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Chronology construction in the borderlands: Bayesian modelling of Potomac Valley settlement histories

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Abstract

Bayesian modelling of radiocarbon dates to construct detailed chronologies has become a key methodology in North America's 'historic turn,' though the Middle Atlantic has seen few efforts to apply these techniques. Drawing from 70 legacy dates and 25 new assays, this study develops Bayesian chronological models for 10 Late Woodland (AD 900-1600) sites in the Potomac Valley. Our goal is to assess how the arrival of Luray communities impacted the region's settlement history. During the Late Woodland period Native communities tied to three cultural traditions established a series of towns in the Potomac Valley, at times close to one another. With evidence of population movements, intergroup violence, and coalescent communities, the Late Woodland Potomac Valley appears to have represented a dynamic borderland during these centuries. The chronology developed in this study points toward a landscape of settlements we have labelled Persistent Places, Unsettled Settlements, and Transitory Towns.

Keywords

Bayesian modelling, Potomac Valley, Palisaded settlements, Frontiers and borderlands, Coalescent communities

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Introduction

The following summarizes our efforts to construct a chronology of Native settlements in the Potomac Valley through Bayesian modeling of radiocarbon dates. During the Late Woodland period (AD 900–1600) the river drainage was home to several culturally distinct Native communities that interacted regularly (Clark, 2019; Means and Moore, 2020; Potter, 1993). From the Potomac Creek site near the fall line west to the river's headwaters, the Late Woodland Potomac Valley was a landscape of population movements, fortified towns, and periodic intercommunity violence (Blanton et al., 1998; Dent, 1995; Jirikowic, 1995; Kavanagh, 2001; Stewart 1997). This study considers how the arrival of Luray communities in the Potomac Valley circa AD 1400 impacted the region's settlement history. To address this question, we have developed chronological models for the establishment and abandonment of 10 prominent settlements from the Potomac's headwaters to its fall line. Building on a suite of 95 radiocarbon assays, our goal is to create a temporal baseline for this borderland landscape. Our sampling strategy focuses on palisaded villages and substantial residential communities with published site reports and accessible field records. Not everyone in the Middle and Upper Potomac lived in such settlements, though these places served as focal points for regional populations, exchange relations, and ceremonial practices. Nor have all palisaded towns and large villages in the Potomac Valley yielded enough radiocarbon dates to produce a viable chronological model, but those that have point to a dynamic frontier landscape. Our simulations indicate that accurate and precise chronological models may be built for Late Woodland settlement histories in the region with at least five radiocarbon dates. The sites included in this study have yielded between five and 14 radiocarbon dates.

Constructing more precise and accurate chronologies for these settlements is a critical step toward developing a regionally specific narrative of precolonial historical processes (Ethridge and Bowne, 2020). Refined chronologies also bring the archaeological record closer to the lived experiences of Native communities, offering a tool for advancing Indigenous-led research agendas in the process (Birch et al., 2021). Studies applying Bayesian methods to model radiocarbon chronologies are scarce in the Middle Atlantic, though such approaches have been instrumental to the 'historic turn' embraced by archaeologists in the Northeast (e.g., Birch et al., 2021) and Southeast (e.g., Cobb et al., 2015). Middle Atlantic archaeology needs similar studies that combine legacy radiocarbon dates with new assays to develop detailed culture histories.

The Potomac Valley offers an ideal setting for such an effort. As a result of decades of research building on the Potomac River Archaeological Survey (Dent, 1995: 63–65), well-reported excavations (e.g., Blanton et al., 1998; Jirikowic, 1995), and cogent syntheses of the regional archaeology (e.g., Potter, 1993), the broad outlines of the valley's culture history are well understood. From as early as the eleventh century, settlements were frequently constructed by Native communities tied to several distinct cultural traditions, including those labelled by

archaeologists as Montgomery and Page. From circa AD 1400, the establishment of palisaded settlements, especially those associated with the Luray Complex in the Piedmont and the Potomac Creek Complex in the Coastal Plain, added to the diversity of social traditions in the Potomac Valley and, we suspect, the region's borderland dynamics. Other cultural traditions, including Shenks Ferry in the Susquehanna Valley and Monongahela in the Upper Ohio Valley, underscore the wide range of social actors in and around the Potomac drainage. These actors likely included Algonquian speakers in the Tidewater region, Siouan speakers in the interior, and Iroquoian groups that periodically raided or settled in the Potomac Valley (Wall, 2004). Communities in the Potomac region interacted and likely intermarried regularly, as evidenced by the frequent presence of non-local trade goods and ceramics throughout the area.

While cultural traditions may be mapped with tightly bounded polygons in other parts of the Middle Atlantic, the Late Woodland and early colonial Potomac Valley was home to shifting and overlapping social networks centered on palisaded settlements and large towns (e.g., King et al., 2016; MacCord, 1989: 90). The archaeological evidence of cultural differences, population movements, and intergroup violence suggests to us that the Middle and Upper Potomac represented a frontier or borderland during the final Late Woodland centuries. Frontiers or borderlands, terms we are using interchangeably here, are understood as ambiguous "Third Spaces" within which diverse groups encounter one another often, where communities from distinct cultural backgrounds occupy the same areas, and where little distance separates communities tied to different traditions (Naum, 2010: 101). Research aimed at frontier settings has emphasized that these spaces were dynamic zones of political, cultural, and social interaction and innovation (e.g., Barth, 1969; Green and Perlman, 1985; Lightfoot and Martinez, 1995). More than simply a line on a map, frontier zones were (and are) open to new forms of political organization, social personhood, and value accumulation.

Whether framed in terms of a "middle ground", "borderland", or "periphery", many previous studies of frontiers drew on histories of European colonialism and expanding state authority (Lightfoot and Martinez, 1995). In their effort to "untame" the frontier as an analytical concept, Parker and Rodseth (2005) urged that we push these notions further by developing frontier studies in unfamiliar settings, a challenge that several Eastern Woodlands studies have taken to heart (e.g., Comstock and Cook, 2018; Jones et al., 2020). These studies highlight zones of cross-cutting social networks in which new cultural practices and social identities emerged.

In some frontier settings, new communities formed when groups from diverse backgrounds joined together. *Coalescent societies* are well documented in the early colonial Southeast (e.g., Beck, 2013: 7; Ethridge and Hudson, 1998; Hudson, 2002: xv–xvi), and similar historical processes unfolded in the precolonial Northeast at the community scale (e.g., Birch, 2012). Several studies have highlighted historical processes during periods of crisis leading to the creation of coalescent communities that were

organized around collective defense, intensified agriculture, and new forms of collective decision-making (e.g., Arkush, 2018; Kowalewski, 2006). Similar developments shaped settlements in the Potomac Valley borderland too.

