Conflict, Population Movement, and Microscale Social Networks in Northern Iroquoian Archaeology

Jennifer Birch and John P. Hart

We employ social network analysis of collar decoration on Iroquoian vessels to conduct a multiscalar analysis of signaling practices among ancestral Huron-Wendat communities on the north shore of Lake Ontario. Our analysis focuses on the microscale of the West Duffins Creek community relocation sequence as well as the mesoscale, incorporating several populations to the west. The data demonstrate that network ties were stronger among populations in adjacent drainages as opposed to within drainage-specific sequences, providing evidence for west-to-east population movement, especially as conflict between Wendat and Haudenosaunee populations escalated in the sixteenth century. These results suggest that although coalescence may have initially involved the incorporation of peoples from microscale (local) networks, populations originating among wider mesoscale (subregional) networks contributed to later coalescent communities. These findings challenge previous models of village relocation and settlement aggregation that oversimplified these processes.

Keywords: social network analysis, ancestral Wendat archaeology, village removal sequences, settlement systems, multiscalar analysis

Nous employons une analyse des réseaux sociaux de la décoration des collets de vases iroquoiens pour réaliser une analyse multi-scalaire de signalisation des pratiques au sein des communautés ancestrales Huron-Wendat sur la rive nord du lac Ontario. Notre analyse met l'accent sur la micro-échelle ainsi que la méso-échelle de la séquence de réinstallation de la communauté de West Duffins Creek, incorporant plusieurs populations à l'ouest. Les données montrent que les liens tissés au sein du réseau étaient plus solides chez les populations dans les bassins hydrographiques adjacents qu'au sein des séquences spécifiques au bassin, prouvant un mouvement de population d'ouest en est, alors que le conflit entre les peuples Wendat et Haudenosaunee s'aggravait au seizième siècle. Ces résultats suggèrent que bien que la coalescence puisse avoir au départ impliqué l'incorporation de peuples en provenance de petits réseaux (locaux), les populations originaires de réseaux plus larges (sous-régionaux) ont contribué à une coalescence ultérieure des communautés. Ces résultats remettent en cause les modèles précédents de réinstallation et de regroupement des villages qui simplifiaient trop ces procédés.

Mots clés: l'analyse de réseau social, archéologie ancestrale Wendat, séquences de retrait du village, systèmes de règlement, analyse multiscalaire

One of the strengths of archaeology as a social science is its ability to analyze evidence for human behaviors over extended periods of time and space (Smith et al. 2012). Related to this is its ability to analyze evidence over varied chronological and spatial scales, thereby discovering patterns that are not visible in single temporal and spatial frames. Such multiscalar analyses have been used to good effect in a myriad of situations worldwide using a variety of analytical methods and techniques. These include social network analysis

Jennifer Birch ■ Department of Anthropology, University of Georgia, 250 Baldwin Hall, Jackson Street, Athens, GA 30602-1619, USA (jabirch@uga.edu).
John P. Hart ■ Research and Collections Division, New York State Museum, 3140 Cultural Education Center, Albany, NY 12230, USA (john.hart@nysed.gov, corresponding author).

American Antiquity 86(2), 2021, pp. 350–367

doi:10.1017/aaq.2021.5

(SNA), which by its very nature facilitates analyses of human interactions at various scales (Mills et al. 2015). Here, we expand on previous SNA of mid-fourteenth through mid-seventeenth-century (all dates in this article are AD) Northern Iroquoia in southern Ontario (Birch and Hart 2018; Hart et al. 2016), taking advantage of refined chronological control, which has resulted from recently completed Bayesian analyses of radiocarbon dates (Birch et al. 2021; Manning et al. 2018, 2019). As in our previous work, we identify design motifs on the collars of cooking pots as signals of network membership by the makers and users of those pots—primarily women—who in turn were active in the sociopolitical interactions of ancestral Iroquoian village communities (Birch and Hart 2018; Hart and Engelbrecht 2012). Site-specific assemblages of decorated collars are used in SNA to generate signaling networks as proxies for human sociopolitical interactions.

Northern Iroquoian societies occupied—and continue to occupy—portions of present-day New York, Ontario, and Québec. This article focuses in particular on one Iroquoian population in southern Ontario, Canada, which is composed of ancestors of the contemporary Huron-Wendat Nation. Ancestral Huron-Wendat communities occupied portions of Ontario and Quebec, with dense clusters of settlement located on multiple drainages flowing south into Lake Ontario. These patterns persisted until the early seventeenth century when their population coalesced in the Simcoe Uplands, located between Lake Simcoe and Lake Huron's Georgian Bay, a territory known as historic Wendake. Although early Iroquoian settlements had been present in that region since the fourteenth century, the gradual agglomeration of population there seems to have been related to the formation of the Wendat confederacy, whose core membership was concentrated in this region during the early seventeenth century (Trigger 1976).

In previous efforts, we have used SNA to understand how interactions between ancestral Huron-Wendat villagers changed through time from 1350 to 1650 across the north shore of Lake Ontario and northward to historic Wendake and the adjacent Tionontaté (Petun) territory (Birch and Hart 2018; Hart et al. 2016). In these macroscale analyses (following Mills et al. 2015), we found that, from 1350 to 1450, ancestral Huron-Wendat villagers were strongly interwoven in regional signaling networks. Our analyses of village sites from 1450 to 1650 indicated complete networks with bonding ties and an increased use of meta-identifier designs on pottery collars as one mechanism to integrate communities into a confederacy that coalesced in a restricted geographical area (Birch and Hart 2018; Hart et al. 2016). This trend, however, was not a straight-line trajectory. Important changes occurred in signaling networks that tracked regional sociopolitical developments and patterns of intra- and interregional conflicts throughout the time span. For example, during the period of increased conflict and coalescence of villages into larger settlements, signaling became more inwardly focused within geographical clusters of villages (Hart et al. 2016:19).

