# Radiocarbon Dating the Iroquoian Occupation of Northern New York

Timothy J. Abel, Jessica L. Vavrasek, and John P. Hart

*The results of Bayesian analysis using 43 new high-precision AMS radiocarbon dates on maize, faunal remains, and ceramic residues from 18 precontact Iroquoian village sites in Northern New York are presented. Once thought to span AD 1350–1500, the period of occupation suggested by the modeling is approximately AD 1450–1510. This late placement now makes clear that Iroquoians arrived in the region approximately 100 years later than previously thought. This result halves the time in which population growth and significant changes in settlement occurred. The new chronology allows us to better match these events within a broader Northeast temporal framework.*

**Keywords**: radiocarbon dating, Late Woodland archaeology, Northeastern North American archaeology, Iroquoian archaeology

*Nous présentons les résultats d'une analyse bayésienne de 43 nouvelles datations radiocarbone de haute précision effectuées sur du maïs, des restes fauniques et des résidus carbonisés adhérant à des tessons de poterie. Ces datations proviennent de 18 sites villageois iroquoiens situés dans le nord de l'État de New York. Ces sites étaient présumés dater de la période allant de 1350–1500 de notre ère, mais la modélisation suggère plutôt une période d'occupation entre 1450–1510. Ces datations tardives confirment que les Iroquoiens sont arrivés dans la région en question cent ans plus tard que proposé auparavant par les archéologues. Ce résultat réduit de la moitié le temps que nous pouvons allouer à des processus comme l'augmentation démographique ou les changements dans le schème d'établissement. La nouvelle chronologie nous permet ainsi de mieux harmoniser ces évènements dans le contexte plus large de la chronologie du Nord-Est.*

**Mots clés**: datation au radiocarbone, archéologie du Sylvicole supérieur, archéologie du Nord-Est de l'Amérique du Nord, archéologie iroquoienne

In the fifteenth and sixteenth centuries AD, Northern New York south and east of the St. Lawrence River headwaters was home to six clusters of Iroquoian village and related settlement sites (Figure 1). This concentration of sites has been variously recognized by the terms St. Lawrence Iroquoians (Pendergast 1991, 1993a; Pratt 1991; Tuck 1971), Jefferson County Iroquoians (Engelbrecht et al. 1990), or Northern New York Iroquoians (Abel 2001). Who these people were, where they originated, and where they went are topics that have perplexed archaeologists for over 150 years. For much of that time, these sites were known only through a handful of excavations and site reports. Only a few components in the region had been radiocarbon dated (Pendergast 1993b, 1996). The bulk of our knowledge, by far, came from scattered museum collections made by early antiquarians and collectors.

Over the last 30 years, the Iroquoian occupations of Northern New York have received a

**Timothy J. Abel** ■ Consulting Archaeologist, 33512 SR 26, Carthage, NY 13619 USA (tabel@twcny.rr.com, corresponding author) https://orcid.org/0000-0003-0399-8120
**Jessica L. Vavrasek** ■ Department of Anthropology, University at Albany, Research and Collections Division, New York State Museum, 3140 Cultural Education Center, Albany, NY 12230 USA (jvavrasek@albany.edu)
**John P. Hart** ■ Research and Collections Division, New York State Museum, 3140 Cultural Education Center, Albany, NY 12230 USA (john.hart@nysed.gov) https://orcid.org/0000-0003-2009-0624



doi:10.1017/aaq.2019.50

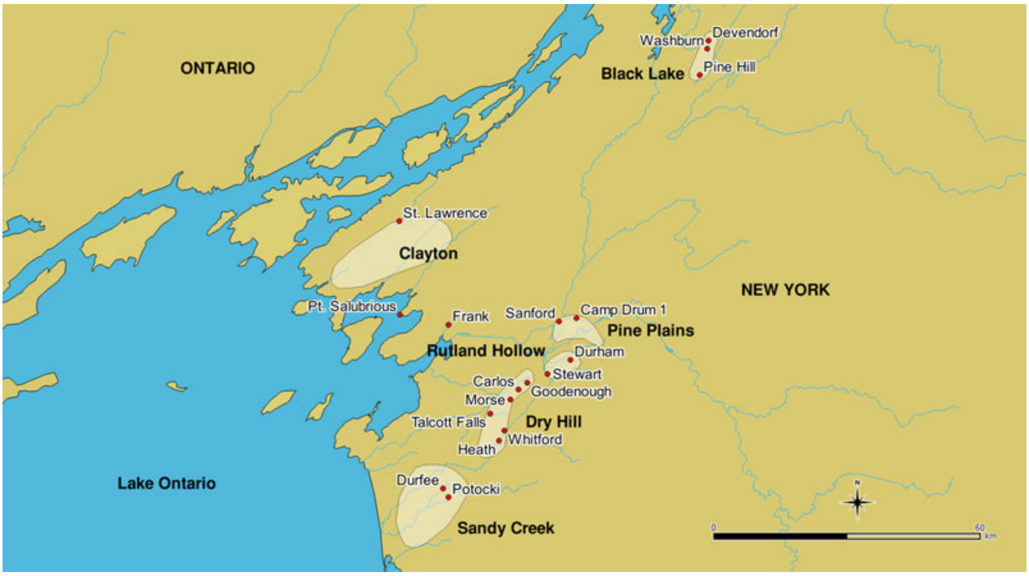


**Figure 1. Map with the locations of Northern New York geographical site clusters and sites from which radiocarbon dates were obtained for this study.**

renewed research focus. Reanalyses of older data (Engelbrecht 1995, 2004; Engelbrecht et al. 1990), in conjunction with the publication of new excavations and analyses (Abel 2001, 2015, 2016; Baron et al. 2016; Dermarkar et al. 2016; Engelbrecht and Jamieson 2016a, 2016b; Hart et al. 2017; Hart, Winchell-Sweeney, and Birch 2019; Jones et al. 2018; Vavrasek 2010; Wonderley 2005), have greatly increased our understanding of this once-enigmatic region and period (Abel 2019a). As a result of this research, it is apparent that the region and its inhabitants played a far more integral role in the broader social, economic, and political fabric of greater Iroquoia than had been previously acknowledged. Their dispersal in the early sixteenth century AD may have played a role in the development of the Haudenosaunee (Iroquois) and Wendat (Huron) confederacies (Abel 2001; Engelbrecht 1995; Hart, Winchell-Sweeney, and Birch 2019).

A paucity of high-precision radiocarbon dates has prevented a firm chronological understanding of this region's Iroquoian occupations. Interregional seriations of pottery have suggested an occupation span of AD 1350–1520 (Abel 2001; Engelbrecht 1995). Here we use a large series of recently obtained, high-precision accelerator mass spectrometry (AMS) radiocarbon dates to establish a refined chronological framework for the occupation. We do this through Bayesian modeling of 43 radiocarbon dates from 18 sites. The resulting models shorten the occupational span and place the start of the occupation approximately 100 years later than earlier seriation-based estimates.