In addition to helping us understand the development of the Potomac Valley borderland, our focus on chronology construction responds to the recent call for a 'historic turn' in the precolonial Southeast (e.g., Ethridge and Bowne, 2020). Archaeologists have begun to highlight cultural sequences during 'prehistory' that were eventful, contingent, and local (e.g., Hantman, 1990). Whether framed in terms of deep history (Cobb, 2005), eventful history (Sassaman, 2010), big history (Pluckhahn et al., 2020), or historical processualism (Pauketat, 2001), researchers have developed rich narratives for historical processes including migration, coalescence, and ethnogenesis well before the arrival of European settlers in the Americas (Ethridge et al., 2020). These studies highlight the steep evidentiary requirements for the historic turn, including tight chronologies (e.g., Krus and Cobb, 2018), river-valley scale comparisons (e.g., Pluckhahn et al., 2020), and large-scale excavations (Alt, 2020).

With the addition of new radiocarbon assays generated for this study, the Potomac Valley offers a dataset meeting these requirements. The following briefly outlines the current understanding of Late Woodland Potomac Valley culture history, focusing on prominent cultural traditions and key sites, before summarizing the results of our Bayesian modeling and their implications for constructing a new narrative of the Potomac Valley borderland.

The Late Woodland Potomac Valley

Prior to the colonial era, the Potomac River was a conduit through which people, materials, and ideas moved to and from the Atlantic Coast into the adjacent Ohio River and Susquehanna River systems (Johnson and Means, 2020; Means and Moore, 2020: 161; Rountree et al., 2007: 262). The Potomac River cuts across about 380 miles, and the river basin draws from parts of four states (Maryland, Pennsylvania, Virginia, and West Virginia) and the District of Columbia. The Potomac is the second largest watershed in the Chesapeake Bay after the Susquehanna, arising in the Appalachian Plateau before flowing through the Ridge and Valley, Blue Ridge, Piedmont, and Coastal Plain. The Potomac River's headwaters abut the Ohio River and James River basins, while tributaries in Pennsylvania border the Susquehanna River system. In the Upper Potomac, the Shenandoah River is a major tributary that flows northeast along the Great Valley and was a focus of palisaded Late Woodland settlement. Running the length of the Appalachian Mountains, the Great Valley was an important north-south transportation corridor prior to and during the colonial era. Ceramics recovered from sites in the Shenandoah Valley portion of the Great Valley highlight ties to the Upper Delaware Valley and Iroquoia as well as the Southeast (Stewart 1997). Farther east, Great Falls and the Potomac River Fall Line represented a prominent physical boundary between the Middle and Lower Potomac and, for at least some

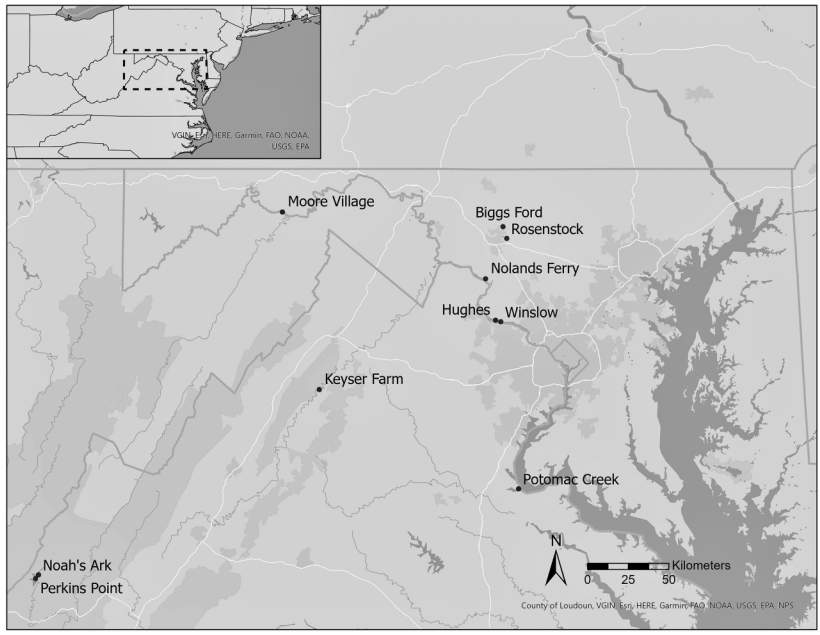

Figure 1. Map of sites modelled in this study.

periods of Native history, a geographic boundary across which Algonquian, Siouan, and Iroquoian speaking groups from distinct social networks interacted.

During the early colonial era, colonist John Smith's (1986) *Map of Virginia* recorded 12 "King's Houses" and 30 "Ordinary" towns in the Lower Potomac, Algonquian speakers on the northern fringes of the Powhatan chiefdom. In the interior Coastal Plain near the Fall Line, Potomac Creek and Accokeek Creek were two prominent fortified villages dating to the precolonial era (Potter, 1993: 120). These substantial towns likely represented the paired settlements of an immigrant community from outside the area (Dent and Jirikowic, 2001; Potter, 1993: 137). While historical maps indicate that the lower Potomac was densely inhabited during the early colonial era, the cartographic and archaeological evidence for the portion of the Potomac River drainage above the falls is more ambiguous. Historian James Rice (2009: ix) has gone as far as to describe this colonial era landscape as a "hole in the map" with few settlements there during the centuries immediately before contact. A cross on John Smith's *Map of Virginia* near the Fall Line indicates the extent of his exploration and that he did not travel into the Potomac River Piedmont. Historical accounts from the years after the initial colonial encounters reference a shifting set of Native groups in this area, including Massawomecks and Susquehannocks who periodically raided settlements in the region (Wall, 2004; Wall and Lapham, 2003).

Three prominent cultural groupings, labelled by archaeologists as the Page, Montgomery, and Luray complexes, played important roles in the Middle and Upper Potomac. Our models include Middle and Upper Potomac sites from these three traditions as well as the Potomac Creek site, a closely related town just east of the Fall Line (Figure 1). Described below, the three archaeological complexes we have focused on are distinguished mainly in mortuary practices and ceramic attributes, including temper and cordage twist direction. We have followed the regional convention of recognizing dominant ceramic types on each site as signals of distinct groups of people. While a useful starting point for chronology construction and a heuristic for tracing distinct social networks and cultural traditions, it is also clear that people and ideas moved regularly across communities and social boundaries in the Late Woodland Potomac Valley (Dent and Jirikowic, 2001). Most sites in our sample contain more than one ceramic type, complicating the effort to identify distinctive social groupings. Cordage twist also varied considerably within some of these communities, likely in relation to kinship networks, population movements, and group coalescence (Custer, 2004).

Page Complex

Beginning in the Appalachian Mountains by AD 1000, settlements associated with the Page Complex spread into the Shenandoah Valley and Potomac River Piedmont circa AD 1300, persisting until after 1400 AD (Potter, 1993: 130–131; Wall, 2001: 17–23). Piedmont sites associated with the Page Complex are found at or near the confluence of the Potomac and Monocacy rivers (Kavanagh, 2001: 8–9; Dent, 2010: 11–14), often interspersed between clusters of Montgomery villages. Page ceramics were limestone-tempered and cord-marked, often smoothed, with Z-twist cordage. Mason Island ceramics are identical to Page, and we have combined both under the Page label. Page Complex sites were marked by individual extended burials, with some flexed internments (Means and Moore, 2020: 167). Their subsistence practices integrated maize horticulture with seasonal hunting and gathering (Kavanagh, 2001: 8). Most Page settlements were not palisaded (Dent, 2010: 8).