Mills and colleagues (2015) demonstrate how multiscalar SNA can result in important insights into regional trends. Although our macroscale SNA has resulted in new understandings of regional interactions in response to changing sociopolitical developments and regional conflict, microscale analyses are needed to understand how these trends played out within particular subregions. An SNA of early Iroquoian sites in historical Onondaga territory in the Finger Lakes region of New York, for example, showed how signaling networks changed substantially over short periods of time within one discrete subregional population (Hart and Engelbrecht 2017).

Recent Bayesian analyses of large suites of radiocarbon dates have refined our knowledge of regional time frames as well as the nature of coalescence and conflict in Iroquoia (Birch et al. 2021; Manning et al. 2018, 2019). Here, we incorporate this new knowledge into microscale and mesoscale (Mills et al. 2015) SNA to understand how the macroscale trends played out in a sequence of sixteenth- to early seventeenth-century village sites in the West Duffins Creek drainage. Mesoscale refers to the north shore of Lake Ontario subregion, whereas microscale refers to specific communities and local village relocation sequences. Our results suggest that although coalescence may have initially involved the incorporation of peoples from microscale (local) networks, populations originating among wider mesoscale (subregional) networks also contributed to later coalescent communities, especially as conflict between Wendat and Haudenosaunee populations escalated in the sixteenth century. These results further ongoing efforts to understand the dynamic and multilinear nature of Northern Iroquoian settlement systems (see also Birch 2019; Birch and Lesage 2020; Hart 2020), as opposed to overly simplified models of both site relocation sequences and coalescence and conflict.

Site Relocation Sequences

From the fourteenth century onward, ancestral Huron-Wendat communities lived in villages consisting of multiple longhouses (Birch and Williamson 2018). In southern Ontario, during the sixteenth and seventeenth centuries, these villages became quite large and in some cases reached estimated populations of 1,500–2,000 individuals (Warrick 2008). These later, larger settlements were more often than not surrounded by multirow defensive palisades. Villages were typically single component, although the reoccupation of village sites is not unknown (Hawkins et al. 2018).

Ancestral Wendat settlements are generally thought to have been occupied for a few decades (Warrick 1988) before communities established new villages at a distance of several kilometers. This was done for a variety of social and environmental reasons. Depletion of firewood, deterioration of structures, pest infestation, and exhaustion of agricultural soils are often cited as functional reasons for village relocation (Engelbrecht 2003; Gramly 1977; Trigger 1976). However, social and political dynamics such as disagreements between community members, increases in conflict, concern for collective defense, and processes of nation and confederacy formation also influenced community relocation, including decisions about village fission and fusion (Jones and Wood 2012; Ramsden 2009; Trigger 1976). The Wendat scholar Georges Sioui (2019:155) has noted that village fission may have been a way to resolve potential conflict by forming smaller units that were better able to maintain peaceable relationships, whereas settlement aggregation has usually been attributed to concerns about collective defense (Birch 2012; Trigger 1976).

Village durations are commonly understood to have lasted 10–40 years. Having evaluated multiple methods, Warrick determined that the average density of house wall posts was the most viable means for estimating Iroquoian village duration (1988, 2008:125). His methods suggested that sites were occupied for an average of 25–30 years in the fifteenth and sixteenth centuries. Seventeenth-century ethnohistoric accounts report village durations of 10–40 years (Biggar 1922–1936; Wrong 1939) and as few as 8–12 years (Thwaites 1896–1901). Based on these lines of evidence, village duration is typically stated as a likely interval of no more than 40 years. As such, any given individual in an Iroquoian community may have experienced a village relocation at least once in their lifetime (Engelbrecht 2003). Although village duration undoubtedly varied somewhat from site to site, radiocarbon dates and modeled village occupatio ns are in keeping with these estimates (Birch et al. 2021).

Sequences of village sites have typically been defined by the geographic proximity of settlements in specific drainages (e.g., Birch and Williamson 2013; Warrick 2008) and regional ceramic type and attribute seriations (e.g., Niemczycki 1984; Ramsden 1977; Tuck 1971), as well as the type and frequency of European trade goods for sites assumed to postdate 1500 (Bradley 1987; Kenyon and Kenyon 1983). Since at least the 1970s (e.g., Ramsden 1977; Ritchie and Funk 1973; Tuck 1971), it has been assumed that village sites within specific stream basins represent the sequential movements of a single community and, in some cases, coalescences of multiple communities (Birch 2012; Birch and Williamson 2013). This assumption has been strongly relied on in southern Ontario, where a series of subparallel, north–south-trending streams drain into the north shore of Lake Ontario. MacDonald (2002) suggested that these stream basins formed natural territories that facilitated the separation of communities and their needs for agricultural soils as well as hunting and fishing territories. The single-village relocation model