## Iroquoian Settlements in Northern New York

There are more than 65 known Iroquoian village and related sites in Jefferson and St. Lawrence Counties, New York. Six site clusters have been identified in the region, including Sandy Creek (aka Ellisburg), Dry Hill, Rutland Hollow (aka Rutland Hill), Pine Plains, Clayton, and Black Lake (Abel 2002; Engelbrecht 1995; Pendergast 1993a; Figure 1). There are other likely village sites scattered between Black Lake and St. Regis (Abel 2019a), but their relationship to the identified clusters is uncertain given that no artifact collections exist. The clusters are generally interpreted to represent sequential community relocations through time, although the relationship and boundaries between the clusters are in some cases uncertain. Until recently, the sequences of sites in each cluster has been estimated based on ceramic attribute frequency seriation.

The Iroquoians of Northern New York shared many traits with neighboring Iroquoian communities across Ontario, Quebec, and New York. They lived in palisaded villages characterized by multifamily longhouses, which averaged approximately 7 m wide and up to 30 m long (Louis Berger Associates 1994). Each village is thought to have contained three to five longhouses, housing an estimated 150 to 250 people, although some villages likely contained upward of a dozen or more longhouses. Subsistence studies document that these villages were supported by mixed economies based on agriculture, which were heavily supplemented by hunting, gathering, and fishing. Floral assemblages document the cultivation of maize, beans, squash, sunflower, and tobacco. Many uncultivated species, including bramble, strawberry, Lamb's quarter, sumac, and St. John's wort were also harvested (Fecteau 2013). Faunal assemblages are dominated by deer, but numerous species of mammals, fish, and reptiles are also represented (Abel 2001; Cottrell 1979; Vavrasek 2010).

The ceramic assemblage is dominated by large, globular, grit-tempered jars with high, flaring, collared, and castellated rims. Decoration is mostly confined to the collar, consisting of alternating parallel obliques, and verticals executed in either dentate stamping or incising. Annular punctates, some forming effigy faces, often adorn the castellations. The collar base is often underlined with one or several horizontal lines, over which large tool impressions are executed at the collar base. The lips are often decorated with interior and exterior ticks or punctates (Engelbrecht 1995). Also prominent is a ceramic pipe assemblage consisting of elbow forms with elaborate collared, ring, or effigy bowls (Wonderley 2005). The lithic assemblage is dominated mostly by expedient flakes and ground stone tools. There are few chipped stone tools (Engelbrecht and Jamieson 2016a, 2016b). The lack of a stone tool assemblage seems mitigated by a rich bone assemblage made up of projectile points, awls, drills, punches, rasps, combs, and needles (Abel 2001, 2002; Gates St-Pierre 2001, 2010, 2015; Jamieson 2016; Louis Berger Associates 1994; Vavrasek 2010). Rolled native copper beads have been found at the Morse (A04520.000053; Dry Hill Cluster) and Burrville (A04520.000016; Rutland Hollow Cluster) sites (Abel et al. 2019). No artifacts of verifiable European origin have been found in good contexts on any of the sites.

Perhaps the most intriguing aspect of all St. Lawrence Iroquoian research—and the one that has received the most attention over the last century—is the dispersal of populations from the St. Lawrence Valley between 1520 and 1603 (Jamieson 1990b; Pendergast 1993a). Warfare, climate change, and European contact have all been proposed as potential causes of their disappearance (Jamieson 1990a). Pendergast (1991, 1993a) showed that significant population relocations, especially in Jefferson County, had occurred well before European presence in the region. Research has since focused on aspects of demography, warfare, and climate change to explain the St. Lawrence Iroquoian diaspora (Abel 2002; Chapdelaine 2004; Engelbrecht 1995; Jamieson 1990a).

## Building a Chronology for Northern New York Iroquoians

Across northeastern North America, late prehistoric chronology-building has, until recently, relied primarily on comparisons of material culture and culture historical systematics. In the early twentieth century, the Iroquoian occupations of Northern New York were thought to be ancestral to the historical Onondaga in the Finger Lakes area to the south. In fact, these occupations were often referred to as "Onondaga-Oneida" (Harrington 1922; Skinner 1921). This view influenced MacNeish's (1952) seriation of four Jefferson County sites into his Onondaga-Oneida ceramic sequence. Tuck's (1971) suggestion of an in situ origin for the Onondaga and Oneida in central New York challenged the idea of Jefferson County to Onondaga-Oneida continuity. Subsequently, the region was regarded as a branch of Iroquoian developments farther down the St. Lawrence Valley (Pendergast 1991, 1993a; Pratt 1991; Tuck 1971).

The practices of framing the Iroquoians of Northern New York as part of external cultural units was in large part due to a lack of published information and detailed analyses. Until recently, only a handful of sites had been excavated, and even fewer of these had published reports (e.g., Harrington 1922; Sidler 1971). Few detailed assemblage analyses existed (MacNeish 1952; Sidler 1971). There were no syntheses of data that made an independent evaluation possible. The only accessible databases were the collections of professional and avocational archaeologists that resided in museums across the Northeast (Engelbrecht et al. 1990).

Engelbrecht (1995) developed a ceramic seriation based on 24 site assemblages within four proposed clusters based on comparisons to central New York Iroquoian ceramic sequences. A later expanded analysis by Abel (2001) compared Jefferson County ceramics to assemblages in St. Lawrence County, New York, as well as Prince Edward and Leeds and Grenville Counties, Ontario (Figure 1). Engelbrecht's ceramic seriation suggested that the Sandy Creek, Dry Hill, and Rutland Hollow Clusters represented nearly complete early-to-late village sequences. He suggested that the Clayton Cluster was a late village sequence. Abel's seriation suggested that the Black Lake Cluster represents early-sequence components. Englebrecht did not assign dates to these sequences. Citing the lack of European trade goods, however, he suggested an early sixteenth-century AD end to the sequence. Abel (2001, 2002) suggested the sequence spanned from approximately AD 1350–1500 based on ceramic seriation. Throughout the interior Northeast, the earliest European trade goods are believed to be metal objects present on sites dating from the 1520s (Birch and Williamson 2013; Bradley 1987; Noble 1971; Williamson et al. 2016). However, this date has been recently challenged based on AMS redating of some of those early contact-period sites (Manning et al. 2018).

The first conventional radiocarbon dates for the region were run on bulk charcoal samples from the Potocki site (A04508.000093) in the Sandy Creek Cluster. Marian White obtained two dates that, when calibrated, span the fourteenth to fifteenth centuries AD (Supplemental Table 1; Pendergast 1993b, 1996). Much later, Louis Berger Associates (1994) obtained three bulk charcoal dates from the Camp Drum 1 site (A04511.000337) in the Rutland Hollow Cluster. One late fifteenth-century calibrated date was obtained while the other two returned questionable seventeenth-century dates. Excavations at the Clayton Cluster St. Lawrence site (A04505.000223/A04547.000041) by the Thousand Islands Chapter of the New York State Archaeological Association resulted in the recovery of bulk maize that produced a late fifteenth-century calibrated date (Abel 2001).

These dates had little impact on chronological models of the region. As broader analyses have shown, the radiocarbon dates from the St. Lawrence Valley made little sense (Chapdelaine 2004; Pendergast 1993b, 1996; Timmins 1985). Some dates are clearly too old—perhaps attributable to the "old wood" problem. Others, such as two from Camp Drum 1, were clearly too recent—a problem attributed to association error. The large error terms prevalent in the conventional assays, which were more than 50 years in most cases, caused dates to overlap considerably. Multiple dates from single components can span more than a century, and they are of little help in determining when a site was occupied, much less in constructing chronologies.

