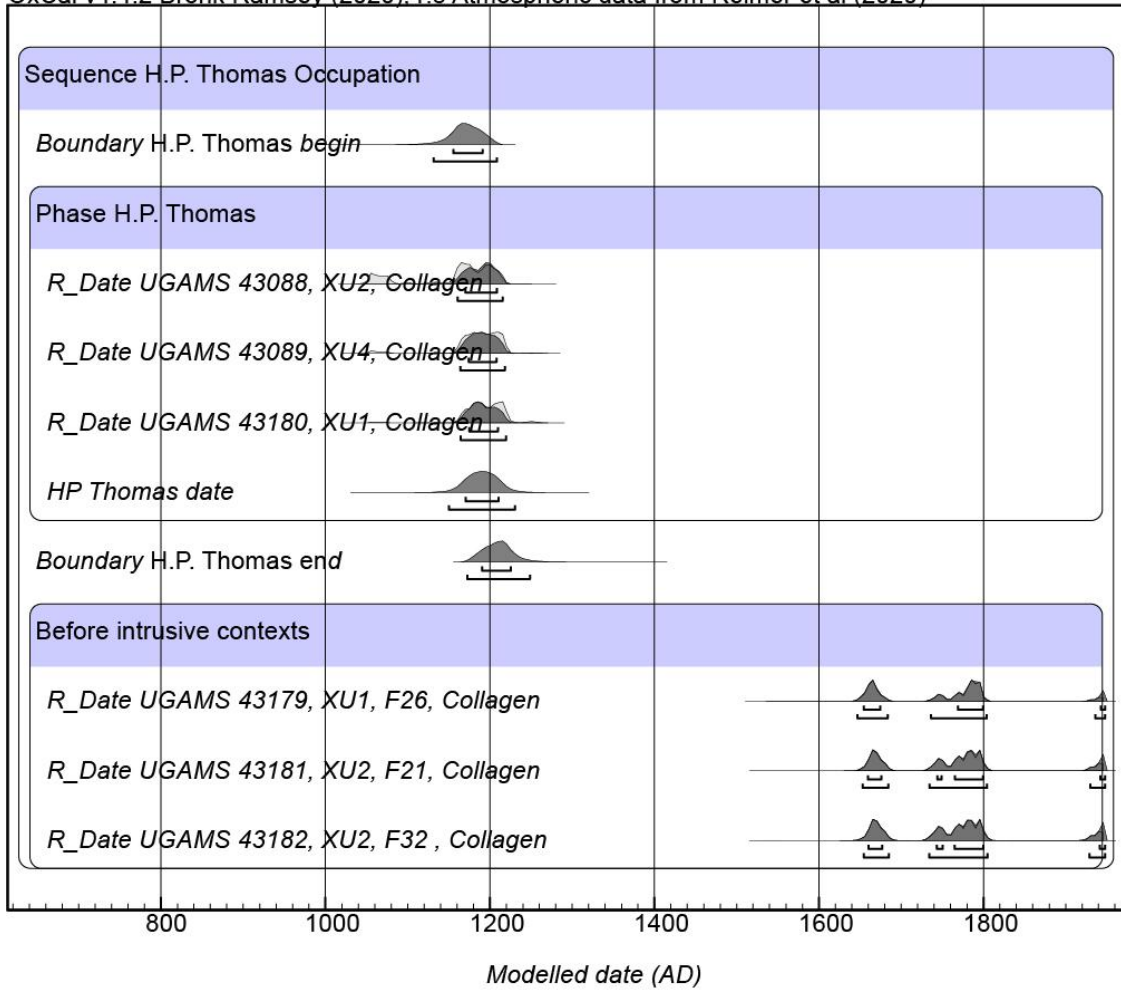
D.4.7 Durkin

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



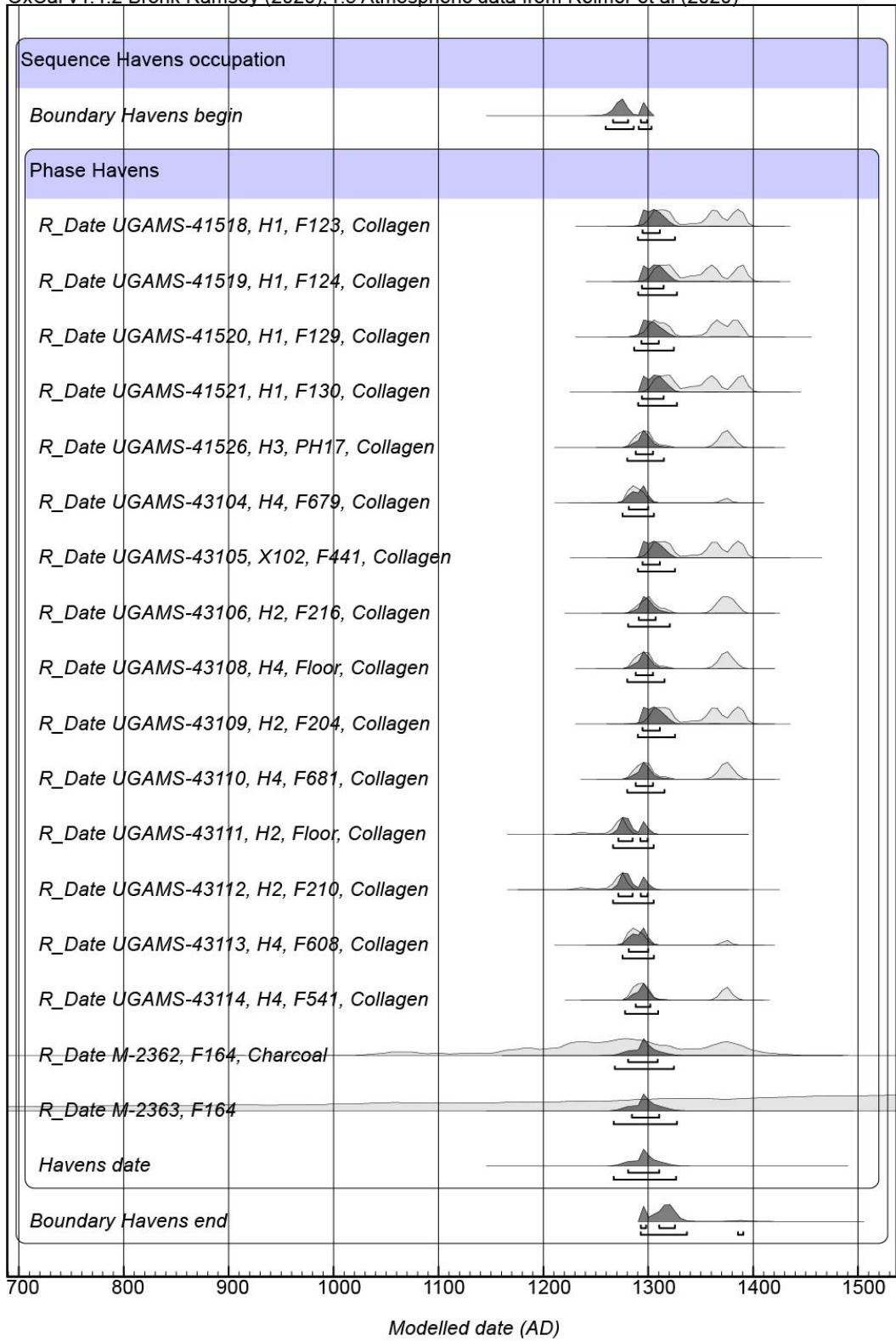
D.4.8 H. P. Thomas

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



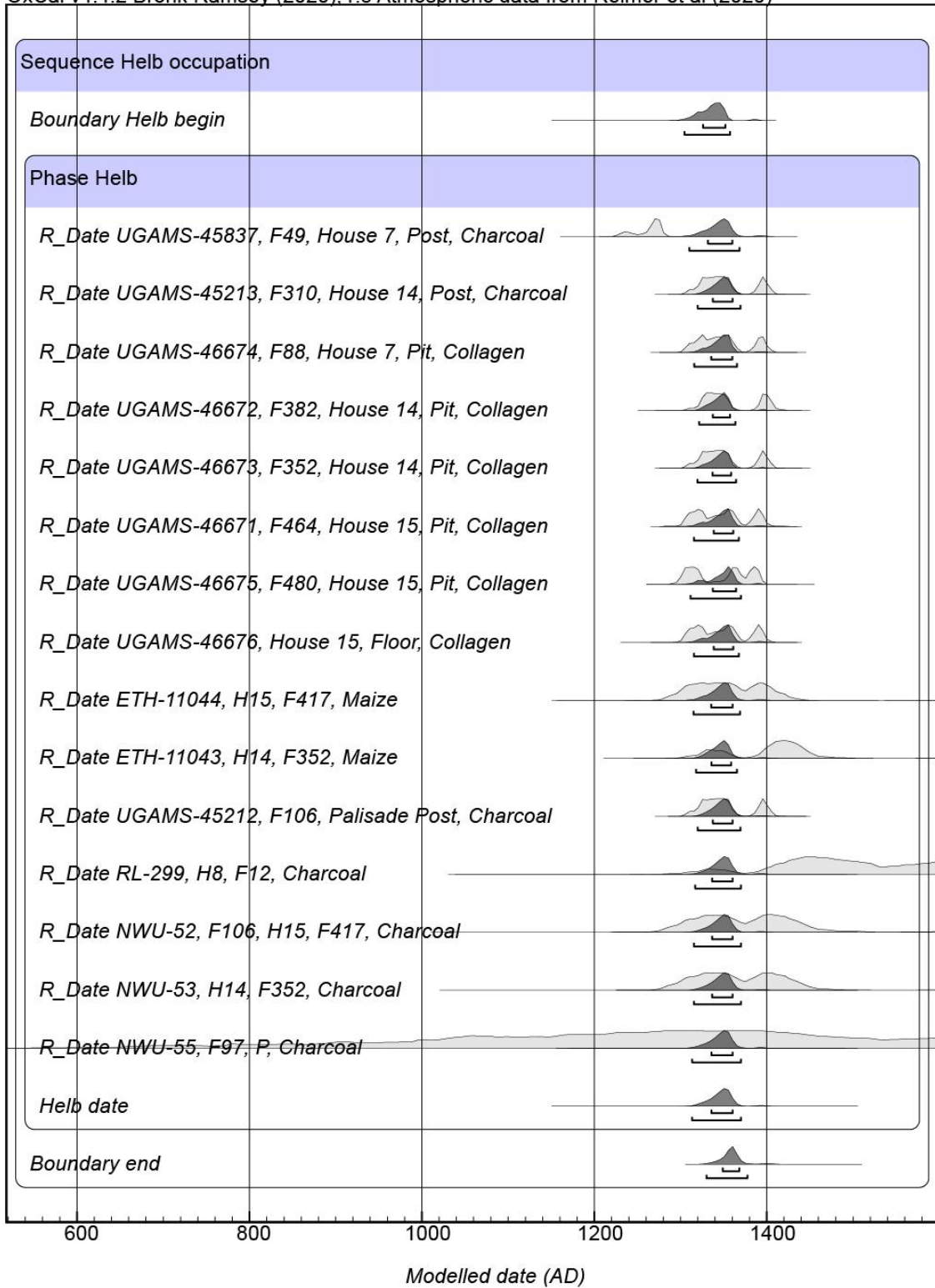
D.4.9 Havens