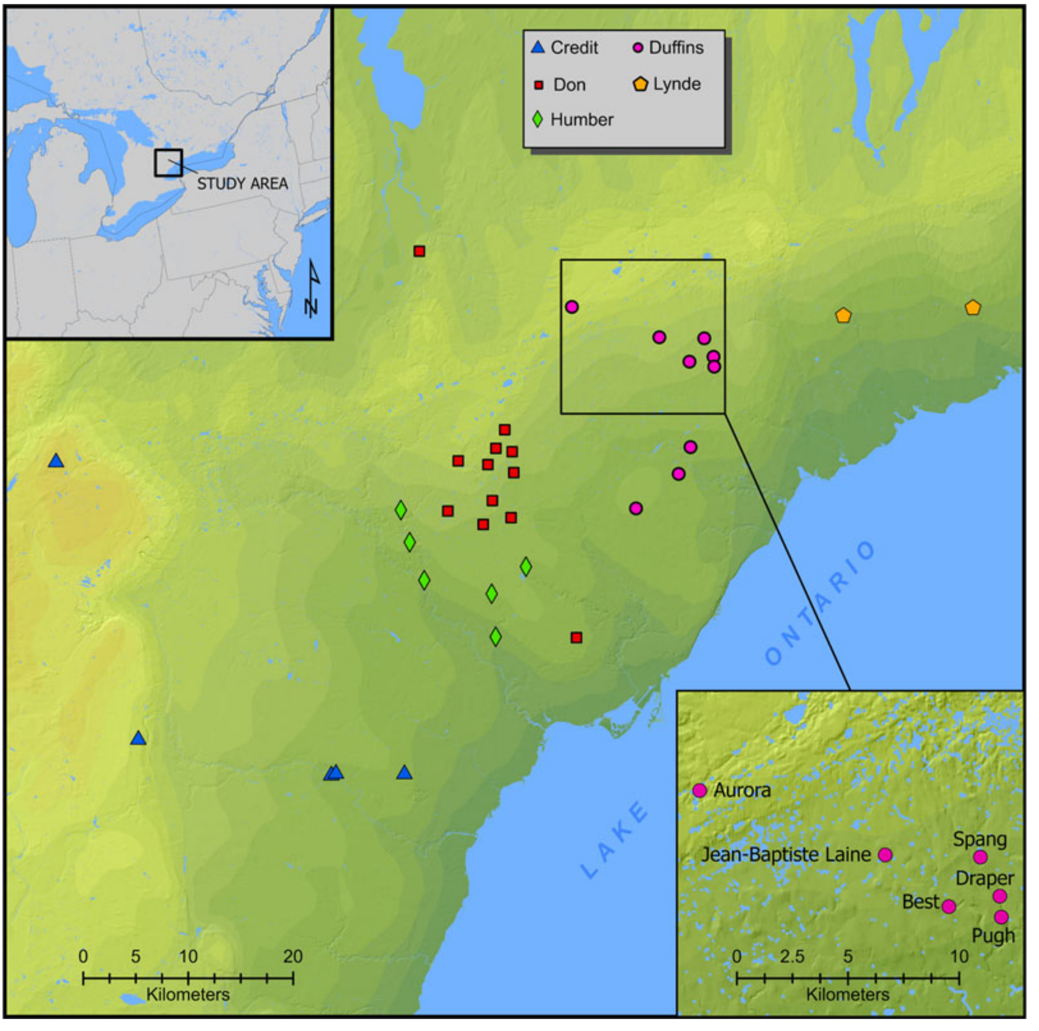

Figure 1. Locations of north-shore village sites used in the social network analysis.

has perhaps been most visible in the West Duffins Creek drainage, where it has been argued that the Draper, Spang, and Jean-Baptiste Lainé (the latter formerly known as Mantle) sites represent sequential iterations of a single aggregated village community (Figure 1; Birch 2012; Birch and Williamson 2013; Williamson 2014; see also Finlayson 1985). For other village relocation sequences in the Humber, Don, and Trent River systems of southern Ontario, the precise sequence of village relocations is less clear. It is likely that multiple communities occupied each of these drainages contemporaneously (Birch and Williamson 2013:30–43).

Despite explanatory frameworks based on village relocation sequences, flexibility has always been a defining characteristic of the ancestral Wendat settlement landscape (Birch 2015; Birch and Lesage 2020). Population movement, amalgamation, coalescence, dispersal, resettlement, incorporation, and abandonment occurred at the local and regional scales throughout Northern Iroquoian history. In addition to the regular relocation of village-communities, as described above, the short-distance relocation of households and subcommunity groups between villages and the long-distance relocation of those same social units to new regions also occurred. In some cases, household clusters

https://doi.org/10.1017/aaq.2021.5 Published online by Cambridge University Press

were added to existing villages, and in others, the distribution of nonlocal materials indicates that newcomers were integrated into existing longhouse structures (e.g., Birch 2012; Ramsden 2009, 2016; Williamson et al. 1998). Both the ethnohistoric and archaeological records attest to the incorporation of Wendat and non-Wendat peoples into Wendat villages (Ramsden 2016; Thwaites 1896–1901; Williamson et al. 2016). In these ways, despite the seemingly sedentary nature of Iroquoian village-communities and the regular relocation of villages within drainages, their composition could in fact be rather fluid. Such patterns of local and regional mobility—termed "population circulation"—have been documented in middle-range and urban settlements elsewhere (Bernardini 2011; Schachner 2012; Smith 2014). As such, there is an inherent tension between the reliance on the site sequence model in Iroquoian archaeology and the realities of population circulation and residential flexibility as is evident in settlement pattern data (Birch and Lesage 2020), isotopic data (Pfeiffer et al. 2020), ethnohistoric accounts (Thwaites 1896–1901), and oral histories (Sioui 1999).