Page sites in this study include Nolands Ferry, Noah's Ark, and Perkins Point. While it is not clear whether Noland's Ferry was palisaded, the site is nonetheless important for this study as it represents the easternmost extent of the limestone-tempering tradition (Peck, 1980: 2; Dent, 2010: 14). Two additional Page sites included here are in the Ridge and Valley province near the headwaters of both the James and Potomac River systems. The palisaded Perkins Point site contained primarily limestone-tempered and cord-marked ceramics, classified by the excavators as Radford (Whyte and Geier, 1982: 268). Mortuary practices at Perkins Point included flexed and bundle burials (Whyte and Geier, 1982: 271). Perkins Point has been classified as part of the 'Intermontane Culture,' a label MacCord (1989) used to highlight shared settlement forms, cultural practices, and social connections that linked palisaded towns in Virginia's Great Valley circa AD 1300–1600.

Montgomery Complex

Settlements associated with the Montgomery Complex or Focus were primarily located in the Potomac Piedmont but extended west into the Upper Potomac (Means and Moore, 2020: 166–167). The Complex is generally dated to between AD 900 and 1450 (Potter, 1993: 127). Shepard ware, the primary ceramic style, was tempered with quartz or igneous rock and cord-marked, mainly with Z-twist cordage. Mortuary practices centered on individual, flexed burials (Potter, 1993: 126). These horticultural communities included a mix of farmsteads, hamlets, and villages (Kavanagh, 2001: 5–6). Villages typically consisted of a central plaza, surrounded by rings of storage pits, circular houses, and palisades (Curry and Kavanagh, 2004: 29–32). Households may have cycled between locations as soils were exhausted by maize-based agriculture (Dent, 2007: 41).

Key sites with well-reported excavation results include Biggs Ford and Rosenstock, both located along the Monocacy River, a Middle Potomac tributary in Maryland (Dent, 2021: 1). Biggs Ford contains evidence of two distinct occupations. The first, a Montgomery occupation, was dispersed and lacked a palisade (Hall, 2021). The second, a Keyser occupation, was larger and was surrounded by a palisade. Rosenstock contained a central plaza and a surrounding storage pit arc (Curry and Kavanagh, 2004: 29). Located along the Potomac's north bank, the Winslow site was organized consistently with most Montgomery settlements with a central plaza surrounded by concentric rings of storage pits, houses, and an outer palisade (Dent, 2021: 3).

Luray Complex

The Luray Complex probably represents a migration of Native people into the Potomac. Existing interpretations suggest that Luray Complex people arrived in the region circa AD 1400 (Means and Moore, 2020: 168–169). Similar Luray sites are present in the Appalachian Mountains, Shenandoah Valley, and Potomac Piedmont, suggesting a population movement south and east from the Ohio River Valley (Wall, 2001: 17–23; Manson et al., 1944: 375–376). Luray Complex sites are associated with Keyser ceramics, which were tempered with crushed freshwater shell and cord-marked with S-twist cordage. Mortuary practices included flexed, extended, and secondary bundle burials, with individual and multiple internments (Means and Moore, 2020: 168). There are some indications in the botanical evidence that Luray Complex peoples practiced more intensive agriculture than their neighbors (Wall, 2001: 29). Their settlements centered on large circular or oval palisaded villages (Means and Moore, 2020: 168). In the Piedmont, Luray components at Biggs Ford, Hughes, and Mason Island II were located near Montgomery and Page site clusters (Jirikowic, 1999: 28–32; Dent, 2010: 13).

Luray Complex sites in this study include Moore Village, Hughes, Keyser Farm, and Biggs Ford II. Hughes is located on the north bank of the Potomac River near several Montgomery Complex sites, including Winslow (Dent, 2007: 7–6; Jirikowic, 1999:

1). The settlement was a large, palisaded village with domestic structures surrounding a central plaza (Jirikowic, 1999: 121–131). Hughes also contained evidence of intensive deer hide processing in the form of large numbers of bone fleshers or beamers (Jirikowic, 1999: 102; Stearns, 1940: III). Keyser Farm, located on the South Fork of the Shenandoah River in Page County, Virginia, also contained abundant evidence of deer hunting and hide processing (Barber, 2020: 3). Burials were mostly flexed, with some extended and possible bundle burials (Manson et al., 1944: 387–391). The site's ceramics were primarily Keyser wares, with limestone-tempered Page and crushed rock-tempered Potomac Creek ceramics also present (Barber, 2020: 3). The abundance of metatarsal beamers at Keyser Farm alongside non-local ceramics has been cited as evidence that deerskins from Keyser Farm were exchanged for shell beads produced by communities tied to the Potomac Creek Complex to the east (Barber, 2020: 3–7).

Communities linked with the Luray Complex left the valley before AD 1600 (Means and Moore, 2020: 169). The Susquehannocks briefly inhabited the area, signaled by the presence of shell-tempered Schultz Incised pottery (Wall and Lapham, 2003: 169–170; Wall, 2001: 19). By the 1630s, the Susquehannocks were no longer present in the region (Wall and Lapham, 2003: 171) and for the remainder of the seventeenth century the Middle to Upper Potomac Valley settlement history is unclear. Jamestown colonist John Smith described a group labelled the Massawomeck in the area in the early 1600s (Pendergast, 1991), and the Shawnee were also clearly present by the 1690s (Wall, 2001: 29–33). Whether these groups had past connections to the region remains unclear (Wall and Lapham, 2003: 171; Wall, 2001: 33).

Methods: Bayesian Modelling of Settlement Histories in the Potomac Valley

We assembled a dataset of 95 radiocarbon dates from 10 sites in the Potomac River drainage to build a more accurate and precise historical narrative of the precolonial settlements in this area. Of these dates, 25 were collected by the authors from 5 sites for this project, while the remaining 70 were legacy dates (Table 1). New AMS (Accelerator Mass Spectrometry) dates were obtained from two laboratories—the Center for Applied Isotope Studies (CAIS) at the University of Georgia and DirectAMS. All samples submitted by the authors were single entity samples of either maize, nutshell, or bone.

Bayesian models of radiocarbon dates combine sets of dates with 'prior' information drawn from the archaeological record (Bronk Ramsey, 2009a). For chronological models, Bayesian *priors* may range from the simple recognition that a set of dates comes from a single occupation of a site to more complex interpretations of dates in a stratigraphic sequence. The resulting models estimate beginnings and ends of occupations by combining multiple dates and probability distributions.

The sites included in the sample have each yielded at least 5 radiocarbon assays. Our efforts to build models for sites with fewer dates were unconvincing. Following

Table 1. Radiocarbon assays included in this study.