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



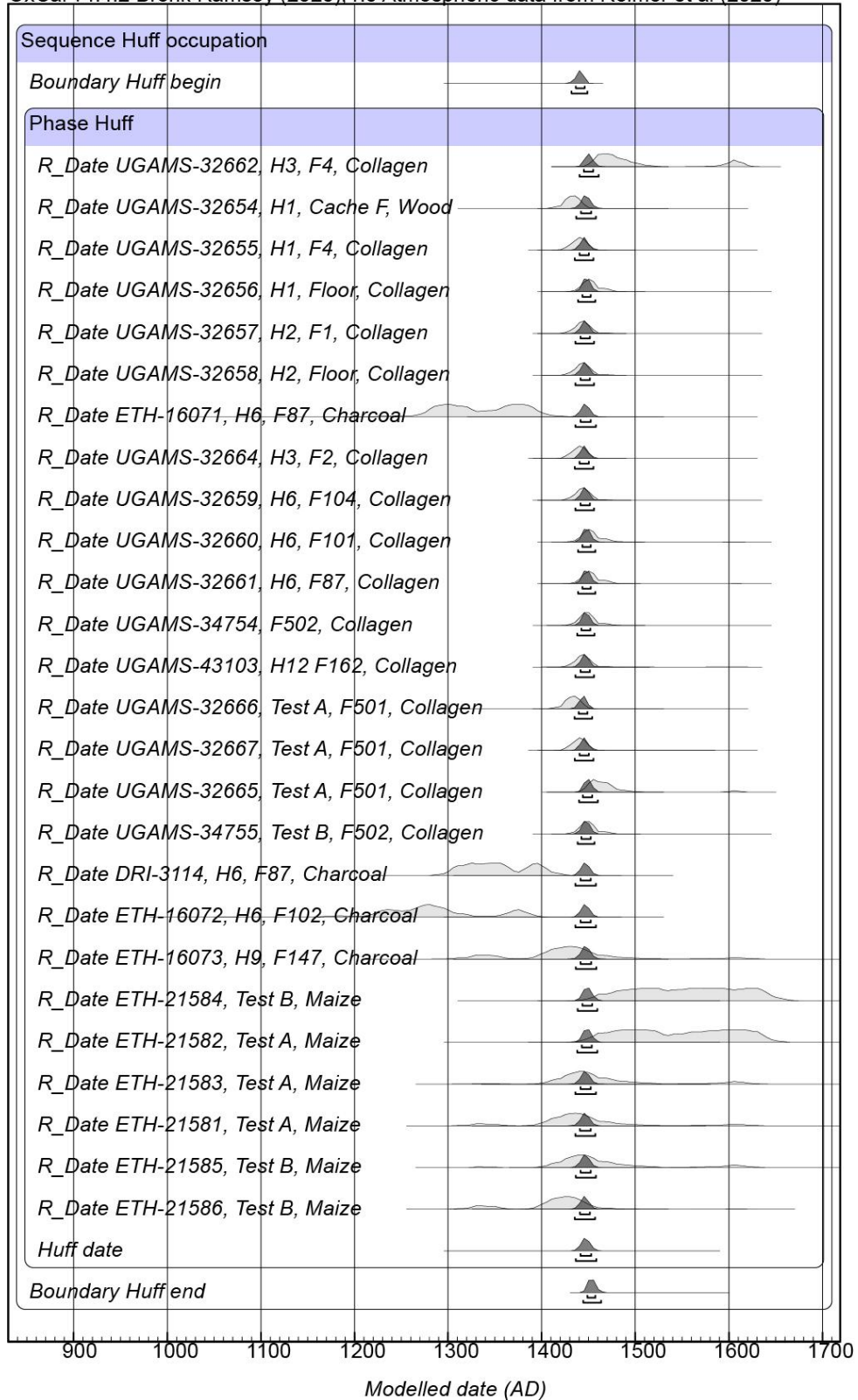
D.4.10 Helb

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



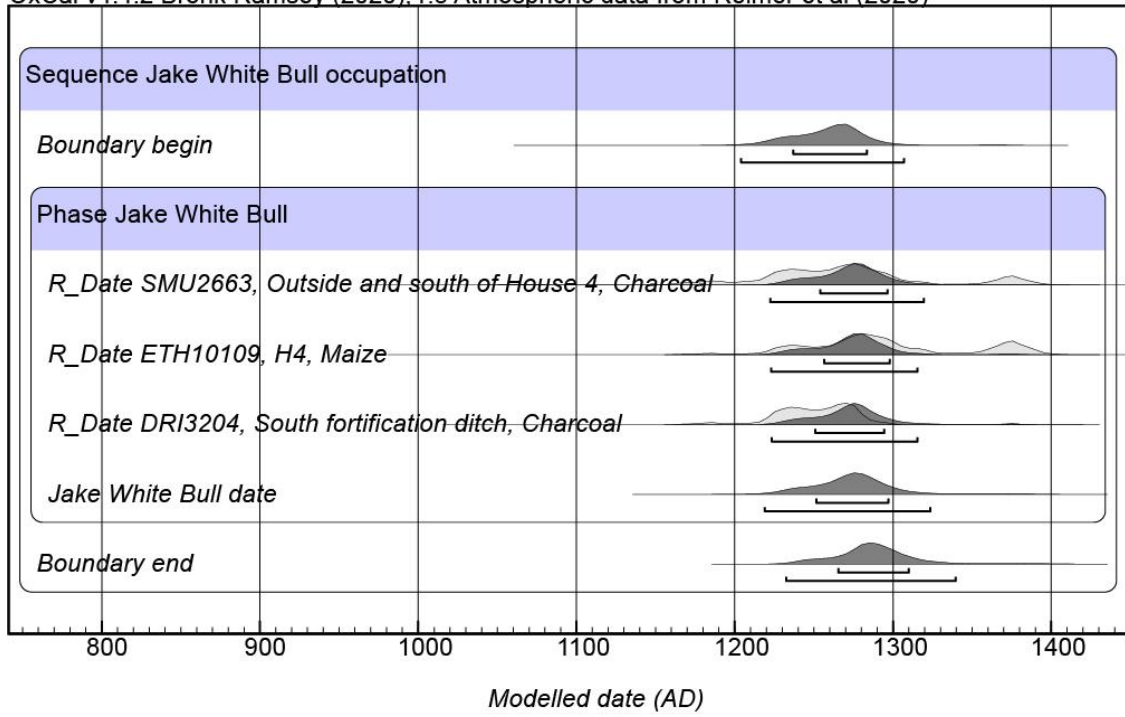
D.4.11 Huff

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



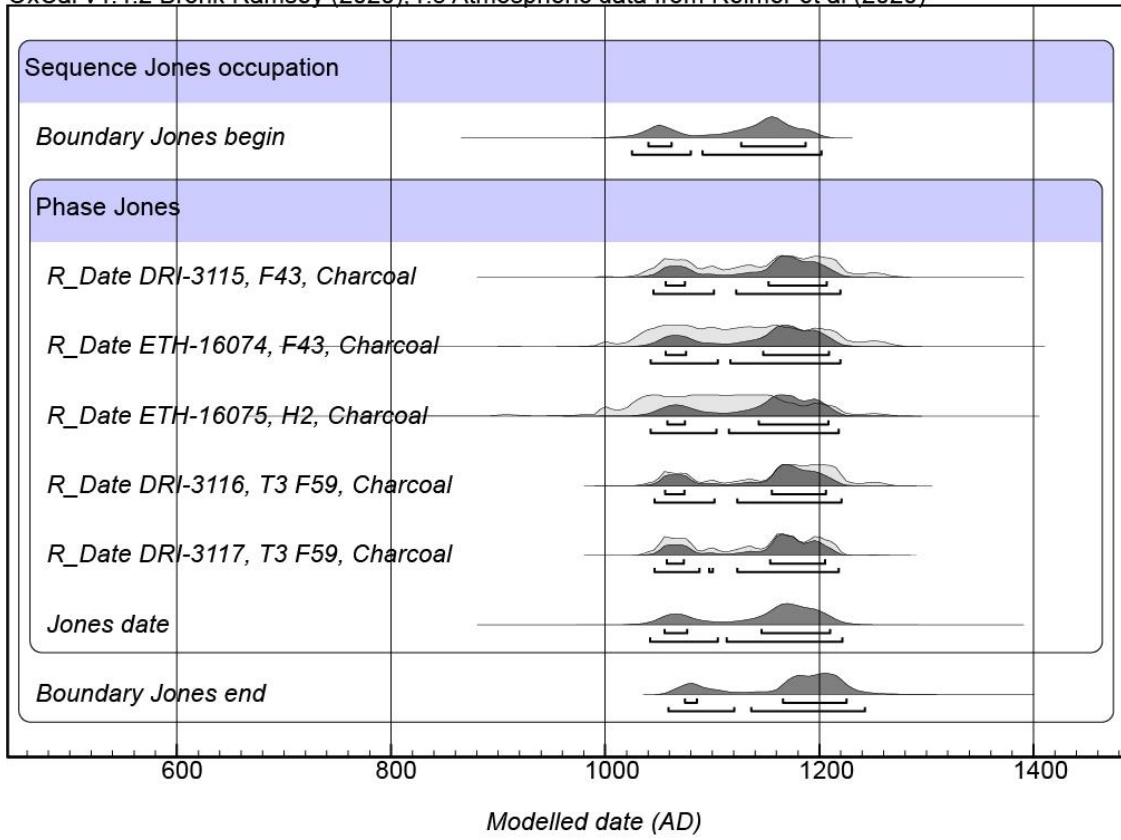
D.4.12 Jake White Bull