Coalescence, Conflict, and Confederacy Formation

Bayesian modeling of radiocarbon dates from multiple village sequences in south-central Ontario and central New York have recently changed our understandings of the timing and causes of coalescence and conflict in Northern Iroquoia in ways that bear directly on the site sequence model described above. Previously, it had been thought that palisaded sites and human remains bearing signs of violent conflict appeared in southern Ontario in the mid-fifteenth century. It was also thought that conflict occurred primarily between ancestral Huron-Wendat communities in adjacent drainages. In New York, conflict was thought to develop slightly later, in the late fifteenth to early sixteenth centuries, also primarily among adjacent groups (Snow 1994). As such, in both regions, the appearance of violent conflict represented the beginning of a new phase or horizon in each region's history. Their asynchronicity—the mid-1400s in Ontario and the late 1400s to early 1500s in New York—gave the impression that early conflict was confined to the local region, with interregional hostilities not emerging until the early contact era.

The new date estimates for Iroquoian site sequences developed by the Dating Iroquoia project (Birch et al. 2021; Manning et al. 2018, 2019) indicate that evidence for conflict first appears in Onondaga and Seneca territory sites in New York and at one contemporary ancestral Huron-Wendat site in the Middle Humber Valley at the west end of Lake Ontario in the late 1400s. Palisaded Huron-Wendat settlements with evidence for violent conflict do not appear further east in the Don Valley and West Duffins Creek Drainages until approximately 1525 (Figure 2). Palisaded settlements also appear to the east in the Trent Valley in the first decades of the 1500s. This suggests that violent conflict came to ancestral Wendake as a wave emanating from the east and west ends of Lake Ontario. The withdrawal of populations off the north shore of Lake Ontario, moving north and east, seems to be in keeping with the formation of a buffer zone along the frontier with the Seneca at the same time confederacy formation was taking place among the Five Nations of the Haudenosaunee. The key finding that bears on this article is that there is no evidence that ancestral Huron-Wendat communities engaged in conflict with one another.

The recognition that (a) there is no evidence for conflict among Huron-Wendat communities and (b) residential flexibility was a common and recurrent practice among members of ancestral Huron-Wendat society raises questions about the assumptions inherent in the site relocation sequence model. If ancestral Huron-Wendat communities were coalescing in response to external threats—as opposed to conflict with neighboring communities as previously assumed—how does this affect our conceptualizations of site relocation sequences? And, how might social network analysis be brought to bear on this question?

Pottery, Social Network Analysis, and Village Sequences

Although SNA has been in occasional use in North American archaeology for several decades

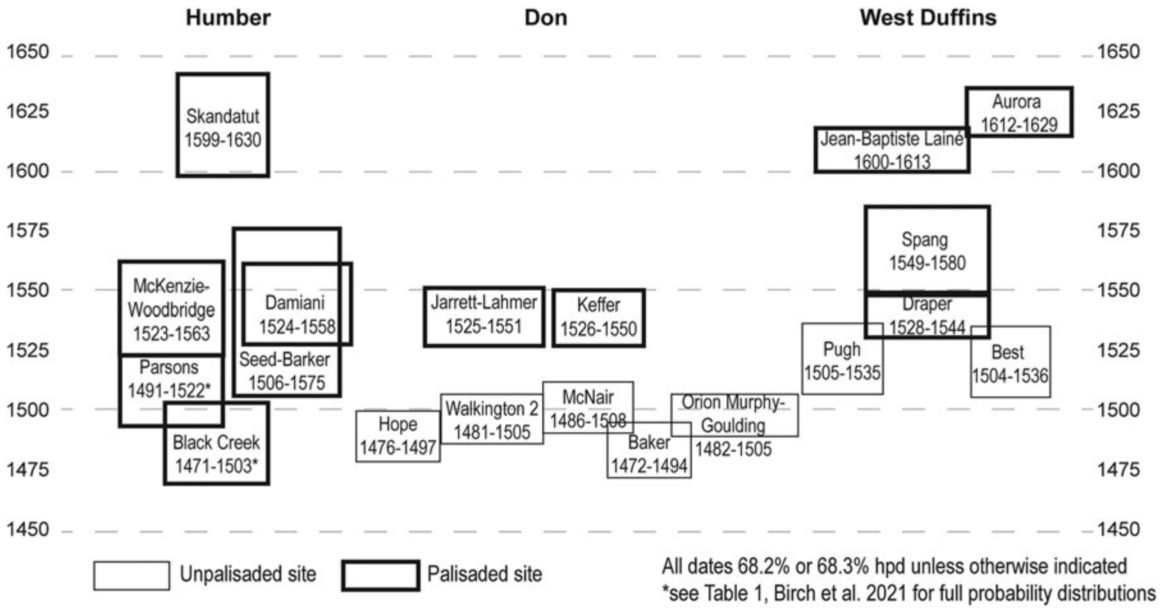

Figure 2. Date estimates and relative contemporaneity of sites in the Humber, Don, and West Duffins Creek drainages.