Site	Lab Number	^{14}C Date	95.4% Calibrated Range (cal AD)	Median Probability Date (cal AD)	Material Dated	δ^{13}C value	Citation
18FR14	SI-3661	915 ± 60	1021–1257	1125	Charcoal		Peixotto 2021
18FR14	SI-3663	765 ± 70	1050–1394	1251	Charcoal		Peixotto 2021
18FR14	SI-3662	550 ± 90	1273–1618	1384	Charcoal		Peixotto 2021
18FR14	DAMS-026287	550 ± 30	1318–1434	1399	Maize		Peixotto 2021
18FR14	DAMS-026288	304 ± 29	1494–1652	1562	Charcoal		Peixotto 2021
18FR14	DAMS-026289	459 ± 28	1415–1469	1441	Charcoal		Peixotto 2021
18FR14	UGAMS-60476*	630 ± 20	1296–1396	1355	Maize	−8.22	
18FR14	UGAMS-60477*	720 ± 20	1267–1299	1282	Bone	−21.35	
18FR14	UGAMS-60478*	720 ± 20	1267–1299	1282	Bone	−21.99	
18FR14	UGAMS-60479*	350 ± 20	1470–1635	1565	Nut	−24.99	
18FR14	UGAMS-60480*	270 ± 20	1523–1794	1642	Nut	−26.29	
18FR14	UGAMS-60481*	340 ± 20	1479–1635	1568	Nut	−26.31	
18MO1	Beta-41367	660 ± 50	1275–1400	1335	Charcoal		Jirikowic 1999
18MO1	Beta-49133	580 ± 60	1291–1435	1357	Charcoal		Jirikowic 1999
18MO1	Beta-41368	510 ± 50	1309–1467	1416	Charcoal		Jirikowic 1999
18MO1	Beta-49132	420 ± 60	1410–1635	1489	Charcoal		Jirikowic 1999
18MO1	Beta-242478	550 ± 40	1306–1440	1394	Maize		Dent 2009
18MO1	Beta-242479	490 ± 40	1327–1468	1428	Maize		Dent 2009
18MO1	Beta-242480	580 ± 40	1300–1425	1352	Charcoal		Dent 2009
18MO1	DAMS-044112*	404 ± 21	1441–1618	1468	Maize	−9.56	
18MO1	DAMS-044113*	355 ± 19	1466–1633	1561	Nut		
18MO1	Beta-603153*	470 ± 30	1407–1460	1436	Maize	−9.4	
18MO1	DAMS-045260*	380 ± 21	1450–1625	1493	Maize	−10.22	
18MO1	DAMS-045261*	469 ± 21	1419–1455	1437	Maize	−9.75	
18MO1	DAMS-045262*	432 ± 19	1434–1475	1451	Maize	−9.71	

(continued)

Table 1. Continued.

Site	Lab Number	^{14}C Date	95.4% Calibrated Range (cal AD)	Median Probability Date (cal AD)	Material Dated	δ^{13}C value	Citation
44PA1	Beta-260819	410 ± 40	1426–1631	1481	Maize	−9	Means and McKnight 2009
44PA1	Beta-214927	350 ± 40	1459–1637	1554	Charcoal		Means and Moore 2020
44PA1	Beta-214928	380 ± 40	1443–1635	1515	Maize		Means and Moore 2020
44PA1	Beta-205354	530 ± 60	1299–1459	1401	Charcoal	−25.9	Means and McKnight 2009
44PA1	Beta-205353	480 ± 40	1328–1479	1433	Charcoal	−24.9	Means and McKnight 2009
44PA1	Beta-260816	390 ± 40	1437–1635	1504	Bean	−24.9	Means and McKnight 2009
44PA1	Beta-260817	360 ± 40	1455–1636	1546	Maize	−8.9	Means and McKnight 2009
44PA1	Beta-260820	380 ± 40	1443–1635	1515	Bean	−24.8	Means and McKnight 2009
44PA1	Beta-260821	380 ± 40	1443–1635	1515	Maize	−7.7	Means and McKnight 2009
44PA1	Beta-260818	370 ± 40	1449–1635	1529	Maize	−10.2	Means and McKnight 2009
44PA1	UGAMS-61107*	290 ± 20	1517–1657	1557	Bone	−21.57	
44PA1	UGAMS-61108*	350 ± 20	1470–1635	1565	Maize	−9.77	
44BA15	UGA-4049	920 ± 120	778–1299	1113	Charcoal		Geier and Warren 1982
44BA15	UGA-4051	695 ± 70	1220–1405	1306	Charcoal		Geier and Warren 1982
44BA15	UGA-4052	700 ± 85	1175–1418	1301	Charcoal		Geier and Warren 1982
44BA15	UGA-4053	675 ± 65	1229–1407	1322	Charcoal		Geier and Warren 1982
44BA15	UGA-4050	645 ± 80	1229–1430	1340	Charcoal		Geier and Warren 1982
18FR17	SI-3880a	875 ± 65	1036–1266	1165	Charcoal		Boyce and Frye 1986
18FR17	SI-3880b	745 ± 60	1172–1391	1268	Charcoal		Boyce and Frye 1986
18FR17	SI-3880c	470 ± 85	1305–1636	1450	Charcoal		Boyce and Frye 1986
18FR17	SI-3881	360 ± 60	1442–1646	1546	Charcoal		Boyce and Frye 1986
18FR17	SI-3882a	455 ± 60	1327–1632	1453	Charcoal		Boyce and Frye 1986
18FR17	SI-3882b	1080 ± 65	773–1150	956	Charcoal		Boyce and Frye 1986
18FR17	SI-3884a	400 ± 60	1425–1637	1509	Charcoal		Boyce and Frye 1986
18FR17	SI-3884b	855 ± 70	1039–1275	1180	Charcoal		Boyce and Frye 1986

(continued)

Table 1. Continued.

Site	Lab Number	^{14}C Date	95.4% Calibrated Range (cal AD)	Median Probability Date (cal AD)	Material Dated	δ^{13}C value	Citation
18FR17	SI-3884c	1020 ± 60	891–1163	1027	Charcoal		Boyce and Frye 1986
18FR17	UGAMS-60482*	650 ± 20	1287–1392	1362	Maize	−9.82	
18FR17	UGAMS-60483*	710 ± 20	1271–1378	1285	Bone	−21.41	
18FR17	UGAMS-60484*	710 ± 20	1271–1378	1285	Bone	−21.34	
18FR17	UGAMS-61677*	720 ± 20	1267–1299	1282	Bone	−21.24	
18FR17	UGAMS-61678*	1010 ± 20	991–1121	1023	Bone	−22.76	
44BA3	UGA-3080	315 ± 60	1448–1797	1566	Charcoal		Whyte and Geier 1982
44BA3	UGA-3082	440 ± 130	1279–1803	1495	Charcoal		Whyte and Geier 1982
44BA3	UGA-3083	435 ± 50	1406–1631	1466	Charcoal		Whyte and Geier 1982
44BA3	UGA-873	550 ± 60	1299–1448	1381	Charcoal		Means and Moore 2020
44BA3	Beta-261038	340 ± 40	1465–1640	1558	Maize	−9	Means and McKnight 2009
44ST2	Beta-102322	640 ± 50	1280–1403	1345	Charcoal	−25	Blanton et al. 1998
44ST2	Beta-102323	540 ± 60	1299–1454	1393	Charcoal	−25.4	Blanton et al. 1998
44ST2	Beta-102324	410 ± 50	1422–1635	1491	Charcoal	−25	Blanton et al. 1998
44ST2	Beta-102325	670 ± 60	1233–1409	1326	Charcoal	−25	Blanton et al. 1998
44ST2	Beta-104592	340 ± 40	1465–1640	1558	Charcoal	−25.3	Blanton et al. 1998
44ST2	Beta-104593	730 ± 30	1229–1378	1279	Charcoal	−25.6	Blanton et al. 1998
44ST2	Beta-104594	990 ± 70	895–1216	1074	Charcoal	−25	Blanton et al. 1998
44ST2	Beta-104595	350 ± 30	1461–1636	1558	Charcoal	−26.5	Blanton et al. 1998
44ST2	Beta-226809	350 ± 40	1459–1637	1554	Maize	−10.8	McKnight and Gallivan 2008
18FR18	SI-4582	935 ± 60	995–1224	1111	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-51754	910 ± 90	980–1279	1127	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-51756	860 ± 80	1028–1280	1172	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-51755	850 ± 120	900–1394	1168	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-55786	740 ± 80	1054–1403	1270	Charcoal		Curry and Kavanagh 2004