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



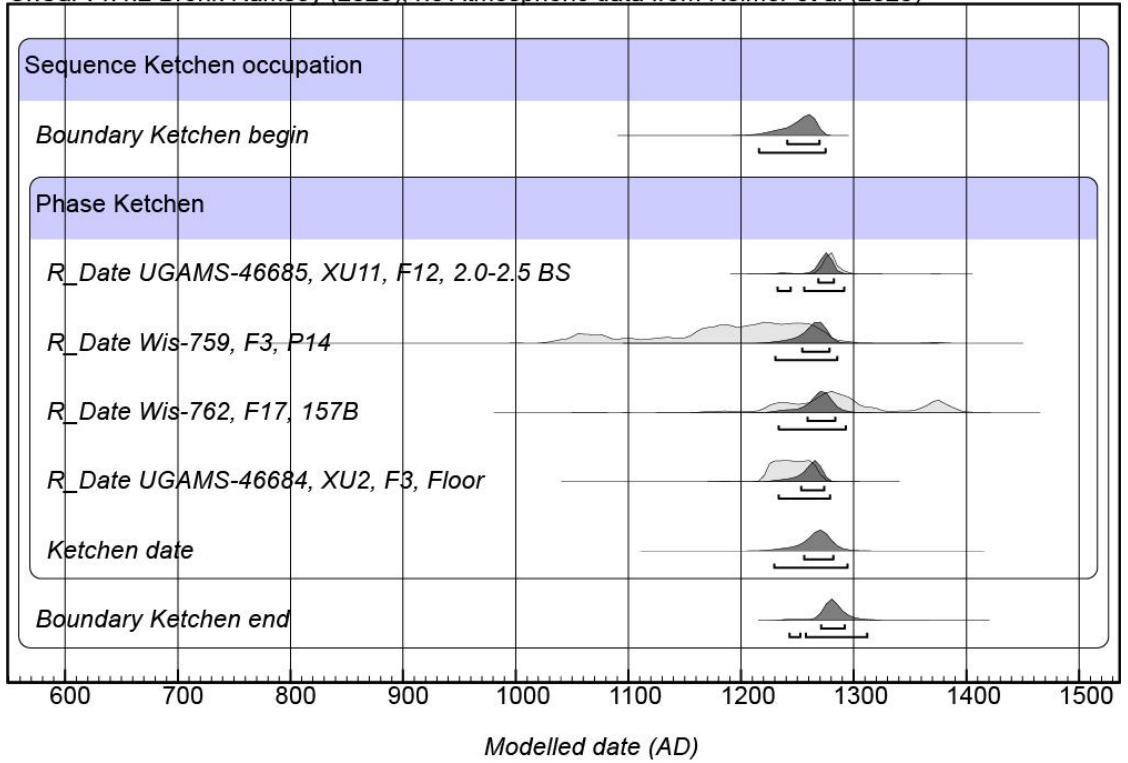
D.4.13 Jones

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



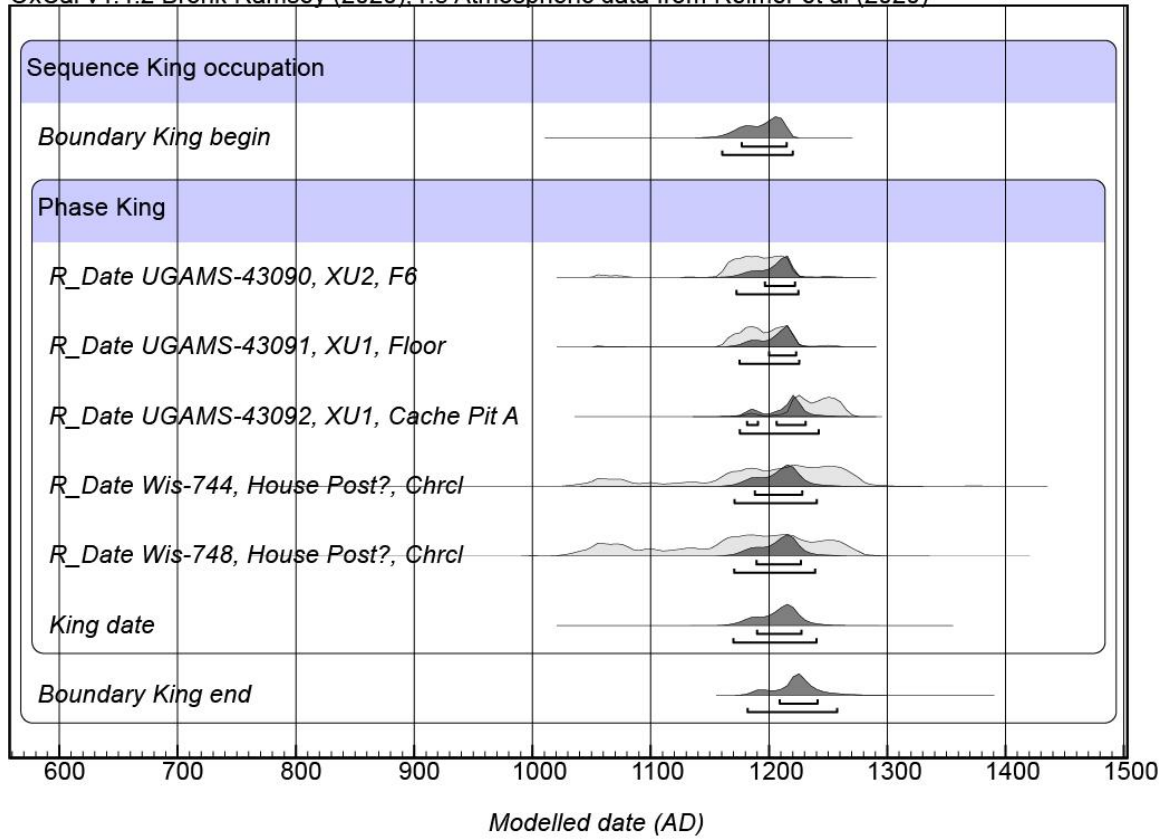
D.4.14 Ketchen

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



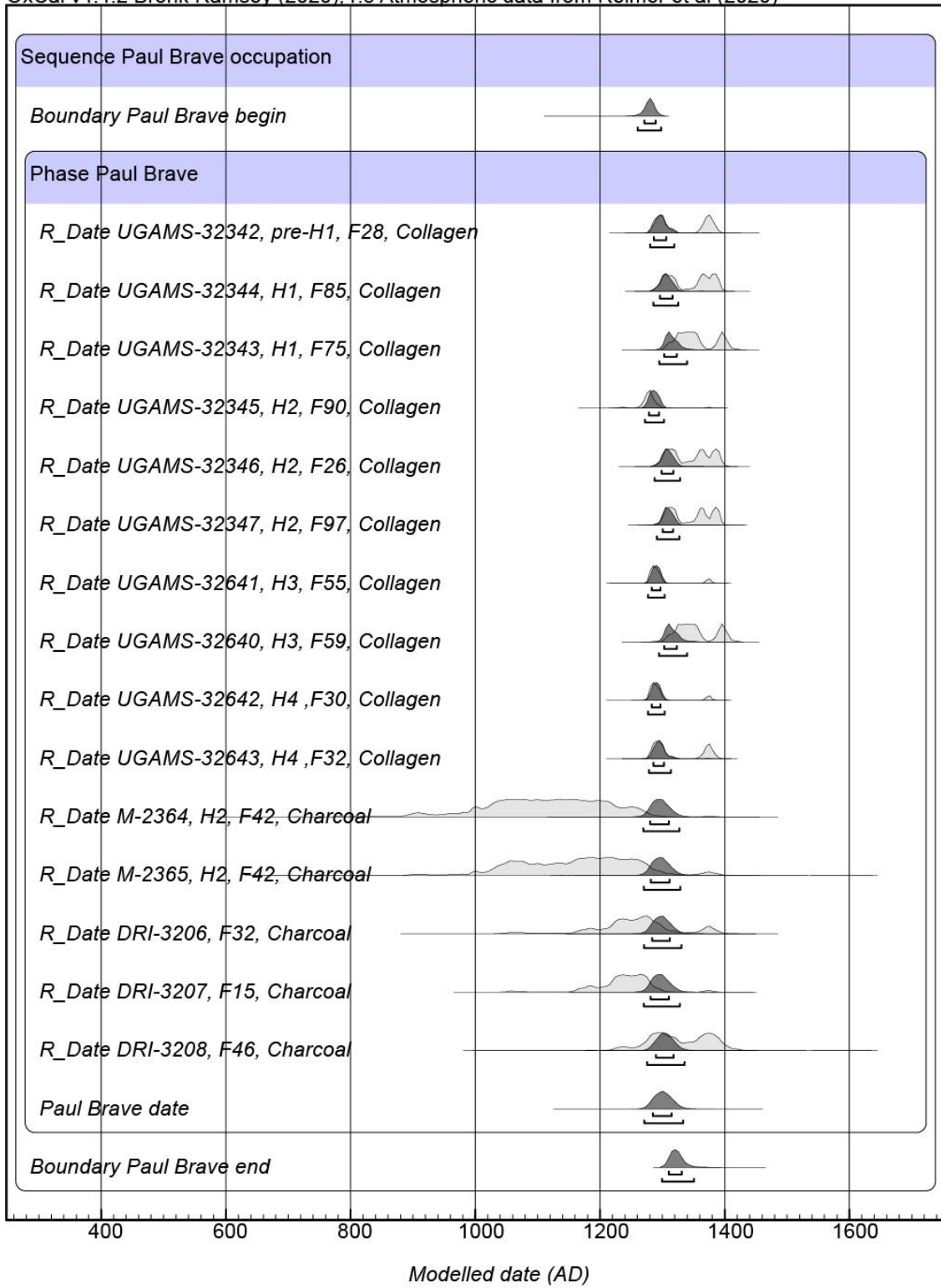