to build understandings of social interactions (e.g., Peregrine 1991), its use has increased substantially over the past decade (e.g., Brughmans 2013; Mills 2017; Peeples 2019). Social network analyses utilize similarity coefficient matrices, which are often calculated from counts of artifact attributes or types; pottery is most frequently used in late prehistoric contexts in North America (e.g., Lulewicz 2019; Mills et al. 2015), although other artifacts—such as shell gorgets (Lulewicz and Coker 2018), lithic technology (Rorabaugh 2019), and lithic raw materials (Hill et al. 2020; Ladefoged et al. 2019)—have been used there and elsewhere. Here, we continue the use of incised and stamped design motifs on the collars of Iroquoian pots as the foundation of our SNA. We acknowledge that other aspects of Iroquoian vessel form, function, and manufacturing technique have been noted to vary in a meaningful fashion (e.g., Curtis and Latta 2000; Hawkins 2004; Martelle 2002, 2004) and that the assembly of datasets that consider both high- and low-visibility attributes of ceramic vessels (e.g., Lulewicz 2019; Peeples 2018) would be a useful complement to this work.

Iroquoian women were the producers of pottery, and they tended to work in family groups (Perrelli 2009). Within the context of these groups, women selected from a corpus of culturally mediated decorative motifs while at the same time expressing their own creativity (Braun 2015). These incised and stamped decorations, consisting mostly of combinations of straight lines, had high contextual and absolute visibility (Carr 1995) within the interiors of longhouses—the primary places of pottery use (Chilton 1996). The decorations and collars were unnecessary for the primary functions of Iroquoian pottery—water-based cooking. Collars required additional materials (clay, temper), manufacturing and drying time, time for planning and execution of decorations, and skill for successful firing. As such, collar decorations were costly signals (Bliege Bird and Smith 2005), conveying to others information about the creators and users of the pots (Hart and Engelbrecht 2012). They were symbolically generalized communication media, which facilitated information exchange in networks of interaction (Mizoguchi 2013).

Ethnoarchaeological research indicates that, in some instances, pottery decorations serve as signals that convey information about women's political activities (Bowser 2000; Bowser and Patton 2004). This seems apt in Northern Iroquoia where we know from the ethnohistorical record that women were important in political activities (Birch 2015). A series of pan–Northern Iroquoian social network analyses have demonstrated that decorative motifs on collars track changes in sociopolitical and settlement systems through time (Hart et al. 2016, 2017, 2019) and differences in confederacy structures (Birch and Hart 2018), reflecting the importance of women in Iroquoian communities as well as intercommunity relationships and politics.

As summarized by Engelbrecht (2003:106) following Allen (1988), geographic proximity and pottery similarity are most often used by archaeologists to determine if a series of Iroquoian sites represent a sequence of village removals (see also Ramsden 1977). Decorations on pottery collars were drawn from a corpus of culturally mediated designs that were readily interpreted by individuals within and outside of a matrifamily, signaling group/network membership. Pottery manufacture was performed by women and taught intergenerationally within matrifamilies. Given the typically short duration of village occupations, women might live in two or three sequential villages during their lifetime. Although women expressed their own skills and ideas in the execution of collar decoration and although external group memberships may have changed over generations, because there was continuity in matrifamilies, we would expect the assemblage of designs from any given village site to be most similar to those from immediately earlier and later sites representing the same community. Similarity in pottery design between villages in different site sequences or clusters might also be interpreted as indicating movement of potters from one community to another.

Methods

All network visualizations were performed in Visone 2.18 (Brandes and Wagner 2004). Louvain cluster analyses—a community detection method that optimizes modularity, resulting in

Table 1. Radiocarbon Dates Newly Reported in This Study.

Site	Lab Number	Sample Material	Context	CRA ^{14}C Age BP	±	$\delta^{13}C$	Calibrated Date Range 95.4%	Calibrated Date Range 68.2%
Best	UGAMS-22313	Unidentified charcoal	Site-level provenience only	441	21	−22.85	1426–1470	1436–1453
Pugh	UGAMS-22314	Unidentified charcoal	Site-level provenience only	352	22	−24.34	1458–1635	1481–1625
Aurora	UGAMS-25448	Maize (*Zea mays*) kernel	Site-level provenience only	367	23	−8.36	1497–1634	1485–1642
Aurora	UGAMS-25449	Maize (*Zea mays*) kernel	Site-level provenience only	331	22	−8.60	1451–1632	1463–1618

Notes: All other radiocarbon dates used in the West Duffins sequence modeling follow Manning and colleagues (2018). Calibration uses OxCal v.4.3 (Bronk Ramsey 2009a) and IntCal 13 (Reimer et al. 2013).

the best node groupings in the network (Blondel et al. 2008)—was also performed in Visone. Other statistical analyses were performed with PAST 4.02 (Hammer et al. 2001) unless otherwise noted in the text. The Brainerd-Robinson (BR) similarity matrix used in the analyses is a subset of the larger matrix published in our previous macroscale analyses (Hart et al. 2016:S1 Appendix, 2017:Data Files S1, 2019:S1 Appendix). The matrix was calculated in the Similarity and Distance Measures module of TFQA 5.0 from site-assemblage motif category counts using (a) the Monte Carlo pairwise algorithm specifying 1,000 iterations and (b) random seed generated by the clock to adjust for sample size variation (Kintigh 2010).