AMS dating requires much smaller samples—ones that could be derived directly from carbonized cooking residues adhering to pottery sherds, small carbonized twigs or outer rings, or single seeds, for instance. This advancement potentially solved both the problems of old wood *and* association. Here, we use 43 high-precision radiocarbon dates on samples of maize, animal bone, and charred cooking residues from 18 Iroquoian sites in Northern New York (Table 1 and Supplemental Table 1). The dated sites are distributed in all six of the geographical clusters, and they include the three previously dated sites (Potocki, Camp Drum 1, and St. Lawrence). The Dry Hill Cluster is the most completely represented, with six of the nine village components dated. The Black Lake Cluster is also well represented, with three of five components dated. For the remaining clusters, only one or two components in each could be dated. Based on ceramic seriation, the dated components span the regional Iroquoian period of occupation. The maize samples were derived from sealed feature and midden contexts. Animal bone and ceramic residue samples were derived from museum site collections, generally

Table 1. Summary of All Radiocarbon Dates Available from Northern New York Iroquoian Sites.

| Site | Material | Lab No. | $\delta^{13}C$ | $^{14}C$ Age (BP) | Cal. 2σ (AD) (IntCal13) | Used in Modeling? | Reference |
|---|---|---|---|---|---|---|---|
| **Sandy Creek Cluster** | | | | | | | |
| Potocki | bulk charcoal | GX-2213 | not reported | 475 ± 95 | 1298–1371 (.18) 1378–1637 (.82) | No | Pendergast 1993b:4 |
| Potocki | bulk charcoal | GX-2214 | not reported | 390 ± 95 | 1318–1351 (.02) 1390–1674 (.96) 1778–1799 (.02) 1942–1949 (.00) | No | Pendergast 1993b:4 |
| Potocki | maize kernel | UGAMS-30327 | −9.3 | 360 ± 25 | 1452–1527 (.50) 1553–1633 (.50) | Yes | This study |
| Potocki | maize kernel | UGAMS-30326 | −8.7 | 310 ± 25 | 1491–1602 (.77) 1614–1647 (.23) | Yes | This study |
| Potocki | maize kernel | UCIAMS-205969 | −9.6 | 370 ± 15 | 1452–1521 (.70) 1577–1583 (.01) 1591–1620 (.29) | Yes | This study |
| Potocki | maize kernel | UCIAMS-205970 | −9.3 | 365 ± 15 | 1455–1521 (.65) 1575–1585 (.03) 1590–1623 (.32) | Yes | This study |
| Durfee | maize kernel | UGAMS-31485 | −10.15 | 315 ± 20 | 1494–1509 (.04) 1511–1601 (.74) 1616–1644 (.21) | Yes | This study |
| Durfee | maize kernel | UGAMS-31486 | −10.11 | 335 ± 20 | 1484–1637 (1) | Yes | This study |
| Durfee | maize kernel | UCIAMS-205978 | −9 | 345 ± 15 | 1472–1527 (.40) 1554–1633 (.60) | Yes | This study |
| Durfee | unarticulated dog bone fragment | UCIAMS-199804 | −9.7 | 460 ± 15 | 1426–1449 (1) | No | This study |
| **Dry Hill Cluster** | | | | | | | |
| Goodenough | unarticulated deer longbone fragment | UCIAMS-204719 | −23.2 | 410 ± 25 | 1436–1512 (.93) 1601–1616 (.07) | Yes | This study |
| Morse | unarticulated dog bone fragment | UCIAMS-199803 | −12.1 | 510 ± 20 | 1406–1439 (1) | No | This study |
| Morse | unarticulated deer bone fragment | UCIAMS-199806 | −22.3 | 410 ± 15 | 1442–1483 (1) | Yes | This study |
| Morse | unarticulated deer skull bone fragment | UCIAMS-204718 | −21 | 420 ± 25 | 1430–1495 (.96) 1602–1614 (.04) | Yes | This study |
| Morse | maize kernel | UCIAMS-205977 | −8.8 | 345 ± 20 | 1469–1529 (.39) 1543–1634 (.61) | Yes | This study |
| Morse | maize kernel | UGAMS-37383 | −10.24 | 315 ± 20 | 1494–1509 (.04) 1511–1601 (.74) 1616–1644 (.21) | Yes | This study |
| Carlos | maize kernel | UGAMS-37382 | −9.06 | 365 ± 20 | 1453–1523 (.6) 1559–1563 (0) 1570–1631 (.39) | Yes | This study |
| Heath | maize kernel | UGAMS-34187 | −10.14 | 340 ± 20 | 1474–1531 (.35) 1538–1635 (.65) | Yes | This study |
| Heath | maize kernel | UGAMS-34188 | −10.13 | 320 ± 20 | 1492–1602 (.79) 1614–1643 (.21) | Yes | This study |
| Heath | maize kernel | UCIAMS-205979 | −9.7 | 365 ± 15 | 1455–1521 (.65) 1575–1585 (.03) 1590–1623 (.32) | Yes | This study |
| Talcott Falls | maize kernel | UGAMS-34445 | −8.83 | 320 ± 20 | 1492–1602 (.79) 1614–1643 (.21) | Yes | This study |
| Talcott Falls | maize kernel | UGAMS-34446 | −9.55 | 315 ± 20 | 1494–1509 (.04) 1511–1601 (.74) 1616–1644 (.21) | Yes | This study |
| Talcott Falls | maize kernel | UCIAMS-207138 | −8.6 | 415 ± 15 | 1440–1479 (1) | Yes | This study |
| Talcott Falls | maize kernel | UCIAMS-205976 | | 345 ± 50 | 1453–1643 (1) | Yes | This study |

Table 1. Continued.