D.4.15 King

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



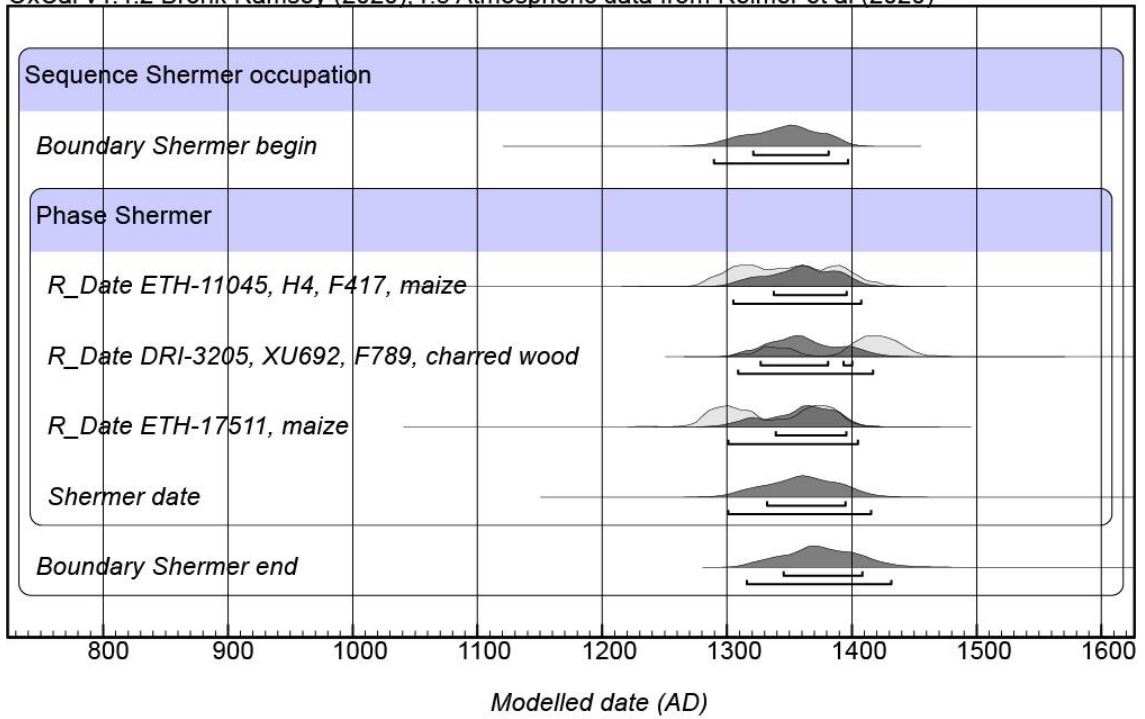
D.4.16 Paul Brave

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)

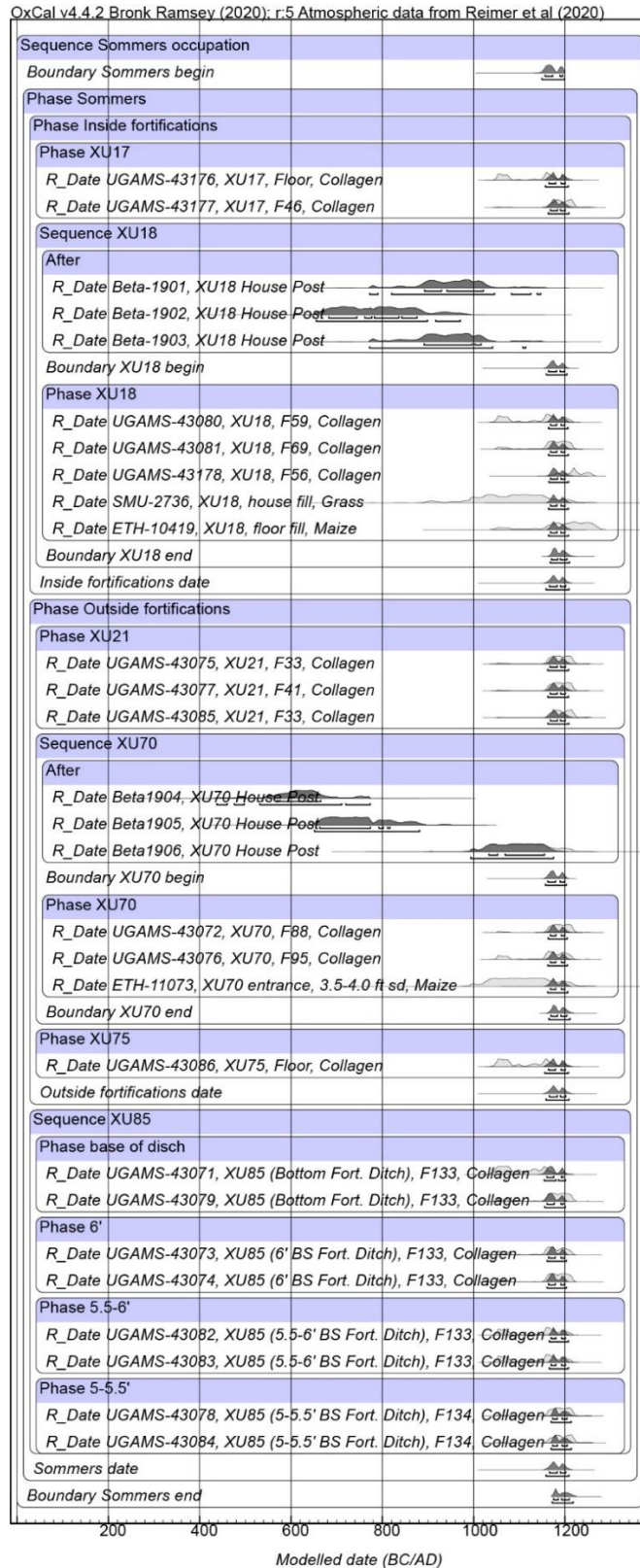


D.4.17 Shermer

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)