AMS radiocarbon dates for the later West Duffins Creek site sequence follow Manning and colleagues (2018), with the exception of dates from the Best, Pugh, and Aurora sites that were acquired from the Center for Applied Isotope Studies at the University of Georgia and that are reported here for the first time (Table 1). Bayesian analyses of radiocarbon dates were done with OxCal 4.3 (Bronk Ramsey 2009a), using various forms of outlier analysis (Bronk Ramsey 2009b; Dee and Bronk Ramsey 2014; Dee et al. 2013) and the atmospheric IntCal13 calibration curve (Reimer et al. 2013). Details of the modeling process and OxCal code are provided in Supplemental Tables 1 and 2. We employ capitalized forms of words such as Sequence, Phase, Boundary, Date, and Interval to refer to OxCal Chronological Query Language (CQL2) Command Reference terms.

The model includes the Best and Pugh sites as a single Phase, followed in a Sequence by the Draper, Spang, Jean-Baptiste Lainé, and Aurora sites as Phases as per traditional understandings of the local sequence. Date estimates were calculated as a summary of each Phase. The Date function in OxCal determines a hypothetical event describing the temporal extent of the Phase between its start and end Boundaries. We have very few dates for Best, Pugh, and Aurora, but including these sites in the modeling extends the Sequence both earlier and later in time, thereby providing additional context for the local sequence in question. Justification for modeling decisions follows Manning and colleagues (2018). All dates reported for other sites and sequences outside of West Duffins Creek follow Birch and colleagues (2021).

Results

Radiocarbon Dating

Modeled Date estimates for radiocarbon-dated sites in the West Duffins drainage are presented in Table 2. These are contextualized by dates from the Humber and Don valley drainages to the east in Figure 2. The earliest villages with defensive palisading occur in the Humber River

Table 2. Modeled Date Estimates, West Duffins Site Sequence.

		Traditional Sequence Model A_{model} 57.5, $A_{overall}$ 58.9		Traditional Sequence Model, Outliers Omitted A_{model} 111.6, $A_{overall}$ 110.4	
Site	Previous Age Estimate	Date (68.2%)	Date (95.4%)	Date (68.2%)	Date (95.4%)
Best	1400–1450	1504–1537	1465–1550	1504–1536	1468–1549
Pugh	1400–1450	1506–1536	1478–1549	1505–1535	1480–1549
Draper	1450–1475	1528–1544	1524–1556	1528–1544	1523–1556
Spang	1475–1500	1546–1575	1537–1593	1549–1580	1539–1595
Mantle	1500–1525	1599–1612	1589–1620	1600–1613	1593–1619
Aurora	1525–1550	1612–1629	1604–1638	1612–1629	1605–1637

Notes: Archaeological assumptions employed in the modeling follow Birch and Williamson (2013). Logic employed in modeling follows Manning and colleagues (2018). See Supplemental Tables 1 and 2 for the OxCal runfiles.

drainage. Conflict and defensive palisading then spread to sites in the Don and West Duffins Creek drainages after approximately 1525.

Social Network Analysis

Figure 3a is an SNA visualization of southern Ontario Iroquoian sites dating from 1350 to 1650 utilizing the entire BR similarity matrix. This is the subregional mesoscale in our analysis. In this network, Best, Pugh, Draper, and Spang—the local sequence or microscale—cluster together at the top, whereas Jean-Baptiste Lainé and Aurora plot amid a large number of earlier sites from the Humber, Don, and Credit Rivers to the west at the bottom left. Figure 3b, a strong-ties network for the same sites using BR values ≥153 (85% of 180, the highest value in the network), shows the same pattern. Louvain community detection analysis with initial clustering set to uniform and edge weight set to BR values results in four clusters: within these Best, Pugh, Draper, and Spang are grouped together in one cluster and Jean-Baptiste Lainé and Aurora in another. Absent two isolates in the network used for Louvain analysis, these results are identical to *k*-means cluster analysis results using the full BR matrix and specifying four clusters (Supplemental Table 3), as well as the results of metric multidimensional scaling (Supplemental Figure 1). In each analysis, Aurora and Jean-Baptiste Lainé cluster with earlier sites to the west, whereas Draper and Spang cluster with Best and Pugh. These results indicate that there was a shift in the use of collar decoration motifs in the sequence between Spang and Jean-Baptiste Lainé, with the community incorporating a greater percentage of motifs previously in use by communities located to the west.

The results of *t*-tests using vectors of BR values between each of the six West Duffins Creek village sites and village sites dating from 1450 to 1600 in the Humber, Don, and Credit river drainages to the west are presented in Table 3. Permutation *p*-values are used because of the small sample size ($n = 15$). Paired *t*-tests were used under the assumption that each set of chronologically sequential sites (the microscale) represents the same community before and after a relocation, respectively. (Because they are not sequential, a paired test was not performed for Best and Pugh.) Each of the paired tests has a *p*-value <0.05, indicating a significant difference between the vector means. The vectors of differences between the pairs do not depart significantly from normal distribution (Supplemental Table 4). The results show an increase in vector means between Best and Pugh, followed by decreases for Draper and then Spang, followed by a substantial increase for Jean-Baptiste Lainé and small decrease for Aurora. *T*-tests were also used with no assumption that the sites represent sequences of the same community. The six vectors do not depart significantly from normal distribution (Supplemental Table 5), and the vector pairs do not have significantly different variances (Supplemental Table 6). The paired *t*-test pattern is duplicated with the exceptions that there is not a significant difference between Best and Pugh or between Jean-Baptiste Lainé and Aurora.