| Site | Material | Lab No. | $\delta^{13}C$ | $^{14}C$ Age (BP) | Cal. 2σ (AD) (IntCal13) | Used in Modeling? | Reference |
|---|---|---|---|---|---|---|---|
| Whitford | maize kernel | UGAMS-30328 | −9.3 | 310 ± 25 | 1491–1602 (.77). 1614–1647 (.23) | Yes | This study |
| Whitford | maize kernel | UGAMS-30931 | −9.55 | 310 ± 20 | 1496–1506 (.03) 1512–1601 (.74) 1616–1646 (.23) | Yes | This study |
| Whitford | maize kernel | UCIAMS-205972 | −8.6 | 335 ± 20 | 1484–1637 (1) | Yes | This study |
| Whitford | maize kernel | UCIAMS-205973 | −8.8 | 355 ± 20 | 1459–1526 (.49) 1555–1632 (.51) | Yes | This study |
| Whitford | charcoal | UGAMS-30329 | −27.5 | modern | modern | No | This study |
| **Rutland Hollow Cluster** | | | | | | | |
| Durham | maize kernel | UGAMS-30325 | −8.7 | 350 ± 25 | 1460–1529 (.44) 1541–1635 (.56) | Yes | This study |
| Durham | maize kernel | UGAMS-30324 | −9.9 | 345 ± 25 | 1467–1532 (.4) 1537–1636 (.60) | Yes | This study |
| Durham | maize kernel | UCIAMS-205971 | −9.8 | 380 ± 15 | 1449–1515 (.81) 1598–1617 (.19) | Yes | This study |
| Stewart | charred cooking residue | UGAMS-37384 | −17.09 | 500 ± 25 | 1406–1444 (1) | Yes | This study |
| **Pine Plains Cluster** | | | | | | | |
| Camp Drum 1 | bulk charcoal | not reported | not reported | 370 ± 60 | 1440–1643 (1) | No | LBA 1994:67 |
| Camp Drum 1 | bulk charcoal | not reported | not reported | 170 ± 80 | 1524–1558 (.03) 1631–1949 (.97) | No | LBA 1994:67 |
| Camp Drum 1 | bulk charcoal | not reported | not reported | 210 ± 60 | 1521–1575 (.07) 1585–1590 (.0) 1625–1892 (.8) 1907–1949 (.13) | No | LBA 1994:67 |
| Camp Drum 1 | maize kernel | UGAMS-30323 | −10.13 | 380 ± 25 | 1446–1523 (.70) 1572–1630 (.30) | Yes | This study |
| Camp Drum 1 | maize kernel | UGAMS-30322 | −9.3 | 350 ± 25 | 1460–1529 (.44) 1541–1635 (.56) | Yes | This study |
| Sanford Corners | maize kernel | UGAMS-26745 | −8.7 | 390 ± 20 | 1445–1516 (.85) 1596–1617 (.15) | Yes | This study |
| Sanford Corners | maize kernel | UGAMS-26744 | −8.7 | 360 ± 20 | 1456–1524 (.54) 1558–1631 (.46) | Yes | This study |
| Sanford Corners | maize kernel | UCIAMS-205974 | −9.7 | 410 ± 20 | 1438–1493 (.97) 1603–1611 (.03) | Yes | This study |
| Sanford Corners | maize kernel | UCIAMS-205975 | −9.4 | 360 ± 15 | 1459–1523 (.58) 1572–1630 (.42) | Yes | This study |
| **No Cluster** | | | | | | | |
| Point Salubrious | unarticulated deer bone fragment | UCIAMS-199805 | −22.3 | 405 ± 15 | 1443–1488 (.99) | Yes | This study |
| Point Salubrious | unarticulated dog bone fragment | UCIAMS-199807 | −14.7 | 515 ± 15 | 1408–1434 (1) | No | This study |
| Frank | unarticulated dog bone fragment | UCIAMS-199798 | −14.3 | 535 ± 20 | 1326–1343 (.10) 1394–1433 (.90) | No | This study |
| Frank | unarticulated dog bone fragment | UCIAMS-199801 | −13.2 | 580 ± 15 | 1314–1357 (.68) 1388–1409 (.32) | No | This study |
| Frank | unarticulated deer bone fragment | UCIAMS-199802 | .22.9 | 410 ± 15 | 1442–1483 (1) | Yes | This study |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Clayton Cluster** | | | | | | | |
| St. Lawrence | bulk maize | Beta-148524 | −9.8 | 400 ± 50 | 1429–1529 (.63) 1541–1635 (.37) | Yes | Abel 2001:70 |
| St. Lawrence | maize kernel | UGAMS-26743 | −8.9 | 400 ± 20 | 1442–1500 (.90) 1504–1511 (.02) 1601–1616 (.08) | Yes | This study |
| St. Lawrence | maize kernel | UGAMS-26742 | −9.9 | 385 ± 20 | 1445–1520 (.81) 1592–1619 (.19) | Yes | This study |
| St. Lawrence | unarticulated deer humerus fragment | UCIAMS-204714 | −22.9 | 485 ± 25 | 1412–1446 (1) | Yes | This study |
| St. Lawrence | unarticulaed dog bone radius | UCIAMS-204715 | −12.1 | 610 ± 25 | 1297–1374 (.77) 1376–1401 (.23) | No | This study |
| St. Lawrence | unarticulated deer longbone fragment | UCIAMS-204716 | −21.5 | 155 ± 25 | 1666–1700 (.17) 1701–1706 (.004) 1719–1784 (.39) 1795–1819 (.11) 1832–1882 (.13) 1914–1949 (.19) | No | This study |
| St. Lawrence | unarticulated dog ulna fragment | UCIAMS-204717 | −14.5 | 705 ± 25 | 1263–1301 (.92) 1368–1381 (.08) | No | This study |
| **Black Lake Cluster** | | | | | | | |
| Pine Hill | unarticulated dog ulna fragment | UCIAMS-204721 | −12.6 | 550 ± 25 | 1317–1354 (.38) 1389–1429 (.62) | No | This study |
| Pine Hill | unarticulated dog bone fragment | UCIAMS-199800 | −10.7 | 490 ± 15 | 1416–1441 (1) | No | This study |
| Pine Hill | maize kernel | UGAMS-37380 | −9.17 | 355 ± 20 | 1459–1526 (.49) 1555–1632 (.51) | Yes | This study |
| Pine Hill | maize kernel | UGAMS-37381 | −8.96 | 390 ± 20 | 1445–1516 (.85) 1596–1617 (.15) | Yes | This study |
| Washburn | unarticulated dog bone fragment | UCIAMS-199799 | −11.5 | 525 ± 15 | 1403–1432 (1) | No | This study |
| Washburn | unarticulated deer longbone fragment | UCIAMS-204722 | −22 | 415 ± 25 | 1433–1499 (.93) 1505–1511 (.01) 1601–1616 (.06) | Yes | This study |
| Devendorf | unarticulated deer longbone fragment | UCIAMS-204720 | −22.8 | 445 ± 25 | 1421–1471 (1) | Yes | This study |

with only site-level provenance. Details for all samples, including those not used in the modeling, are presented in Supplemental Table 1.

## Methods

Samples were assayed at the University of Georgia Center for Applied Isotope Studies (CAIS) or the W. M. Keck Carbon Cycle Accelerator Mass Spectrometry Laboratory of the University of California, Irvine (KCCAMS). All bone samples were assayed at KCCAMS, where they were decalcified in 0.5N HCl, gelatinized at 60°C and pH 2, and ultrafiltered to select a high molecular weight fraction (>30kDa; Beaumont et al. 2010). $\delta^{15}N$ was measured to a precision of <0.2‰ and $\delta^{13}C < 0.1$‰ on ultrafiltered collagen aliquots at KCCAMS. Maize samples were subjected to standard acid-base-acid pretreatments prior to combustion at both facilities. Pretreated maize sample $\delta^{13}C$ values were measured at KCCAMS and CAIS to a precision of <0.1‰ relative to standards traceable to PDB. All dates are corrected for isotopic fractionation and reported according to standards established by Stuiver and Polach (1977). More details on each facility's protocols can be found on their websites.

The Iroquoian occupation of the Northern New York is now represented by 61 radiocarbon assays (Table 1 and Supplemental Table 1). For modeling purposes, we eliminated the ages obtained on dog (*Canis lupus* ssp. *familiaris*) bone, which appear to have offsets relative to ages on maize (*Zea mays* ssp. *mays*) and/or white-tailed deer (*Odocoileus virginianus*) from the same sites (Hart, Feranec et al. 2019). We also eliminated an erroneous date on white-tailed deer bone from the St. Lawrence site (UCIAMS-204716), bulk sample dates as discussed above, and a modern determination from Whitford (UGAMS-30329). Also, one age from Talcott Falls (UCIAMS-205976) on a partial maize kernel was not included. This sample consisted mainly of humates, producing a very small post-pretreatment amount of carbon, resulting in a large error term. The remainder of the same maize kernel was submitted (UCIAMS-207138), which resulted in a larger amount of post-pretreatment carbon and an error term in line with other $^{14}C$ ages obtained for this study.