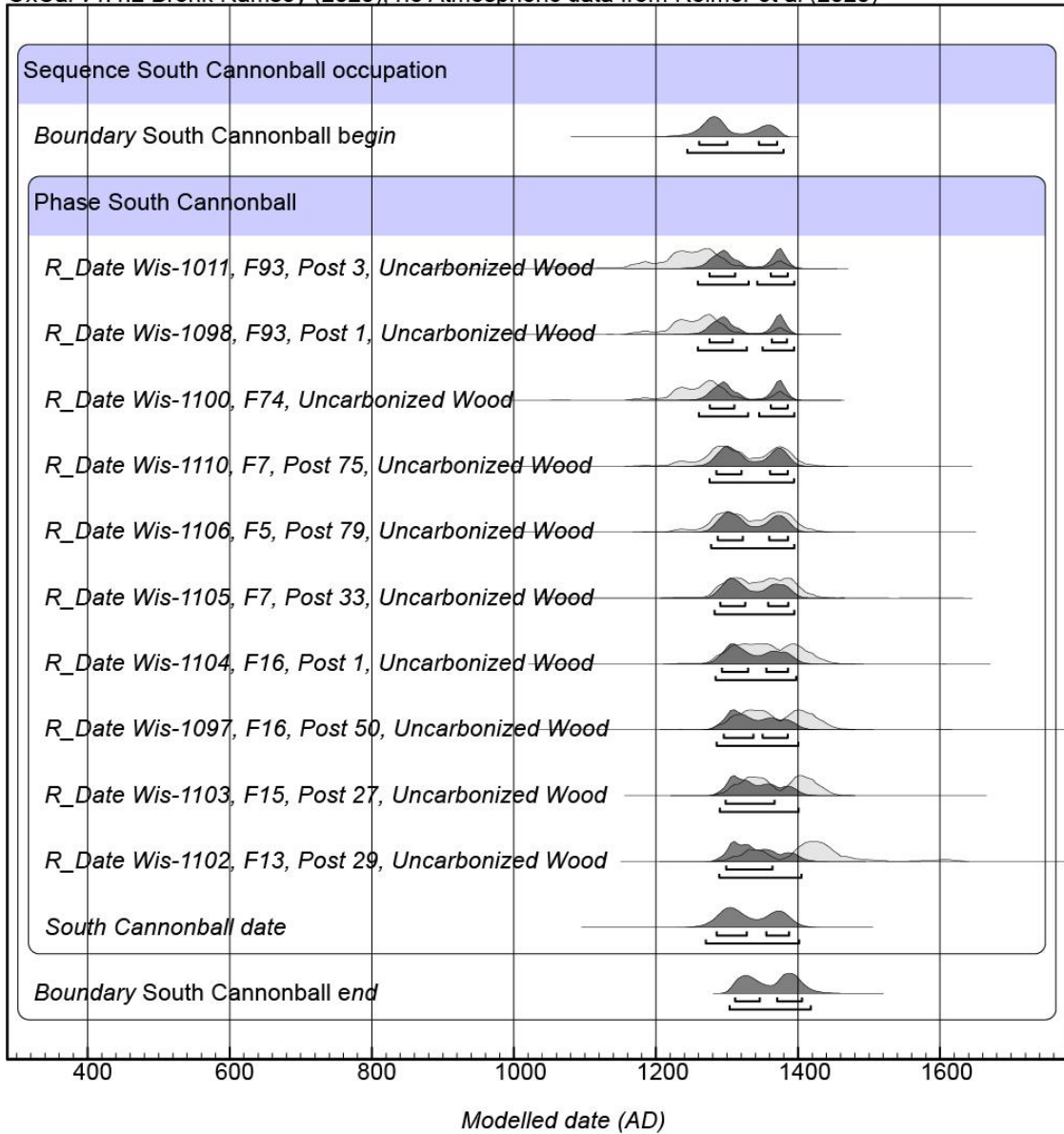


D.4.18 Sommers



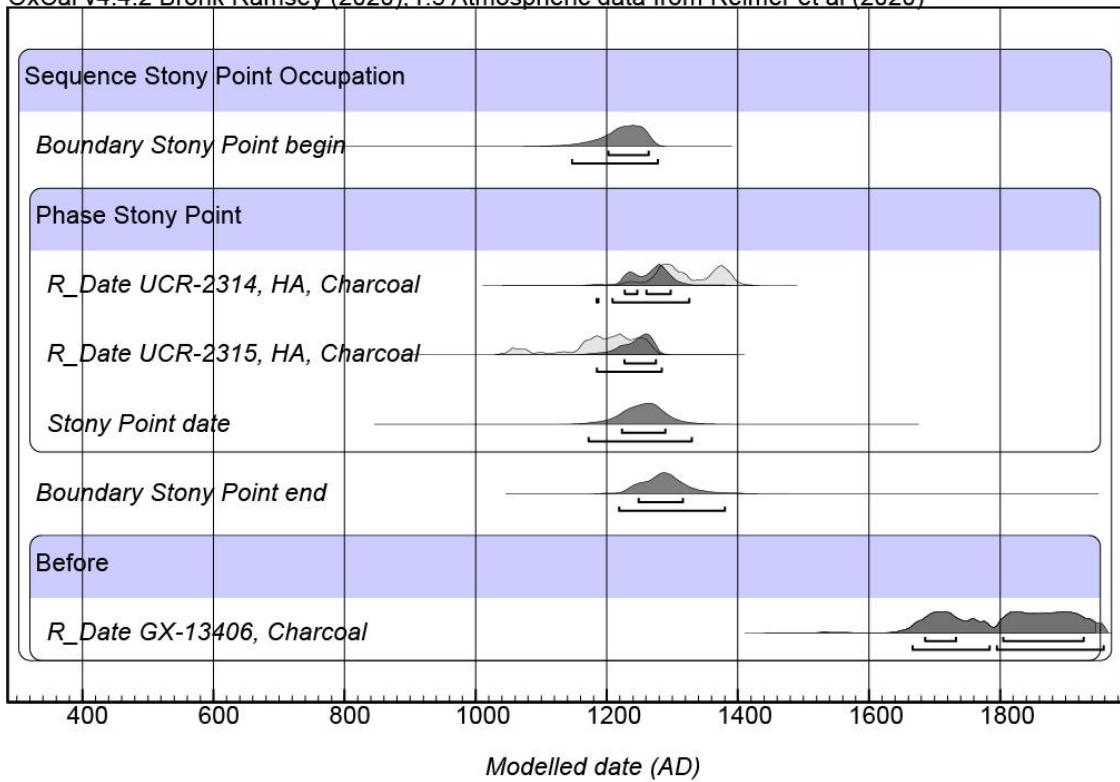
D.4.19 South Cannonball

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



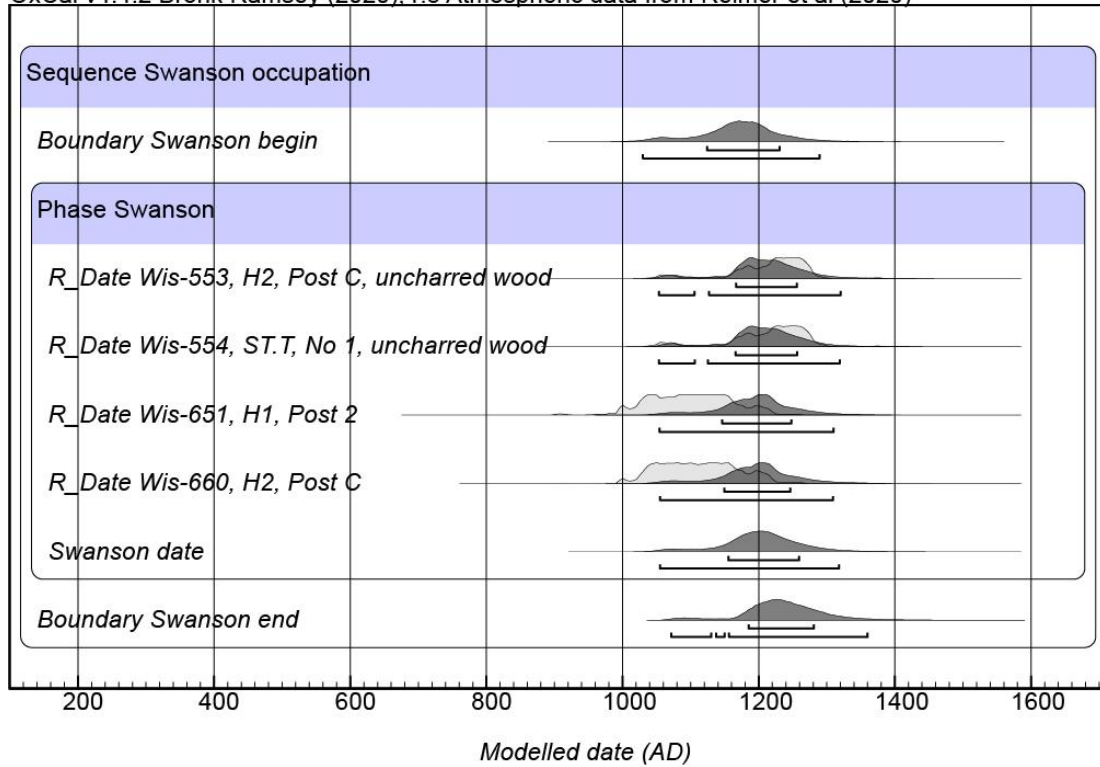
D.4.20 Stony Point

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