https://doi.org/10.1017/aaq.2021.5 Published online by Cambridge University Press

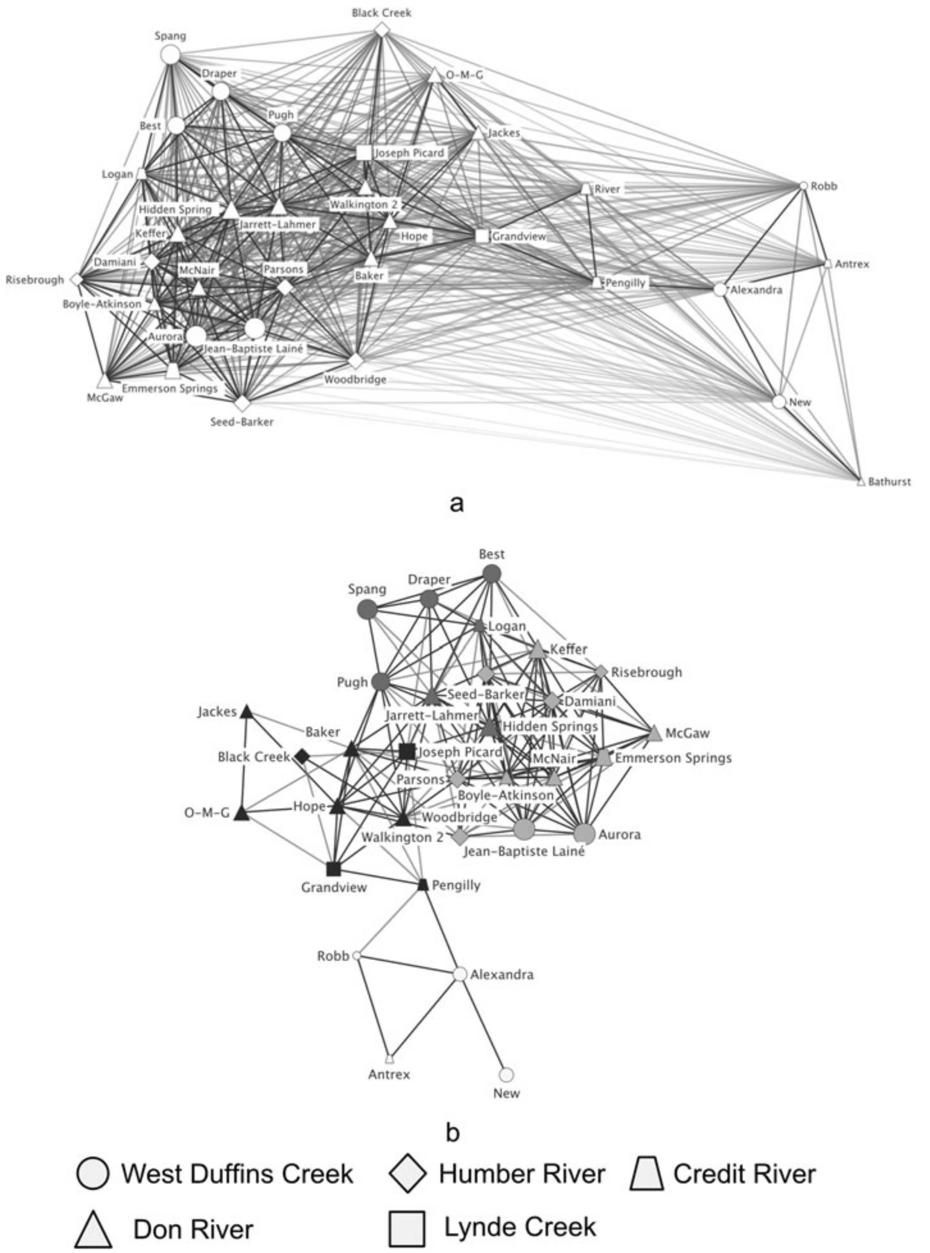

Figure 3. Social network analysis visualizations for north-shore village sites: (a) Backbone visualization using the complete BR matrix; (b) Spring-embedded, strong-ties network using a BR threshold of ≥153 (80% of highest values in the network). Darker ties indicate higher BR values. Node size reflects chronology with the largest nodes representing the youngest sites.

The E-I index was calculated for the 1450–1650 mesoscale network using Borck and colleagues' (2015) R script with 5,000 permutations, and it was normalized for sample size for the 1450–1650 network. This index indicates whether a node within a network is more focused on interactions inside (homophily) or outside (heterophily) of its network group (in this case, the microscale stream basin). Values range from –1 to +1, with negative values indicating

https://doi.org/10.1017/aaq.2021.5 Published online by Cambridge University Press

Table 3. *T*-Test Results for West Duffins Creek Sites' BR Values with North Shore Sites to the West, AD 1450–1600.