We first ran a kernel density estimate (KDE) model with the 43 $^{14}C$ ages using the OxCal default parameters (N (0,1), U(0,1)). The KDE model provides an estimate of the density of dated and undated events when little or no prior quantitative knowledge is available (Bronk Ramsey 2017:1819). We then ran uniform Phase (Bronk Ramsey 2009) and trapezoidal Phase (Lee and Bronk Ramsey 2012) models with all $^{14}C$ ages assigned to a single Phase in each model. These models provide specific date estimates for the Northern New York occupation. Both models assume that the events ($^{14}C$ ages) in a model are related. In this case, we assume that the $^{14}C$ ages are related because they reflect the occupation of a region over a specific span of time. The uniform Phase model assumes abrupt Phase boundaries. The trapezoidal model assumes gradual Start and End Boundaries (Lee and Bronk Ramsey 2012). These two models account for the possible range of occupational histories of Northern New York, support abrupt arrival and dispersal to gradual arrival and dispersal, and are therefore complementary.

Following Bronk Ramsey (2017), we use three graphical means of summarizing the uniform and trapezoidal Phase models: within Phase sum of marginal posteriors, within Phase undated event, and within Phase KDE plot. The Start and End Boundaries are used to provide date ranges for the occupation of Northern New York, as is the undated event obtained with the Date(); command (Bronk Ramsey 2017:1812; Loftus et al. 2016; Manning et al. 2018). For the trapezoidal model, the reported Start and End Boundaries are $t_\alpha$ *and* $t_\delta$, respectively (Lee and Bronk Ramsey 2012:108–109). The CQL run file for each model is provided in Supplemental File 1.

## Results

Details on all $^{14}C$ ages from Northern New York, including those not used in the models, are presented in Supplemental Table 1. All bone sample C/N ratios for these samples fall within acceptable ranges for radiocarbon dating and isotopic assay (Van Klinken 1999).

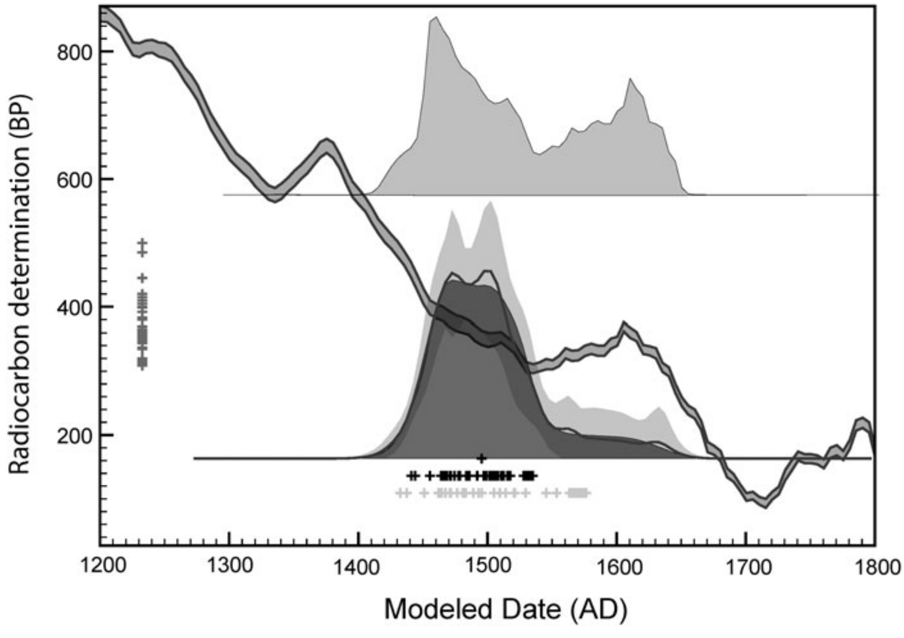


**Figure 2. Kernel density estimate (KDE) model (below) and sum of events plots. The KDE distribution is in gray, whereas the black line and light gray shading are mean ± 1σ samples of the KDE distribution that were generated through the MCMC routine. Black crosses are the medians of the marginal probability distributions for each date, and the gray crosses are the medians of the unmodeled, calibrated probability distributions for each date. Note that the probability distribution of the sum of events follows the shape of the calibration curve.**

The KDE model (Figure 2) has a span that occupies the fifteenth century and the first half of the sixteenth century AD, with a low probability tail that extends through the sixteenth and seventeenth centuries; 88% of the KDE model marginal posteriors probabilities fall before *AD 1540* (Figure 3). It is conceivable that the low probability distribution after *AD 1540* in part reflects occupations of the area that postdate *AD 1540*. However, given the lack of European artifacts on these sites and what is known about the seventeenth-century St. Lawrence valley from the ethnohistorical record (Chapdelaine 2016; Loewen 2016a, 2016b; Trigger 1985), we think it is most likely an artifact of the calibration curve plateau shown in Figure 2. Regardless, the model suggests that primary occupation of the area fell before *AD 1540*.

The uniform and trapezoidal Phase models are largely in accord (Table 2; Figure 3), although the trapezoidal model distributions extend earlier for the Start Boundary and later for the End Boundary, as expected. The 68.2% Start Boundary distributions fall in the first half of the fifteenth century AD, and the 68.2% End Boundary distributions extend no later than AD 1550 (uniform) and 1566 (trapezoidal). The 95.4% End Boundary for the trapezoidal model extends to 1632 as a result of a long, low probability density tail (Figure 3), which we assume is an artifact of the calibration curve plateau, although here too, it may reflect later occupations beyond the primary span of occupations. The 68.2% probability undated event distributions span the second half of the fifteenth century AD and the second decade of the sixteenth century AD, while the 95.4% probability distributions range between *AD 1427* and *1560* (uniform) or *1551* (trapezoidal). Occupational spans are at most 122 years at 68.2% probability and 182 years at the 95.4% probability. The consistency of results between the two models confirms a short occupation span for the region, which, if confined to the 68.2% probability undated event distributions following Manning and colleagues (2018), is approximately 70 years (Table 2).