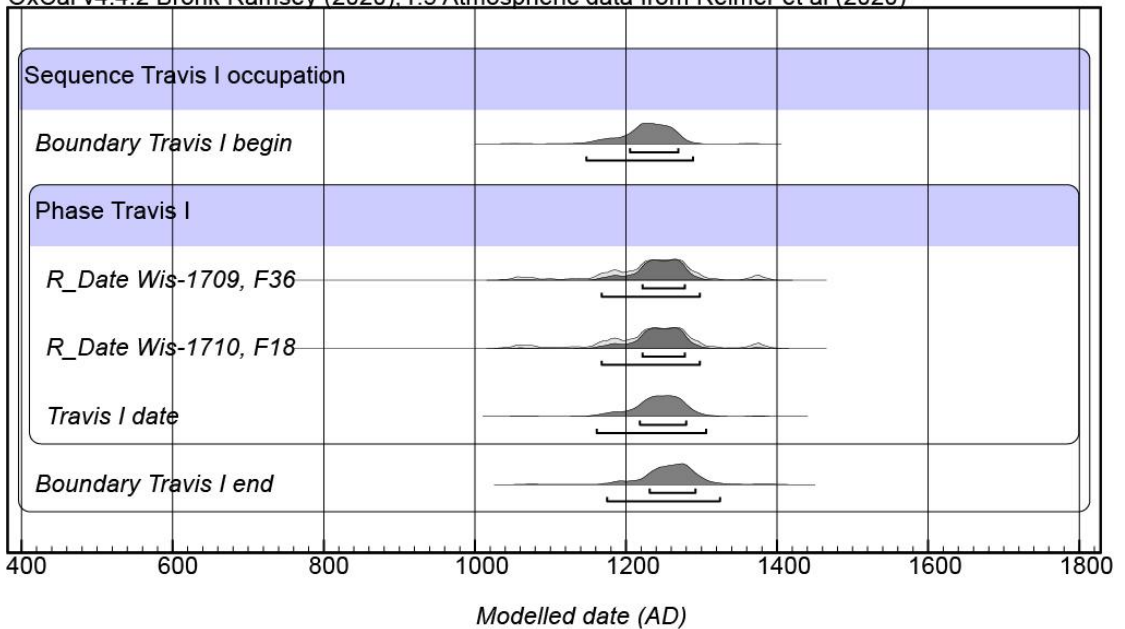
D.4.21 Swanson

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



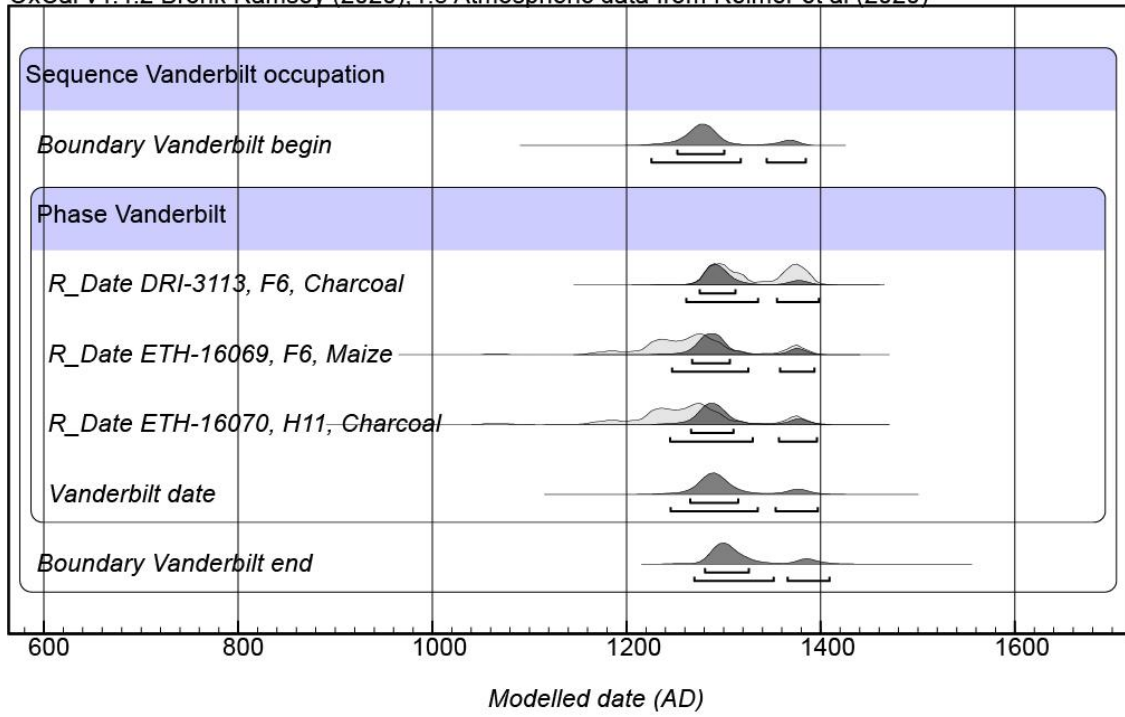
D.4.22 Travis I

OxCal v4.4.2 Bronk Ramsey (2020): r:5 Atmospheric data from Reimer et al (2020)