(continued)

Table 1. Continued.

Site	Lab Number	^{14}C Date	95.4% Calibrated Range (cal AD)	Median Probability Date (cal AD)	Material Dated	δ^{13}C value	Citation
18FR18	Beta-55048	720 ± 70	1178–1400	1286	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-55047	700 ± 90	1165–1422	1300	Charcoal		Curry and Kavanagh 2004
18FR18	SI-4579	615 ± 60	1282–1420	1350	Charcoal		Curry and Kavanagh 2004
18FR18	SI-4578	530 ± 60	1299–1459	1401	Charcoal		Curry and Kavanagh 2004
18FR18	SI-4581	500 ± 30	1399–1450	1425	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-55044	520 ± 80	1283–1620	1407	Charcoal		Curry and Kavanagh 2004
18FR18	SI-4580	475 ± 60	1317–1625	1438	Charcoal		Curry and Kavanagh 2004
18FR18	Beta-55045	380 ± 70	1424–1648	1532	Charcoal		Curry and Kavanagh 2004
18MO9	SI-37	635 ± 80	1233–1437	1344	Charcoal		Dent 2005
18MO9	SI-47	665 ± 100	1175–1443	1324	Charcoal		Dent 2005
18MO9	Beta-177862	580 ± 40	1300–1425	1352	Charcoal		Dent 2005
18MO9	Beta-177863	580 ± 40	1300–1425	1352	Charcoal		Dent 2005
18MO9	UGAMS-60485*	320 ± 20	1496–1642	1563	Maize	−9.42	
18MO9	UGAMS-61109*	580 ± 25	1306–1415	1348	Maize	−9.59	
18MO9	UGAMS-61110*	520 ± 20	1400–1438	1418	Maize	−10.36	
18AG43	Beta-6783	530 ± 50	1305–1452	1404	Charcoal		Pousson 1983
18AG43	Beta-6784	450 ± 50	1398–1630	1452	Charcoal		Pousson 1983
18AG43	UGAMS-63747*	420 ± 20	1436–1490	1456	Nut		
18AG43	UGAMS-63744*	410 ± 20	1439–1615	1463	Seed		
18AG43	UGAMS-63746*	320 ± 20	1496–1642	1563	Nut		
18AG43	UGAMS-63745*	300 ± 20	1510–1650	1556	Seed		

* Indicates new dates collected by the authors.

the practice of other researchers (Krus and Cobb, 2018) we conducted a simple simulation experiment to assess the minimum number of dates necessary to construct a usable model. Our simulations indicated that 5 dates are the minimum necessary to develop a reliable model (see Supplemental Materials for details regarding the simulations). Chronological models were constructed for each site and generated in OxCal using the IntCal20 14C calibration dataset (Reimer et al., 2020). Where applicable, the primary models use charcoal outlier modeling to account for the unknown age offset in wood charcoal and soot samples (Bronk Ramsey, 2009b). Radiocarbon dates drawn from unidentified wood charcoal may introduce biases in chronological models due to charcoal's ubiquity on sites with long occupations (Cook and Comstock, 2014;

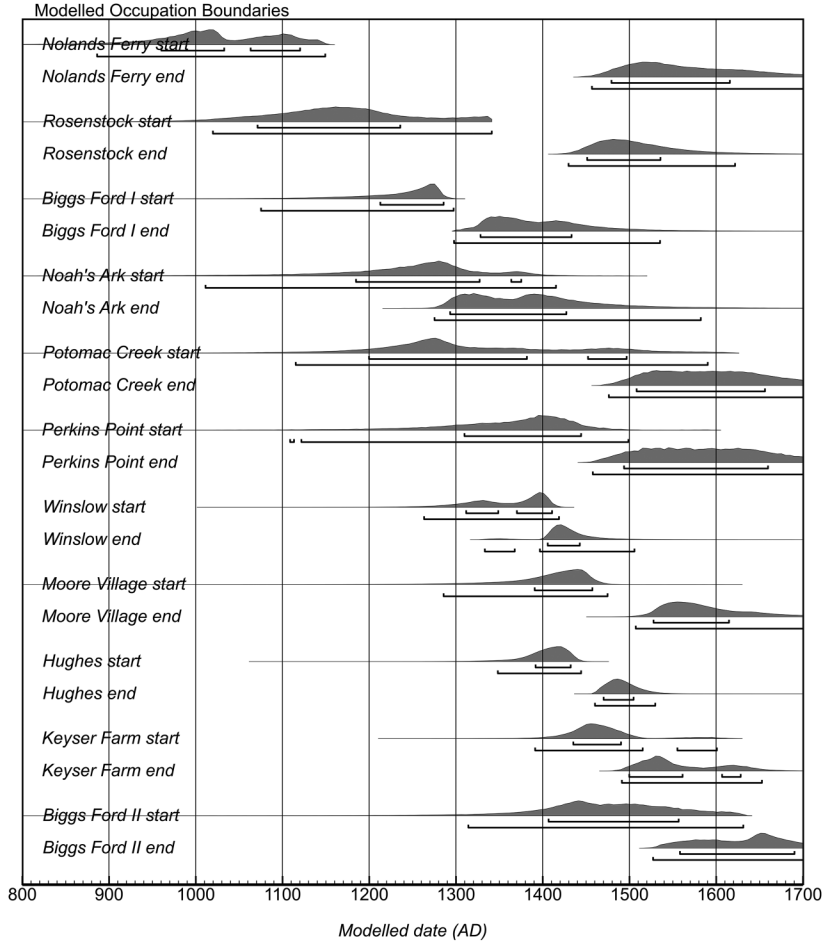

Figure 2. OxCal output of modelled occupation start and ends.

Schiffer, 1986). While charcoal was once seen as an ideal medium for radiocarbon dating, long-lived tree species may produce a date from heartwood which is centuries old by the time the tree was felled. The possible time-lag between felling and final deposition introduces another bias toward early outliers. All the new assays generated for this study were drawn from short-lived specimens such as seeds or nuts, or when necessary, large faunal elements deposited in pit feature contexts.