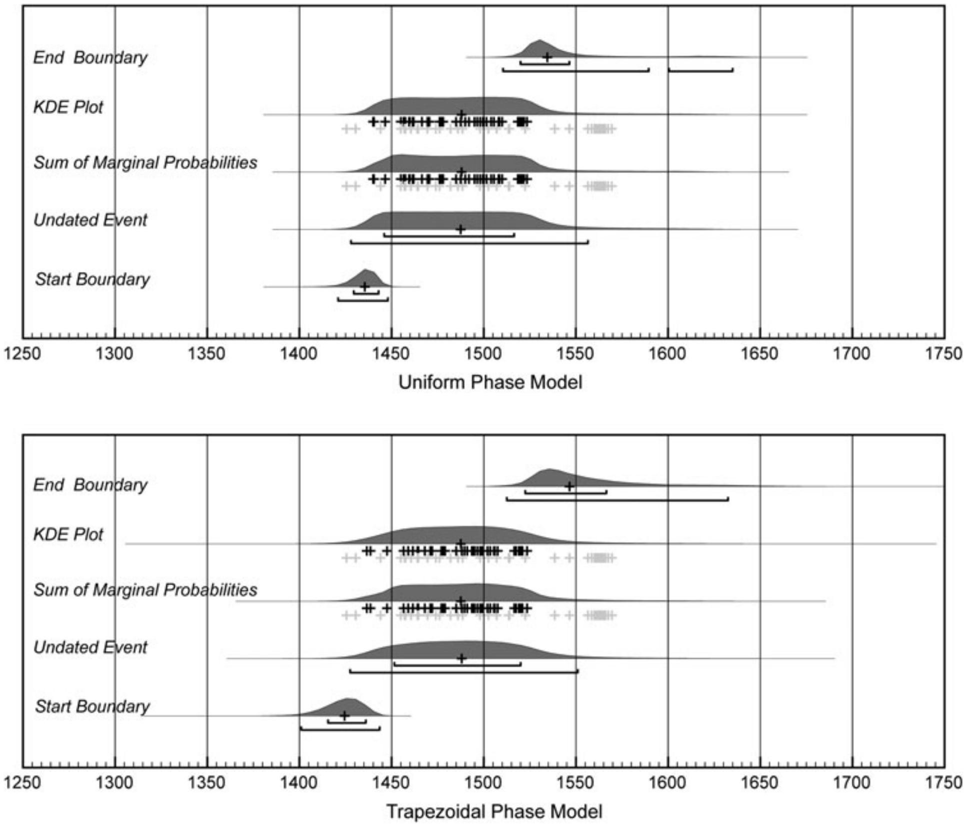


**Figure 3. Within-phase summary plots for each model. Black crosses are the medians of the marginal probability distributions for each date, and the gray crosses are the medians of the unmodeled, calibrated probability distributions for each date.**

Table 2. Results of Bayesian Modeling with 43 AMS Dates from Northern New York Iroquoian Sites.

| Statistic | Uniform Phase | | Trapezoidal Phase | |
|---|---|---|---|---|
| | 68.2% | 95.4% | 68.2% | 95.4% |
| Start Boundary (AD) | *1429–1442* | *1420–1448* | *1415–1436* | *1401–1443* |
| Undated Event (AD) | *1445–1517* | *1427–1560* | *1451–1520* | *1427–1551* |
| End Boundary (AD) | *1520–1550* | *1512–1587 (87.3) 1603–1635 (8.1)* | *1522–1566* | *1512–1632* |
| Span (years) | 78–112 | 69–151 (87.3) 164–199 (8.1) | 82–122 | 72–182 |
| Agreement model | 87.3 | | 87.7 | |
| Agreement overall | 79.8 | | 78.2 | |

## Discussion

It is now apparent that the Iroquoian occupation of Northern New York had a fifteenth-century AD origin. There is currently no unequivocal evidence for a substantial ancestral population in the region (Abel 2019a). The latest well-established pre-Iroquoian cultural manifestation probably dates before AD 1100 (Abel and Fuerst 1999). It is very likely, then, that the fifteenth-century Iroquoian settlements originated from outside the upper St. Lawrence region. Where those origins lie is an open question.

Earlier ceramic seriation estimates placed the Iroquoian occupation of Northern New York between AD 1350 and 1520—a

170-year span—with a starting date 50 years earlier than the earliest estimate in the two Bayesian models. The Bayesian models suggest spans between approximately 80 and 120 years at 68.2% probability. The 68.2% probability undated events are shorter by more than half of previous estimates, whereas the 95.4% probability undated events are 37 to 46 years shorter. During this time, more than 50 village sites were occupied in the six clusters. Although earlier estimates suggested that some clusters may be derivative from other clusters in the region (Engelbrecht 1995), results of the Bayesian modeling suggest that all of the clusters are roughly contemporaneous (Abel 2019b). To account for that number of villages in this short span, occupations must have been of relatively short duration, perhaps a decade or so. It is also possible that some clusters, such as the Sandy Creek and Dry Hill Clusters, had dual (primary and satellite) village settlement patterns (Abel 2019b).

Almost all these villages were recorded to have been enclosed by earthworks, and those that have been excavated have evidence of single or double palisades (Abel 2019a). Where these features have been recorded, village sizes show a wide size range of <1.0 to 3.2 ha. The two largest villages, Potocki and Morse, rival coalescent communities in neighboring Wendat and Haudenosaunee territories for their size (cf. Birch 2010, 2012; Engelbrecht 2003; Snow 1994). Community coalescence is a phenomenon associated with intensive agriculture, increased warfare, and political realignments throughout the Northeast (Birch 2010, 2012, 2013; Birch et al. 2016; Creese 2016).

The Bayesian models confirm earlier seriation estimates that the Northern New York Iroquoian occupation likely terminated in the first half of the sixteenth century AD. Where these populations dispersed has been a long-term topic of research (Abel 2001; Engelbrecht 1995; Pendergast 1993a). Current interpretations suggest that the dispersal was multidirectional and followed shifting political alliances (Abel 2001, 2002; Engelbrecht 1995, 2004). The directions of this dispersal, however, demand rethinking considering recent AMS dating (Abel 2019a).

## Conclusions

Bayesian analysis of 43 recently obtained AMS dates have significantly revised the chronology of the Iroquoian occupation in Northern New York. The Bayesian models place this occupation between *AD 1445* and *1517* (68.2% probability) or *AD 1427* and *1560* (95.4% probability) for the uniform model and between *AD 1451* and *1520* (68.2% probability) or *AD 1427* and *1551* (95.4% probability) for the trapezoidal model using the undated event estimate following Manning and colleagues (2018). Although consistent with previous seriation-based estimates for the abandonment of the region, the revised chronology considerably shortens the previously accepted occupation period and minimally moves the beginning of the occupation forward in time 50 years. This will have significant implications for current interpretations of Northern New York Iroquoian origins, settlement growth, and community dispersal.

*Acknowledgments.* All dates were paid with funds provided by the Robert E. Funk Memorial Archaeology Foundation and the Thousand Islands Chapter, NYSAA to Abel and the New York State Museum to Hart.

*Data Availability Statement.* All data used in the analyses are provided within the text or supplemental files.

*Supplemental Materials.* For supplemental material accompanying this article, visit https://doi.org/10.1017/aaq.2019.50.

Supplemental Table 1. Data for All Radiocarbon Dates Available for Northern New York Sites.

Supplemental File 1. CQL Run File for Each Model.

## References Cited

Abel, Timothy J.

2001 The Clayton Cluster: Cultural Dynamics of a Late Prehistoric Village Sequence in the Upper St. Lawrence Valley. PhD dissertation, Department of Anthropology, University at Albany-SUNY.

2002 Recent Research on the St. Lawrence Iroquoians of Northern New York. *Archaeology of Eastern North America* 30:137–154.

2015 *Phase 1b/2 Archaeological Investigations, W. Main St. Improvement Project, Village of Sackets Harbor, Jefferson County*. Unpublished CRM report submitted to Bernier, Carr Associates.