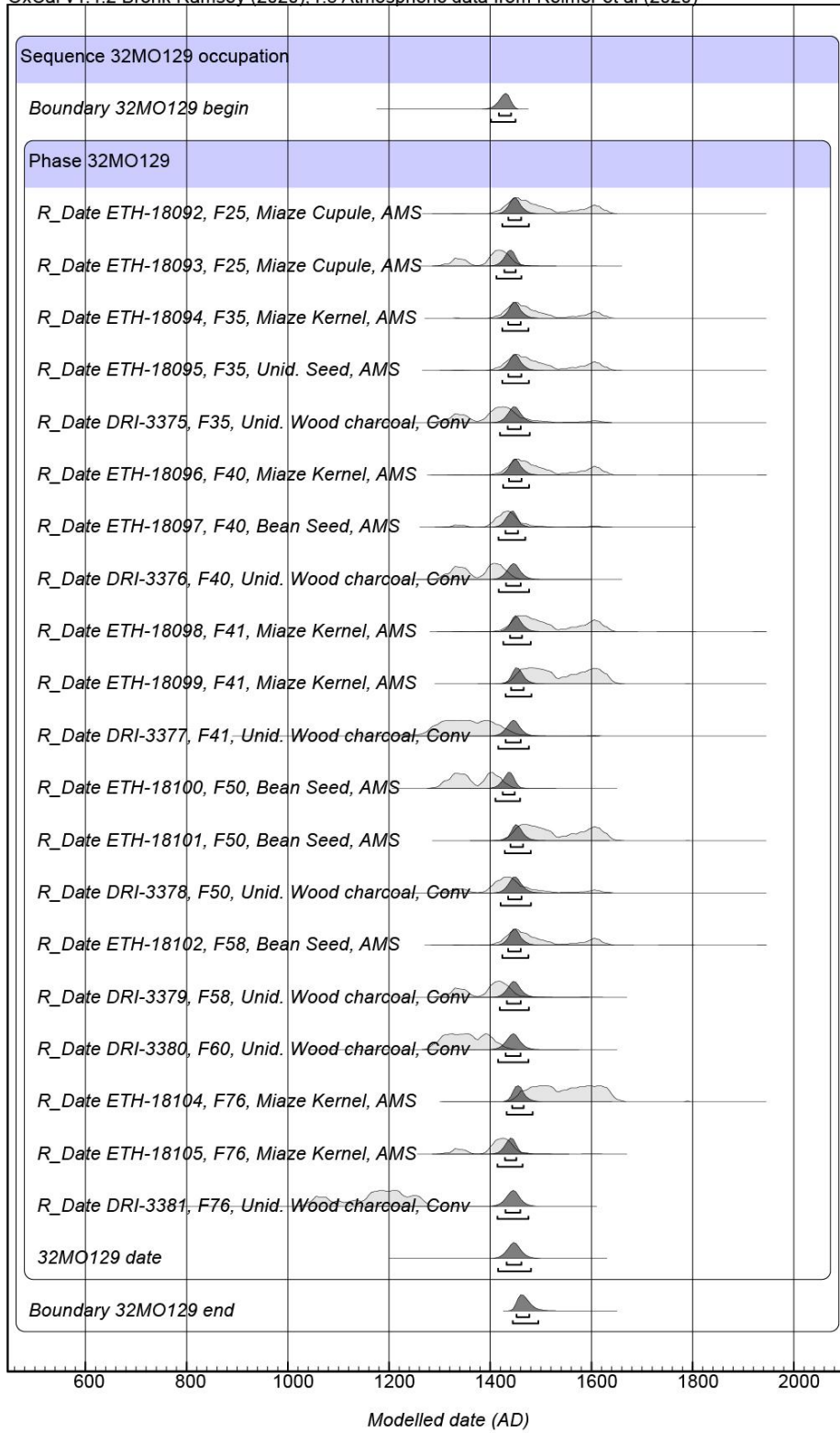
D.4.23 Vanderbilt

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



D.4.24 32MO291

OxCal v4.4.2 Bronk Ramsey (2020); r:5 Atmospheric data from Reimer et al (2020)



Appendix E: List of Middle Missouri and Coalescent Sites

* Includes Ahler and Haas's (1993) Painted Woods and Heart River complexes

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
32EM1		EMM			Ahler and Haas 1993
32EM10		EMM			Johnson 2007a; Lehmer 1971
32EM3		EMM			Johnson 2007a; Lehmer 1971
32ME1		EMM			Johnson 2007a
32ME10		EMM			Ahler and Haas 1993
32ME12		EMM			Ahler and Haas 1993
32ME202		EMM			Ahler and Haas 1993
32ME208			IC		Johnson 2007a
32ME3		EMM			Ahler and Haas 1993
32ME311		EMM			Ahler and Haas 1993
32ME312		EMM			Ahler and Haas 1993
32ME366		EMM			Ahler and Haas 1993
32ME383		EMM			Ahler and Haas 1993
32ME4		EMM			Ahler and Haas 1993
32ME407		EMM			Ahler and Haas 1993
32ME409		EMM			Ahler and Haas 1993
32ME410		EMM			Ahler and Haas 1993
32ME412		EMM			Ahler and Haas 1993
32ME413		EMM			Ahler and Haas 1993

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
32ME414		EMM			Ahler and Haas 1993
32ME415		EMM			Ahler and Haas 1993
32ME416		EMM			Ahler and Haas 1993
32ME464		EMM			Ahler and Haas 1993
32ME487		EMM			Ahler and Haas 1993
32ME490		EMM			Ahler and Haas 1993
32ME499		EMM			Ahler and Haas 1993
32ME59		EMM			Ahler and Haas 1993
32ME7		EMM			Ahler and Haas 1993
32ME8		EMM			Ahler and Haas 1993
32ME9		EMM			Ahler and Haas 1993
32ML6		EMM			Ahler and Haas 1993
32MO11		EMM			Johnson 2007a; Lehmer 1971
32MO2		EMM			Johnson 2007a; Lehmer 1971
32MO291		EMM			Johnson 2007a
32OL10		EMM			Ahler and Haas 1993
32OL103		EMM			Ahler and Haas 1993
32OL11		EMM			Ahler and Haas 1993
32OL12		EMM			Ahler and Haas 1993
32OL13		EMM			Ahler and Haas 1993
32OL14		EMM			Ahler and Haas 1993
32OL144		EMM			Ahler and Haas 1993
32OL148		EMM			Ahler and Haas 1993
32OL16		EMM			Ahler and Haas 1993