The primary models all show good overall agreement between the radiocarbon dates and the assumptions of the models (see Supplemental Materials for Bayesian model details). For each site, we also created an alternative model that did not use charcoal outlier modelling, following standard practices (Krus and Cobb, 2018: 308). By not using charcoal outlier modelling, these models are more susceptible to misleading radiocarbon measurements from old wood. Most alternative models showed good overall agreement between the radiocarbon dates and the assumptions of the models. In the case of Biggs Ford, the alternative model without charcoal outlier modelling did *not* have good overall agreement with the assumptions, due to one legacy charcoal date. This might suggest that this sample was collected on old wood, a result also encountered by other researchers using these approaches (e.g., Cook and Comstock, 2014).

Each model was constructed based on an understanding of site occupation sequences drawn from excavation reports or from an assessment of field records (Figure 2). Models used the current archaeological understanding of each site to assess the beginning and end of each occupation. Each site was modelled as a standalone Oxcal 'Phase' where we assume that the dates fit a uniform probability distribution. Only one site in this study is definitively known to have had multiple occupations, Biggs Ford, each of which was modelled separately. Most of the radiocarbon dates in our sample do not clearly come from destruction events or initial construction episodes, which are difficult to identify in this region, so we have assumed that they are distributed throughout the span of human activity on a site. We have also assumed that the available data are representative of the overall occupation of each site.

Results

The chronological models developed for this study generally align with previous interpretations of the Potomac Valley's settlement history, though they also highlight and clarify historical developments that are difficult to confirm with a reliance on phase-based dating. Table 2 summarizes the results of our Bayesian models, recording the settlement chronologies of ten sites (with 11 occupations) in terms of their likely establishment and abandonment dates. Figure 3 visualizes these settlement histories.

As summarized in Table 3, the modelled chronology extends from the eleventh through the seventeenth centuries AD. To recognize historical patterns and construct a legible Potomac Valley narrative, we have labelled sites with continuous, centuries-long occupations as *Persistent Places*. By *Persistent Places*, we mean a location used across the long-term occupation of a region (Schlanger, 1992: 92). In recent years

Table 2. Summary of Bayesian modelled site chronologies. All dates cal AD.

		68.3% Probability		95.4% Probability			
Site Name	Site Number	*Modelled Start Range*	*Modelled End Range*	*Modelled Start Range*	*Modelled End Range*	*Modelled Median Start*	*Modelled Median End*
Nolands Ferry	18FR17	*960–1120*	*1479–1616*	*886–1149*	*1457–1731*	*1018*	*1557*
Rosenstock	18FR18	*1070–1235*	*1450–1535*	*1019–1340*	*1429–1621*	*1162*	*1499*
Biggs Ford I	18FR14	*1213–1286*	*1328–1433*	*1075–1297*	*1298–1535*	*1248*	*1389*
Noah's Ark	44BA15	*1185–1375*	*1293–1427*	*1011–1415*	*1275–1582*	*1261*	*1384*
Potomac Creek	44ST2	*1199–1496*	*1507–1655*	*1114–1589*	*1475–1787*	*1292*	*1599*
Winslow	18MO9	*1311–1410*	*1405–1442*	*1262–1418*	*1332–1505*	*1365*	*1424*
Perkins Point	44BA3	*1310–1444*	*1494–1660*	*1109–1499*	*1458–1838*	*1377*	*1599*
Hughes	18MO1	*1391–1431*	*1469–1504*	*1347–1443*	*1459–1529*	*1408*	*1489*
Moore Village	18AG43	*1391–1457*	*1528–1615*	*1286–1475*	*1507–1726*	*1419*	*1578*
Keyser Farm	44PA1	*1435–1490*	*1500–1628*	*1391–1601*	*1491–1653*	*1462*	*1544*
Biggs Ford II	18FR14	*1406–1556*	*1557–1689*	*1313–1630*	*1526–1810*	*1472*	*1646*

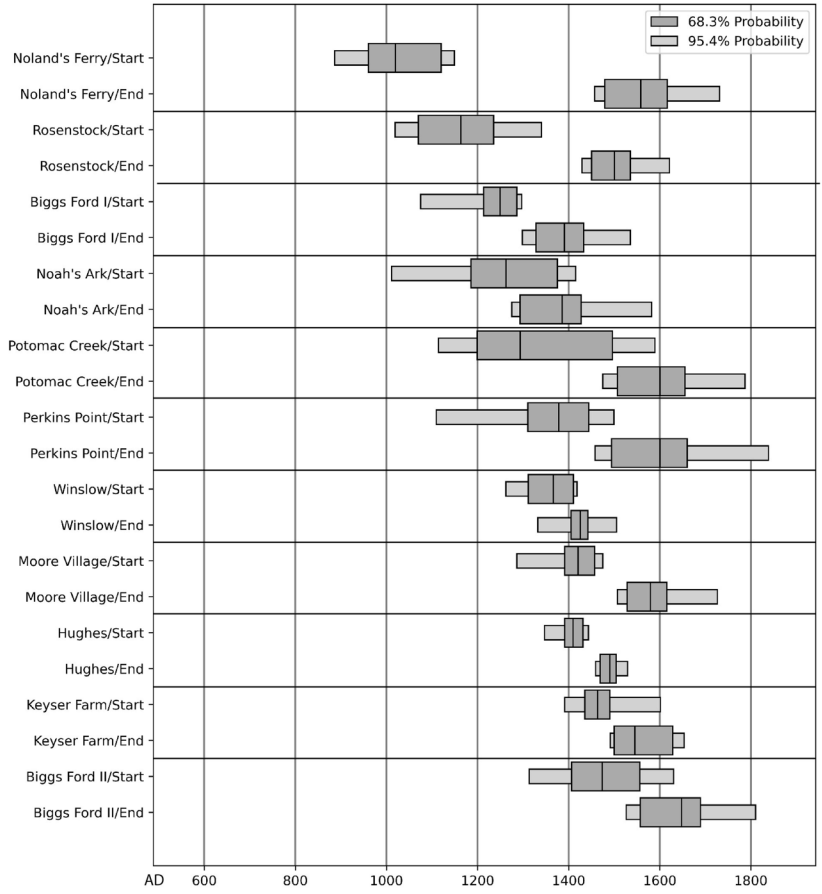

Figure 3. Visualization of the modelled start and end dates for each settlement, with median date (vertical line at the center), 68.3% probability range (dark grey box), and 95.4% probability (light grey box).

researchers have explored the varied ways *Persistent Places* structured Native landscapes and shaped deep histories across various parts of North America (e.g., Maher, 2019; Schneider, 2021; Triplett, 2020). *Persistent Places* in the Potomac Valley include sites linked to the Page, Montgomery, and Potomac Creek cultural traditions. There are indications that Potomac Valley settlements with palisades, burial grounds, and ceremonial structures frequently represented *Persistent Places* that anchored settlement histories over long stretches of time.

We have used the label *Unsettled Settlements* to highlight the interruption and termination of three Montgomery and Page settlements circa AD 1400. The reasons behind the abandonments of Biggs Ford I, Noah's Ark, and Winslow are not clear,

Table 3. Sites included in this study with modelled median start and end dates, occupation span, and associated settlement type based on our settlement classifications. All dates cal AD.