2016 The Iroquoian Occupations of Northern New York: A Summary of Current Research. *Ontario Archaeology* 96:65–75.

2019a The Iroquoian Occupations of Northern New York. In *The Archaeology of New York State, Revisited*, edited

by Susan E. Maguire and Lisa Maria Anselmi, NYSM Bulletin, in press. New York State Museum, Albany.
2019b New Radiocarbon Dates for the Iroquoian Occupation of Northern New York. *Archaeology of Eastern North America* 47, in press.

Abel, Timothy J., and David N. Fuerst
1999 The Prehistory of the St. Lawrence Headwaters Region. *Archaeology of Eastern North America* 27:1–52.

Abel, Timothy J., James W. Bradley, and Lisa M. Anderson
2019 Rediscovery and Analysis of Copper Beads from Two Iroquoian Sites in Jefferson County, New York. *Bulletin of the New York State Archaeological Association*, in press.

Baron, Anne, Bernard Gratuze, Adrian L. Burke, and Claude Chapdelaine
2016 Characterization and Origin of Steatite Ornaments Made by the Saint-Lawrence Iroquoians During the 15th and 16th Centuries. *Journal of Archaeological Science: Reports* 8:323–334.

Beaumont, Will, Robert Beverly, John R. Southon, and R. E. Taylor
2010 Bone Preparation at the KCCAMS Laboratory. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms* 268(7–8):906–909.

Birch, Jennifer
2010 Coalescence and Conflict in Iroquoian Ontario. *Archaeological Review from Cambridge* 25(1):29–48.
2012 Coalescent Communities in Iroquoian Ontario. *American Antiquity* 77:646–670.

Birch, Jennifer (editor)
2013 *From Prehistoric Villages to Cities: Settlement Aggregation and Community Transformation*. Routledge Studies in Archaeology 10. Routledge, London.

Birch, Jennifer, and Ronald F. Williamson
2013 *The Mantle Site: An Archaeological History of a Huron-Wendat Community*. Issues in Eastern Woodlands Archaeology. AltaMira Press, Lanham, Maryland.

Birch, Jennifer, Robert B. Wojtowicz, Aleksandra Pradzynski, and Robert H. Pihl
2016 Multiscalar Perspectives on Iroquoian Ceramics: Aggregation and Interaction in Pre-Contact Ontario. In *Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place*, edited by Eric E. Jones and John L. Creese, pp. 111–144. University Press of Colorado, Boulder.

Bradley, James W.
1987 Native Exchange and European Trade: Cross-Cultural Dynamics in the Sixteenth Century. *Man in the Northeast* 33:31–46.

Bronk Ramsey, Christopher
2009 Bayesian Analysis of Radiocarbon Dates. *Radiocarbon* 51:337–360.
2017 Methods for Summarizing Radiocarbon Datasets. *Radiocarbon* 59:1809–1833.

Chapdelaine, Claude
2004 A Review of the Latest Developments in St. Lawrence Iroquoian Archaeology. In *A Passion for the Past, Papers in Honour of James F. Pendergast*, edited by James V. Wright and Jean-Luc Pilon, pp. 63–76. Archaeological Survey of Canada Mercury Series Paper Vol. 164, Canadian Museum of Civilization, Gatineau, Quebec.
2016 Saint Lawrence Iroquoians as Middlemen or Observers: Review of Evidence in the Middle and Upper Saint Lawrence Valley. In *Contact in the 16th Century: Networks among Fishers, Foragers, and Farmers*, edited by Brad Loewen and Claude Chapdelaine, pp. 149–170. Mercury Series Vol. 176. University of Ottawa Press, Ontario.

Cottrell, Marie G.
1979 The Pine Hill Site, St. Lawrence County. *The Bulletin (Journal of the New York State Archaeological Association)* 77:1–13.

Creese, John L.
2016 Growing Pains: Explaining Long-Term Trends in Iroquoian Village Scale, Density, and Layout. In *Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place*, edited by Eric E. Jones and John L. Creese, pp. 45–77. University Press of Colorado, Boulder.

Dermarkar, Susan, Jennifer Birch, Termeh Shafie, John P. Hart, and Ronald F. Williamson
2016 St. Lawrence Iroquoians and Pan-Iroquoian Social Network Analysis. *Ontario Archaeology* 96:87–103.

Engelbrecht, William E.
1995 The Case of the Disappearing Iroquoians: Early Contact Period Superpower Politics. *Northeast Anthropology* 50:35–59.
2003 *Iroquoia: The Development of a Native World*. Syracuse University Press, Syracuse, New York.
2004 Northern New York Revisited. In *A Passion for the Past, Papers in Honour of James F. Pendergast*, edited by James V. Wright and Jean-Luc Pilon, pp. 125–144. Archaeological Survey of Canada Mercury Series Paper Vol. 164, Canadian Museum of Civilization, Gatineau, Quebec.

Engelbrecht, William E., and J. Bruce Jamieson
2016a St. Lawrence Iroquoian Projectile Points: A Regional Perspective. *Archaeology of Eastern North America* 44:81–98.
2016b Stone-Tipped versus Bone- and Antler-Tipped Arrows and the Movement of the St. Lawence Iroquoians from Their Homeland. *Ontario Archaeology* 96:76–86.

Engelbrecht, William E., Earl R. Sidler III, and Michael Walko
1990 The Jefferson County Iroquoians. *Man in the Northeast* 39:65–77.

Fecteau, Rodolphe D.
2013 *Plant Remains from the NYSM #3499 Site, Jefferson County, New York State, U.S.A.* Rudolphe D. Fecteau Associates. Unpublished report submitted to Thousand Islands Chapter, NYSAA.

Gates St-Pierre, Christian
2001 Variations sur un même thème: Les objets en os des Iroquoiens du Haut Saint-Laurent. *Archaeologiques* 15:35–54.

Gates St-Pierre, Christian
2010 Iroquoian Bone Artifacts: Characteristics and Problems. In *Ancient and Modern Bone Artefacts from America to Russia: Cultural, Technological and Functional Signature*, edited by Alexandra Legrand-Pineau, Isabelle Sidéra, Natacha Buc, Eva David, and Vivian Scheinsohn, pp. 71–85. BAR International Series. Archaeopress, Oxford.

Gates St-Pierre, Christian
2015 Les pointes en os biseautées des Iroquoiens. *Canadian Journal of Archaeology* 39:31–46.

Harrington, M. Raymond
1922 Prehistoric Iroquois Sites in Northern New York:

Report on the Peabody Museum Expedition, 1906. In *The Archaeological History of New York (Part 1)*, edited by Arthur C. Parker, pp. 315–339. Bulletin Vol. 235–238. New York State Museum, Albany.

Hart, John P., Jennifer Birch, and Christian Gates St-Pierre
2017 Effects of Population Dispersal on Regional Signaling Networks: An Example from Northern Iroquoia. *Science Advances* 3(8):e1700497.

Hart, John P., Robert Feranec, Timothy Abel, and Jessica Vavrasek
2019 Freshwater Reservoir Offsets on Radiocarbon-Dated Dog Bone from the Headwaters of the St. Lawrence River, USA. *PeerJ* 7:e7174.

Hart, John P., Susan Winchell-Sweeney, and Jennifer Birch
2019 An Analysis of Network Brokerage and Geographic Location in Fifteenth-Century AD Northern Iroquoia. *PLOS ONE* 14(1):e0209689.