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
32OL18		EMM			Ahler and Haas 1993
32OL21		EMM			Ahler and Haas 1993
32OL22		EMM			Ahler and Haas 1993
32OL9		EMM			Ahler and Haas 1993
32SI14		EMM			Johnson 2007a; Lehmer 1971
32SI19		EMM			Johnson 2007a; Lehmer 1971
32SI2		EMM			Johnson 2007a; Lehmer1971
32SI7		EMM			Johnson 2007a; Lehmer 1971
32SN403			IC		Steinacher 1984
32ST238		EMM			Johnson 2007a; Lehmer 1971
39AR201		EMM			Johnson 2007a; Winham and Hannus 1991
39AR210		EMM			Johnson 2007a; Winham and Hannus 1991
39AR8		EMM			Winham and Hannus 1991
39BF11	IMM		IC		Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39BF12	IMM			EC	Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39BF2				EC	Lehmer 1971
39BF20	IMM				Winham and Hannus 1991
39BF201	IMM				Butler 2014
39BF215	IMM				Butler 2014; Winham and Hannus 1991
39BF220			IC		Fox 1980; Johnson 2007a; Winham and Hannus 1991
39BF221	IMM				Butler 2014; Johnson 2007a; Winham and Hannus 1991
39BF227	IMM				Winham and Hannus 1991
39BF228			IC		Winham and Hannus 1991
39BF3			IC	EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39BF301a			IC		Winham and Hannus 1991
39BF44	IMM				Winham and Hannus 1991
39BF63			IC		Winham and Hannus 1991
39BK20	IMM				Winham and Hannus 1991
39BK38	IMM				Winham and Hannus 1991
39BN85	IMM				Winham and Hannus 1991
39BO58	IMM				Winham and Hannus 1991
39BR10				EC	Johnson 2007a; Winham and Hannus 1991
39BR101	IMM				Butler 2014; Johnson 2007a; Winham and Hannus 1991
39BR13	IMM				Johnson 2007a; Winham and Hannus 1991
39BR16	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39BR201				EC	Johnson 2007a; Winham and Hannus 1991
39BR202	IMM				Winham and Hannus 1991
39BR29	IMM				Winham and Hannus 1991
39BR36				EC	Winham and Hannus 1991
39BR39	IMM				Winham and Hannus 1991
39BR6			IC		Johnson 2007a; Winham and Hannus 1991
39BU2	IMM				Butler 2014
39C0212		EMM			Winham and Hannus 1991
39CA1		EMM			Johnson 2007a; Winham and Hannus 1991
39CA2		EMM			Johnson 2007a; Winham and Hannus 1991
39CA208		EMM			Johnson 2007a; Winham and Hannus 1991
39CA3	IMM	EMM			Johnson 2007a; Winham and Hannus 1991
39CA4		EMM		EC	Johnson 2007a; Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39CH205	IMM				Johnson 2007a; Winham and Hannus 1991
39CH45	IMM				Johnson 2007a
39CH5	IMM				Johnson 2007a; Winham and Hannus 1991
39CH7	IMM				Johnson 2007a
39CO1				EC	Lehmer 1971; Winham and Hannus 1991
39CO10				EC	Winham and Hannus 1991
39CO12				EC	Winham and Hannus 1991
39CO14				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39CO145		EMM			Winham and Hannus 1991
39CO19				EC	Johnson 2007a; Lehmer 1971
39CO201		EMM			Winham and Hannus 1991
39CO212		EMM			Winham and Hannus 1991
39CO213		EMM			Johnson 2007a; Winham and Hannus 1991
39CO214				EC	Winham and Hannus 1991
39CO3		EMM		EC	Johnson 2007a; Winham and Hannus 1991
39CO35				EC	Winham and Hannus 1991
39CO5				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39CO6		EMM			Johnson 2007a; Winham and Hannus 1991
39CO78				EC	Johnson 2007a; Winham and Hannus 1991
39CO9				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39CU206	IMM				Alex 1981
39DA15	IMM				Winham and Hannus 1991
39DA21	IMM				Winham and Hannus 1991
39DA7	IMM				Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39DE5	IMM				Winham and Hannus 1991
39DU3	IMM				Winham and Hannus 1991
39DV2	IMM				Butler 2014; Johnson 2007a; Winham and Hannus 1991
39DV30	IMM				Winham and Hannus 1991
39DV9	IMM				Winham and Hannus 1991
39DW1				EC	Johnson 2007a; Winham and Hannus 1991
39DW101				EC	Winham and Hannus 1991
39DW110				EC	Winham and Hannus 1991
39DW123				EC	Winham and Hannus 1991
39DW134				EC	Winham and Hannus 1991
39DW14				EC	Winham and Hannus 1991
39DW213				EC	Winham and Hannus 1991
39DW219				EC	Winham and Hannus 1991
39DW220				EC	Winham and Hannus 1991
39DW224		EMM			Winham and Hannus 1991
39DW225		EMM			Winham and Hannus 1991
39DW226				EC	Winham and Hannus 1991
39DW230				EC	Johnson 2007a
39DW231		EMM			Johnson 2007a; Lehmer 1972; Winham and Hannus 1991
39DW233		EMM		EC	Lehmer 1971; Winham and Hannus 1991
39DW234				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39DW253				EC	Johnson 2007a; Winham and Hannus 1991
39DW3				EC	Winham and Hannus 1991
39DW6				EC	Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39FA23	IMM				Alex 1981
39FA45				EC	Winham and Hannus 1991
39GR1	IMM		IC	EC	Johnson 2007a; Winham and Hannus 1991
39GR2	IMM				Johnson 2007a
39GR53	IMM				Winham and Hannus 1991
39HD3	IMM				Winham and Hannus 1991
39HM1	IMM				Johnson 2007a
39HS1	IMM				Butler 2014; Johnson 2007a; Winham and Hannus 1991
39HS23	IMM				Butler 2014; Winham and Hannus 1991
39HS46	IMM				Winham and Hannus 1991
39HS75	IMM				Winham and Hannus 1991
39HT1	IMM				Butler 2014; Johnson 2007a
39HU1		EMM			Johnson 2007a; Lehmer 1971
39HU126				EC	Johnson 2007a; Winham and Hannus 1991
39HU13			IC		Winham and Hannus 1991
39HU16		EMM			Winham and Hannus 1991
39HU2				EC	Johnson 2007a
39HU202				EC	Winham and Hannus 1991
39HU203				EC	Winham and Hannus 1991
39HU204				EC	Johnson 2007a; Winham and Hannus 1991
39HU205				EC	Winham and Hannus 1991
39HU206				EC	Winham and Hannus 1991
39HU208				EC	Winham and Hannus 1991
39HU210				EC	Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39HU211	IMM				Butler 2014; Winham and Hannus 1991
39HU213	IMM				Johnson 2007a; Winham and Hannus 1991
39HU214				EC	Johnson 2007a; Winham and Hannus 1991
39HU216				EC	Winham and Hannus 1991
39HU219				EC	Winham and Hannus 1991
39HU223	IMM		IC		Johnson 2007a; Steinacher 1984; Winham and Hannus 1991
39HU224			IC		Fox 1980; Winham and Hannus 1991
39HU225			IC		Winham and Hannus 1991
39HU229			IC		Steinacher 1984; Winham and Hannus 1991
39HU233	IMM				Butler 2014
39HU241			IC		Winham and Hannus 1991
39HU242			IC		Johnson 2007a; Winham and Hannus 1991
39HU28				EC	Winham and Hannus 1991
39HU44				EC	Winham and Hannus 1991
39HU6			IC		Johnson 2007a; Winham and Hannus 1991
39HU60	IMM			EC	Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39HU61			IC		Winham and Hannus 1991
39HU7				EC	Johnson 2007a
39HU75	IMM				Winham and Hannus 1991
39HU83			IC		Winham and Hannus 1991
39HU88				EC	Winham and Hannus 1991
39HU97				EC	Johnson 2007a; Winham and Hannus 1991
39JE1	IMM				Butler 2014; Winham and Hannus 1991
39JE2	IMM				Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39JK101				EC	Winham and Hannus 1991
39JK4				EC	Winham and Hannus 1991
39LK18	IMM	EMM		EC	Winham and Hannus 1991
39LM1	IMM			EC	Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM101	IMM				Butler 2014
39LM139				EC	Winham and Hannus 1991
39LM146	IMM				Winham and Hannus 1991
39LM15			IC		Alex 1981
39LM154				EC	Winham and Hannus 1991
39LM167				EC	Winham and Hannus 1991
39LM174	IMM				Winham and Hannus 1991
39LM2	IMM		IC		Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM201				EC	Johnson 2007a
39LM207				EC	Winham and Hannus 1991
39LM208	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM209	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM212	IMM				Winham and Hannus 1991
39LM218			IC		Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM222				EC	Johnson 2007a; Winham and Hannus 1991
39LM223				EC	Winham and Hannus 1991
39LM224				EC	Johnson 2007a; Winham and Hannus 1991
39LM225	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM226	IMM				Butler 2014; Johnson 2007a; Winham and Hannus 1991
39LM23			IC		Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39LM232	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM238	IMM				Winham and Hannus 1991
39LM247	IMM				Butler 2014; Lehmer 1971; Winham and Hannus 1991
39LM248	IMM				Winham and Hannus 1991
39LM26			IC		Johnson 2007a; Winham and Hannus 1991
39LM301				EC	Johnson 2007a; Lehmer 1971
39LM308				EC	Winham and Hannus 1991
39LM33	IMM	EMM			Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM39				EC	Winham and Hannus 1991
39LM4	IMM	EMM			Lehmer 1971; Winham and Hannus 1991
39LM47	IMM			EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM53		EMM			Winham and Hannus 1991
39LM55	IMM	EMM			Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39LM57	IMM				Winham and Hannus 1991
39LM58	IMM				Winham and Hannus 1991
39LM59	IMM				Butler 2014; Winham and Hannus 1991
39LM6			IC		Johnson 2007a; Winham and Hannus 1991
39LM66	IMM				Winham and Hannus 1991
39LM7	IMM			EC	Winham and Hannus 1991
39LM82			IC		Steinacher 1984; Winham and Hannus 1991
39LM84	IMM				Butler 2014; Winham and Hannus 1991
39LN15	IMM				Johnson 2007a
39LN21	IMM				Winham and Hannus 1991
39LN7	IMM				Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39ME8		EMM			Johnson 2007a
39MH1	IMM				Winham and Hannus 1991
39MH30	IMM				Winham and Hannus 1991
39MT301				EC	Winham and Hannus 1991
39PN561	IMM				Winham and Hannus 1991
39PN590				EC	Winham and Hannus 1991
39PO7				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39RO242	IMM				Winham and Hannus 1991
39SH111			IC		Winham and Hannus 1991
39SH133	IMM				Winham and Hannus 1991
39SH68	IMM				Winham and Hannus 1991
39SL12		EMM			Johnson 2007a; Winham and Hannus 1991
39SL13		EMM			Johnson 2007a; Winham and Hannus 1991
39SL24				EC	Johnson 2007a
39SL29		EMM			Johnson 2007a; Winham and Hannus 1991
39SL4				EC	Johnson 2007a; Lehmer 1971
39SL41		EMM			Johnson 2007a; Winham and Hannus 1991
39SL42		EMM			Winham and Hannus 1991
39SL7		EMM			Johnson 2007a; Winham and Hannus 1991
39ST1		EMM		EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST1				EC	Johnson 2007a; Winham and Hannus 1991
39ST10				EC	Johnson 2007a
39ST11	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST111				EC	Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39ST117				EC	Winham and Hannus 1991
39ST12	IMM			EC	Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST121			IC		Winham and Hannus 1991
39ST124				EC	Winham and Hannus 1991
39ST15		EMM		EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST16	IMM	EMM		EC	Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST175				EC	Winham and Hannus 1991
39ST19	IMM				Winham and Hannus 1991
39ST203		EMM		EC	Johnson 2007a; Lehmer 1972
39ST214	IMM				Winham and Hannus 1991
39ST215				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST218				EC	Winham and Hannus 1991
39ST219				EC	Winham and Hannus 1991
39ST222				EC	Winham and Hannus 1991
39ST223	IMM	EMM			Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST224	IMM	EMM		EC	Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST228	IMM			EC	Johnson 2007a
39ST23	IMM		IC		Butler 2014; Johnson 2007a; Steinacher 1984; Winham and Hannus 1991
39ST232				EC	Johnson 2007a; Lehmer 1972; Winham and Hannus 1991
39ST235	IMM				Butler 2014; Johnson 2007a; Winham and Hannus 1991
39ST238	IMM	EMM			Johnson 2007a; Winham and Hannus 1991
39ST249				EC	Winham and Hannus 1991
39ST26				EC	Lehmer 1971
39ST3		EMM		EC	Johnson 2007a; Winham and Hannus 1991

Site Number	Initial Middle Missouri	Extended Middle Missouri*	Initial Coalescent	Extended Coalescent	References
39ST30	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST35				EC	Winham and Hannus 1991
39ST37	IMM	EMM			Winham and Hannus 1991
39ST38	IMM				Butler 2014; Winham and Hannus 1991
39ST39		EMM		EC	Winham and Hannus 1991
39ST55	IMM				Butler 2014; Winham and Hannus 1991
39ST56	IMM				Butler 2014; Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39ST69	IMM				Winham and Hannus 1991
39ST74	IMM				Winham and Hannus 1991
39ST86				EC	Winham and Hannus 1991
39ST88	IMM				Winham and Hannus 1991
39ST89	IMM				Winham and Hannus 1991
39ST91	IMM				Winham and Hannus 1991
39TD4				EC	Winham and Hannus 1991
39UN10	IMM				Winham and Hannus 1991
39WW10				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39WW203				EC	Johnson 2007a; Winham and Hannus 1991
39WW302				EC	Johnson 2007a; Lehmer 1971; Winham and Hannus 1991
39WW303				EC	Winham and Hannus 1991
39WW7				EC	Johnson 2007a; Lehmer 1971
39WW89		EMM			Winham and Hannus 1991
39YK203	IMM				Johnson 2007a