Site Name	Site Number	Complex	Palisade	*Modelled Median Start*	*Modelled Median End*	*Modelled Median Span*	Settlement Type	Citations
Nolands Ferry	18FR17	Page	No	*1018*	*1557*	*539*	Persistent place	Peck 1980
Rosenstock	18FR18	Montgomery	Possible	*1162*	*1499*	*339*	Persistent place	Curry and Kavanagh 2004
Biggs Ford I	18FR14	Montgomery	No	*1248*	*1389*	*152*	Unsettled settlement	Hall 2021; Peixotto 2021; Dent 2021
Noah's Ark	44BA15	Page	No	*1261*	*1384*	*112*	Unsettled settlement	Geier and Warren 1982
Potomac Creek	44ST2	Potomac Creek	Yes	*1292*	*1599*	*295*	Persistent place	Blanton et al. 1998
Winslow	18MO9	Montgomery	Yes	*1365*	*1424*	*57*	Unsettled settlement	Dent 2007; Slattery and Woodward 1992
Perkins Point	44BA3	Page	Yes	*1377*	*1599*	*234*	Persistent place	Whyte and Geier 1982
Hughes	18MO1	Luray	Yes	*1408*	*1489*	*83*	Transitory town	Jirikowic 1999
Moore Village	18AG43	Luray	Yes	*1419*	*1578*	*167*	Transitory town	Pousson 1983
Keyser Farm	44PA1	Luray	Likely	*1462*	*1544*	*85*	Transitory town	Manson et al. 1944
Biggs Ford II	18FR14	Luray	Yes	*1472*	*1646*	*158*	Transitory town	Hall 2021; Peixotto 2021; Dent 2021

though the timing coincides with the arrival of Luray Complex people in the region. The *Unsettled Settlement* category aims to highlight these developments in the Potomac Valley.

Finally, *Transitory Towns* were occupied briefly and only once. The four *Transitory Towns* in our sample are all Luray settlements that were palisaded or likely palisaded. Based on the modeled occupation spans, we suspect that these settlements were occupied for less than a century. Biggs Ford II has a longer modelled median occupation span of 158 years, and Moore Village's median occupation span was 167 years. Our reliance on legacy radiocarbon dates with large error factors may have resulted in modelled occupation spans at Biggs Ford II and Moore Village that are longer than the actual lengths.

The refined understanding of site chronologies generated by our models (Figure 3) suggests that communities labelled as Page, Mason Island, Radford, or the Intermontane Culture were present in the Potomac Valley from at least the eleventh century through the fifteenth century, well before the arrival of Luray peoples. The earliest site is Nolands Ferry, an unpalisaded *Persistent Place* that witnessed multiple cycles of occupation. The palisaded Perkins Point site near the James and Shenandoah rivers' headwaters is a later site, established circa AD 1380, roughly contemporaneous with the arrival of Luray peoples in the Potomac Valley.

Montgomery settlements included in this study indicate that these communities occupied the Potomac Valley by at least the twelfth century AD. Rosenstock represented the earliest of these settlements, followed by Biggs Ford I within a century. A *Persistent Place* inhabited for at least three centuries, Rosenstock included burial grounds and two semi-subterranean "keyhole" structures that may be the remains of sweat lodges (Curry and Kavanagh, 2004). We have labelled Biggs Ford I and Winslow as *Unsettled Settlements* to highlight their abandonment during the arrival of Luray Complex settlements.

A fourteenth century transition from unpalisaded to palisaded settlements is also clear in the Potomac Valley, with the immigrant Potomac Creek community constructing the earliest stockaded community in our sample. Potomac Creek was clearly a *Persistent Place* and remains so today for the Patawomeck Tribe. As noted above, Potomac Creek and the similar Accokeek Creek site likely represent migrations into the Lower Potomac from other areas (Potter, 1993: 126–138). The original homeland of these groups is unclear, though possibilities include the Middle Potomac, Susquehanna Valley, and Eastern Shore. Some of Potomac Creek's residents may have included groups that moved downriver from Montgomery Complex settlements in the Middle Potomac (Dent and Jirikowic, 2001). With a complicated series of concentric palisade walls and bastions, Potomac Creek exhibited a strong defensive orientation early in its history before later becoming a ceremonial center with several ossuaries and a charnel house (Blanton et al., 1998: 90–98).

Upstream of the Potomac Creek site, the late fourteenth century proliferation of palisaded towns coincided with one of the major developments in the region's eventful history. The modelled chronology clarifies the timeline for Luray population movements

into the Potomac Valley inferred by previous researchers (e.g., Jirikowic, 1995; 1999: 143). Groups using shell-tempered, cord marked ceramics migrated into the Potomac Valley circa AD 1400. The palisaded Hughes Site, established circa AD 1410, represents the earliest Luray settlement in our sample. At approximately the same time, communities across the area constructed palisaded towns. The temporal overlap and geographic proximity of Hughes and the Winslow site (a palisaded Montgomery settlement) suggests that the Middle Potomac was still occupied by Montgomery communities when Luray people arrived. The palisaded Perkins Point site was established circa AD 1380, roughly contemporaneous with the arrival of Luray peoples in the Potomac Valley. The site was located on a James River tributary and is about 70 kilometers (44 miles) southwest of the headwaters of the Potomac River system. Perkins Point's ceramic assemblage included predominantly limestone-tempered ceramics like those of the Page Complex, though shell-tempered Keyser wares tied to the Luray Complex comprised 25% of the total assemblage (Whyte and Geier, 1982: 151). The presence of a significant proportion of shell-tempered Keyser ceramics at Perkins Point signals inter-community exchanges, rather than complete geographic and social separation, even with the establishment of palisaded towns.

Following the arrival of Luray populations in the Potomac Valley, the chronology highlights the abandonment of sites we have classified as *Unsettled Settlements*, including Biggs Ford I, Noah's Ark, and Winslow. After a period of overlapping occupations and interaction, the community at Winslow evidently exhumed their dead and left the site (Dent, 2007: 57). In fact, the only Page and Montgomery settlement in our sample with a termination as late as the seventeenth century, as measured by median modelled dates, was Perkins Point, highlighting the volatile history of this area after the arrival of Luray peoples.

Discussion

The modeled settlement histories allow for several new interpretations related to this eventful history. First, in alignment with Jirikowic's (1999: 143) interpretation of Luray settlement history, our models suggest that the community that established the Hughes site in the eastern Piedmont shifted westward toward the Shenandoah Valley during the latter half of the fifteenth century. The settlement of Keyser Farm circa AD 1460 offers support for this interpretation by highlighting the establishment of a Luray town in the Upper Potomac during the same interval when the Hughes site was abandoned. Our models suggest that the Keyser Farm site was occupied briefly and as much as a century earlier than some previous interpretations suggested (Means and McKnight, 2009; Manson et al., 1944). According to our models, the Luray occupation at Keyser Farm began circa AD 1430–1490 and likely ended during the sixteenth century, with termination falling between AD 1500–1630 at the one-sigma confidence interval. The modelled median estimates for the start and end of Keyser Farm suggest the site was likely occupied circa AD 1460 to 1550.