Jamieson, J. Bruce
1990a The Archaeology of the St. Lawrence Iroquoians. In *The Archaeology of Southern Ontario to A.D. 1650*, edited by Chris Ellis and Neal Ferris, pp. 385–404. Occasional Publication of the London Chapter, Ontario Archaeological Society 5. Ontario Archaeological Society, London.
1990b Trade and Warfare: The Disappearance of the St. Lawrence Iroquoians. *Man in the Northeast* 39:79–86.
2016 Bone, Antler, Tooth and Shell: A Study in Iroquoian Technology. PhD dissertation, Department of Anthropology, McGill University, Montreal.

Jones, Travis W., Jennifer Birch, Ronald F. Williamson, Timothy J. Abel, Robert J. Speakman, and Louis Lesage
2018 Steatite Characterization Using X-Ray Fluorescence and Insights into Northern Iroquoian Interregional Interaction. *Journal of Archaeological Science: Reports* 20:506–515.

Lee, Sharon, and Christopher Bronk Ramsey
2012 Development and Application of the Trapezoidal Model for Archaeological Chronologies. *Radiocarbon* 54:107–122.

Loewen, Brad
2016a Intertwined Enigmas: Basques and Saint Lawrence Iroquoians in the Sixteenth Century. In *Contact in the 16th Century: Networks among Fishers, Foragers, and Farmers*, edited by Brad Loewen and Claude Chapdelaine, pp. 57–75. Mercury Series Vol. 176. University of Ottawa Press, Ontario.
2016b Sixteenth-Century Beads: New Data, New Directions. In *Contact in the 16th Century: Networks among Fishers, Foragers, and Farmers*, edited by Brad Loewen and Claude Chapdelaine, pp. 269–286. Mercury Series Vol. 176. University of Ottawa Press, Ontario.

Louis Berger Associates
1994 *The Stabilization of the NYSM 3450 (Camp Drum #1) Site, Fort Drum Cultural Resources Study, Fort Drum New York*. Fort Drum Cultural Resource Project Technical Appendix 1. Louis Berger and Associates, Inc., East Orange, New Jersey.

Loftus, Emma, Judith C. Sealy, and Julia Lee-Thorp
2016 New Radiocarbon Dates and Baysian Models for Nelson Bay Cave and Byneskranskop 1: Implications for the South African Later Stone Age Sequence. *Radiocarbon* 58:365–381.

MacNeish, Richard S.
1952 *Iroquois Pottery Types: A Technique for the Study of Prehistory*. Bulletin 124. National Museum of Canada, Ottawa.

Manning, Sturt W., Jennifer Birch, Megan A. Conger, Michael W. Dee, Carol Griggs, Carla S. Hadden, Alan G. Hogg, Christopher Bronk Ramsey, Samantha Sanft, Peter Steier, and Eva M. Wild
2018 Radiocarbon Re-Dating of Contact-Era Iroquoian History in Northeastern North America. *Science Advances* 4(12):eaav0280.

Noble, William C.
1971 The Sopher Celt: An Indicator of Early Protohistoric Trade in Huronia. *Ontario Archaeology* 16:42–47.

Pendergast, James F.
1991 St. Lawrence Iroquoians: Their Past, Present, and Immediate Future. *Bulletin of the New York State Archaeological Association* 102:47–74.
1993a More on How and Why the St. Lawrence Iroquoians Disappeared. In *Essays in St. Lawrence Iroquoian Archaeology: Selected Papers in Honour of J. V. Wright*, edited by James F. Pendergast and Claude Chapdelaine, pp. 9–47. Occasional Papers in Northeastern Archaeology Vol. 8. Copetown Press, Dundas, Ontario.
1993b Some Comments on Calibrated Radiocarbon Dates for Saint Lawrence Iroquoian Sites. *Northeast Anthropology* 46:1–31.
1996 High Precision Calibration of the Radiocarbon Time Scale: CALIB 3.0.3 (Method "A") in a St. Lawrence Iroquoian Context. *Bulletin of the New York State Archaeological Association* 111–112:35–62.

Pratt, Marjorie K.
1991 The St. Lawrence Iroquois of Northern New York. *Bulletin of the New York State Archaeological Association* 102:43–46.

Reimer, Paula. J., Edouard Bard, Alex Bayliss, J. Warren Beck, Paul G. Blackwell, Christopher Bronk Ramsey, Caitlin E. Buck, Hai Cheng, R. Lawrence Edwards, Michael Friedrich, Pieter M. Grootes, Thomas P. Guilderson, Haflidi Haflidason, Irka Hajdas, Christine Hatté, Timothy J. Heaton, Dirk L. Hoffmann, Alan G. Hogg, Konrad A. Hughen, K. Felix Kaiser, Bernard Kromer, Sturt W. Manning, Mu Niu, Ron W. Reimer, David A. Richards, E. Marian Scott, John R. Southon, Richard A. Staff, Christian S. M. Turney, and Johannes van der Plicht
2013 IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP. *Radiocarbon* 55:1869–1887.

Sidler, Earl R., III
1971 The Durham Site: A Prehistoric Iroquoian Component in Jefferson County, New York. Master's thesis, Department of Anthropology, State University of New York at Buffalo.

Skinner, Alanson
1921 Notes on the Iroquois. In *Indian Notes and Monographs*. Museum of the American Indian, Heye Foundation, New York.

Snow, Dean R.
1994 *The Iroquois*. Blackwell, Oxford.

Stuiver, Minze, and Henry A. Polach
1977 Discussion: Reporting of 14C Data. *Radiocarbon* 19:355–363.

Timmins, Peter A.
1985 *The Analysis and Interpretation of Radiocarbon Dates in Iroquoian Prehistory*. Research Report 19. Museum of Indian Archaeology, London, Ontario.

Trigger, Bruce G.
1985 *Natives and Newcomers: Canada's "Heroic Age" Revisited*. McGill-Queens University Press, Montreal.

Tuck, James A.
1971 *Onondaga Iroquois Prehistory: A Study in Settlement Archaeology*. Syracuse University Press, Syracuse, New York.

Van Klinken, Gert J.
1999 Bone Collagen Quality Indicators for Palaeodietary and Radiocarbon Measurements. *Journal of Archaeological Science* 26:687–695.

Vavrasek, Jessica Lee
2010 *Faunal Remains from the Pine Hill Site (PS-6), St.* Lawrence County, New York. Master's thesis, Department of Anthropology, University of Tennessee, Knoxville.

Williamson, Ronald F., Meghan Burchell, William A. Fox, and Sarah Grant
2016 Looking Eastward: Fifteenth- and Sixteenth-Century Exchange Systems of the North Shore Ancestral Wendat. In *Contact in the 16th Century: Networks among Fishers, Foragers, and Farmers*, edited by Brad Loewen and Claude Chapdelaine, pp. 235–255. Mercury Series Vol. 176. University of Ottawa Press, Ontario.

Wonderley, Anthony
2005 Effigy Pipes, Diplomacy, and Myth: Exploring Interaction between St. Lawrence Iroquoians and Eastern Iroquois in New York State. *American Antiquity* 70:211–240.

*Submitted February 25, 2019; Revised April 30, 2019; Accepted May 15, 2019*