Second, the modelled chronology offers evidence that deerskin trading centered on Luray settlements had a deep precolonial history in the Potomac Valley. Other scholars

(Barber, 2020, 2022; Nash, 2022) have noted this previously, and the Bayesian models developed here offer additional supportive evidence regarding the chronology. In an innovative and persuasive study, Barber (2020, 2022) noted that Keyser Farm's archaeological record includes evidence of intensive processing of deerskins for exchange, including beaming tools and non-local exchange goods (e.g., shell beads and Potomac Creek ceramics). In this reading, the Keyser Farm community exchanged deerskins and shell beads with chiefly communities as far east as the Coastal Plain. Native communities in the region also hunted deer to obtain hides for trade during the 1600s as a response to European colonial market demand (Lapham, 2005). The trade in deerskins no doubt produced shifts in exchange networks, political alliances, and gender relations, and clarifying its chronology is important. The modelled dates produced for this study suggest that intensive deerskin harvesting and trade with Tidewater communities developed during the late precolonial centuries. Keyser Farm's occupation predated direct European colonization of the Shenandoah Valley by as much as a century. The Hughes site, which also contained many bone tools used to process deerskins, was occupied even earlier, at the turn of the 1400s.

Third, our models confirm previous interpretations (e.g., Jirikowic, 1999: 125–129) that Keyser communities were often short-lived. The Hughes site model indicates an occupation of roughly 80 years, or about three generations, and the Keyser Farm site was likely occupied for about 90 years. The Luray occupations at Biggs Ford and Moore Village may have each been somewhat longer at about 160 years each. The Biggs Ford II model strays into an uncertain area of the radiocarbon curve that makes estimating the end of occupation difficult, though the presence of European artifacts suggests termination sometime in the early colonial period. These relatively short-lived occupations, which we have labelled *Transitory Towns*, highlight the unsettled social environment in which Luray Complex communities found themselves. These communities evidently had an orientation to movement and migration that differed from that of the Montgomery and Page complexes, who often inhabited *Persistent Places*. In contrast, Luray sites in the Potomac Valley highlight a people on the move. As other scholars have suggested (Barber, 2022; Jirikowic, 1999), Keyser Farm may have been founded by migrants from Hughes based on the two settlements' chronological alignment and shared focus on deerskin trading.

Finally, there are indications that two sites in our sample may have represented *coalescent communities* based on the blending of ceramics from distinct communities of practice. Occupied circa AD 1460–1540, the Keyser Farm site is the most prominent of these. The site represents a Luray settlement, and shell-tempered Keyser ceramics were accompanied by Potomac Creek and Page pottery in the same feature contexts. Highlighting the diverse ceramic assemblage and blended surface treatment practices, Johnson (2018: 96) suggested that Keyser Farm may have absorbed refugees from displaced settlements in the region. Where the Keyser Farm site appears to have been a predominantly Luray settlement containing ceramics from other traditions, Perkins Point may represent the inverse. Occupied at the same time as Keyser Farm, Perkins Point's features contained predominantly limestone-tempered ceramics

assigned by the excavators to the Page and Radford traditions. The site also contained a significant proportion of shell-tempered ceramics linked to the Luray Complex in the same feature contexts (Whyte and Geier, 1982: 149–156).

Conclusion

Bayesian modelling of settlements in the Potomac Valley offers a timeline for a borderland landscape in which distinct groups encountered one another regularly, where communities from different social networks occupied the same areas, and where little distance separated settlements tied to different traditions. The refined chronology afforded by these methods points toward a settlement history of locations we have labelled *Persistent Places*, *Unsettled Settlements*, and *Transitory Towns.* The refined chronology and settlement model can serve as the basis for a more eventful history of the Potomac Valley borderland between AD 1200 and 1600. With a regional framework in place, additional studies that trace the detailed histories of settlements are now possible, ideally aided by additional radiocarbon dating and refined modelling of settlement histories tied to detailed contextual analysis.

Drawing from these chronological models and from previous overviews of the region's culture history (e.g., Potter, 1993; Dent, 1995), an overarching narrative of the Middle and Upper Potomac begins to come into view. Communities classified as Page and Montgomery resided in the region from at least AD 1150, cycling between settlements inhabited for centuries. Palisaded settlements first appeared in the Potomac Valley as early as AD 1300 at Potomac Creek. Circa AD 1400, palisaded settlements became more prevalent across the valley, a development that may be tied to the arrival of outsiders. The advent of Luray peoples in the region at this time was accompanied by the abandonment of several Montgomery and Page settlements (i.e., *Unsettled Settlements*) and new economic practices centered on the deerskin trade. During the 1400s, Luray communities in the Potomac Valley were mostly short-lived *Transitory Towns*. Unlike neighboring communities tied to the Montgomery and Page complexes, people associated with the Luray complex rarely constructed *Persistent Places* in the Potomac Valley. A socially diverse Potomac Valley persisted across these developments, with settlements from several cultural traditions occupying the same areas, interacting regularly until at least AD 1500. In this setting, there are indications that people from distinct social traditions lived together and blended material practices in the same coalescent communities (Johnson, 2018). However, by AD 1600 our models suggest that most, if not all, of the sites in our sample were no longer occupied. The colonial era ushered in a different social landscape in the area marked by the arrival of new immigrant communities from outside the valley (Wall and Lapham, 2003).

Bayesian modelling of radiocarbon assays represents a methodological development that opens new interpretive possibilities in the Middle Atlantic region and beyond. These methods bring a related set of sites into conversation through a shared timeline, providing an opening for an eventful history of the precolonial era. Modelled chronologies also

highlight historical patterns and social changes that are otherwise difficult to recognize. As a result, new narratives of key historical processes become more legible.

These methods are not always easy to employ. Bayesian modelling requires 'priors' drawn from careful excavation, detailed reporting, and conscientious curation of datable samples. For this study, we stand on the shoulders of archaeologists who worked in the Potomac Valley previously as well as the talented staffs at Maryland and Virginia's state historic preservation offices today. Bayesian chronology construction requires time consuming efforts to understand excavation records from complex sites, including those investigated decades ago. Legacy radiocarbon dates can also be problematic. Frequent reliance on charcoal samples rather than short-lived specimens, the long error factors from the instrumentation used by laboratories in the past, and sampling strategies keyed to research questions different from our own all pose challenges.

Acknowledging these challenges, we see great promise in more studies like this one in the Middle Atlantic. The region has produced a considerable body of archaeological research that lends itself to archaeology's historic turn along with a rich dataset of radiocarbon assays, as the newly released national radiocarbon database attest (Kelly et al., 2022). Most field research in the Middle Atlantic today is conducted under the auspices of cultural resource management. We are hopeful that these studies include robust funding for multiple radiocarbon assays drawn from short-lived specimens and clearly defined contexts. Combining new dates with those produced previously will open the way toward constructing historical narratives of the Native past in the region.

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Supplemental material

Supplemental material for this article is available online.

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