Site Sequence	n	Difference between Means	Paired *T*-Test		*T*-Test	
			t	p^a	t	p^b
Best—**Pugh**	15	8.8667	—	—	2.0006	0.0598
Pugh→Draper	15	8.8667	4.3930	0.0074	2.2871	0.0335
Draper→Spang	15	9.8000	18.5840	0.0001	2.6460	0.0120
Spang→**Jean-Baptiste Lainé**	15	22.8000	7.0181	0.0001	5.3080	0.0001
Jean-Baptiste Lainé→Aurora	15	4.5333	2.4121	0.0342	0.8306	0.4206

Note: Bold indicates the site with the greater mean.
[a] Exact permutation.
[b] Monte Carlo permutation.

homophily and positive values heterophily. Results are presented in Supplemental Table 7. Although all of the indices are positive, there is a drop-off following Pugh, with Spang having the lowest value. The value for Jean-Baptiste Lainé is over four times greater than the value for Pugh, whereas the value for Aurora is slightly higher than that of Jean-Baptiste Lainé.

Taken together, the results indicate that the communities at Jean-Baptiste Lainé and Aurora made greater use of collar decoration signals previously used by communities to the west than did the communities at Draper and Spang. This is consistent with our previous macroscale analysis that indicated less external signaling during the period of regional conflict (Hart et al. 2016). As is apparent in Supplemental Table 8, the pottery assemblages of sites in the cluster with Jean-Baptiste Lainé and Aurora had high percentages of simple motifs (diagonal or vertical lines), whereas those in the Draper and Spang cluster had lower percentages of simple motifs and higher percentages of crossed motifs (designs with one or more lines crossing at an angle), including sites dating to the fifteenth century. Our earlier analyses (Birch and Hart 2018; Hart et al. 2016) identified the simple motif category as a metaidentifier for the Wendat confederacy.

Expanding the SNA to the macroscale to include sites to the north in historic Wendake and the adjacent Tionontaté (Petun) area provides additional contexts for these changes (Figure 4). The resulting strong-ties network SNA visualization for the 1450–1650 time frame continues to separate Jean-Baptiste Lainé and Aurora from earlier sites in the West Duffins Creek drainage. Aurora is assigned to the Louvain cluster containing most of the Wendake-Tionontaté sites. The last villages in our sample from the Credit (Emmerson Springs), Don (Keffer, but not Jarrett-Lahmer), and Humber (Diaimani, Seed-Barker, MacKenzie-Woodbridge) cluster with Jean-Baptiste Lainé. This indicates a west-to-east trend in use of the metaidentifier (simple motifs), a signal of membership in a network focused to the north. This shift in signaling network is evident in paired Wilcoxon and Mann-Whitney tests of the West Duffins Creek sites' BR values with Wendake-Tionontaté sites dating to 1450–1650 (Table 4). These nonparametric tests were used because the vectors of Wendake-Tionontaté BR values depart significantly from normal distribution (Supplemental Table 9). A significant shift in BR values occurs between the occupations of Spang and Mantle.

By the time Jean-Baptiste Lainé and Aurora were occupied, other drainages to the west had been abandoned, with the exception of the Upper Humber drainage where the Skandatut site is located. Although Skandatut's decorated pottery collar assemblage is not large enough to be included in the SNA analysis, the 3.2 ha site is unlikely to have accommodated the multiple communities of villages abandoned after 1580 in the Upper Humber drainage and to the west. Even though the abandonment of villages from the west may have resulted, in part, due to functional reasons for village relocation (limitations of soil fertility, firewood, etc.), it now seems far more likely that this pattern of population movement had more to do with the expansion of a buffer zone on the frontier of escalating conflicts with the Seneca and the

Figure 4. A stress-minimization, strong-ties network visualization of north-shore and Wendake-Tionontaté village sites dating between 1450 and 1650 using a BR threshold of ≥164 (80% of highest values in the network). Darker ties indicate higher BR values.

larger Haudenosaunee confederacy (Birch et al. 2021).

The strong ties between Jean-Baptiste Lainé and Aurora and multiple villages in the drainages of the Don, Humber, and Credit Rivers indicate that signaling behavior employed at these earlier sites was now taking place at Mantle and Aurora. This is in keeping with the increasing and widespread use of metaidentifiers at the mesoscale. Approaching these patterns from the microscale causes us to rethink the composition of these communities, including the possibility that

https://doi.org/10.1017/aaq.2021.5 Published online by Cambridge University Press

Table 4. Wilcoxon and Mann-Whitney Tests of BR Wendake-Tionontaté Site 1450–1650 Vectors for West Duffins Creek Sites.

		Paired Wilcoxon		Mann-Whitney	
Site Sequence	*N*	*W*	p^a	*U*	p^a
Pugh → Draper	33	263.5	0.7671	539.0	0.9483
Draper → Spang	33	513.0	0.0000	365.5	0.0208
Spang → **Jean-Baptiste Lainé**	33	477.5	0.0002	204.0	0.0001
Jean-Baptiste Lainé → Aurora	33	380.0	0.0761	417.0	0.1030

Note: Sites with bolded name have higher medians (*W*) or mean rank (*U*).
[a] Monte Carlo permutation.

these villages may have been refugia for subcommunity groups fleeing hostilities to the west.

Although little is known about the internal structure of the Aurora site (but see Emerson 1954), we know a great deal about Jean-Baptiste Lainé's occupational history (Birch and Williamson 2013). The village was originally constructed with longhouses arranged in a radial alignment surrounding a plaza that also contained a number of lightly built, temporary structures (Figure 5). Partway through the site's occupation, two major changes occurred: the palisade was contracted and reinforced with the addition of a ditch and earthen embankment, and the plaza was filled in with new, permanent structures. The contraction of the palisade has been thought to have coincided with a portion of the population leaving the village, possibly

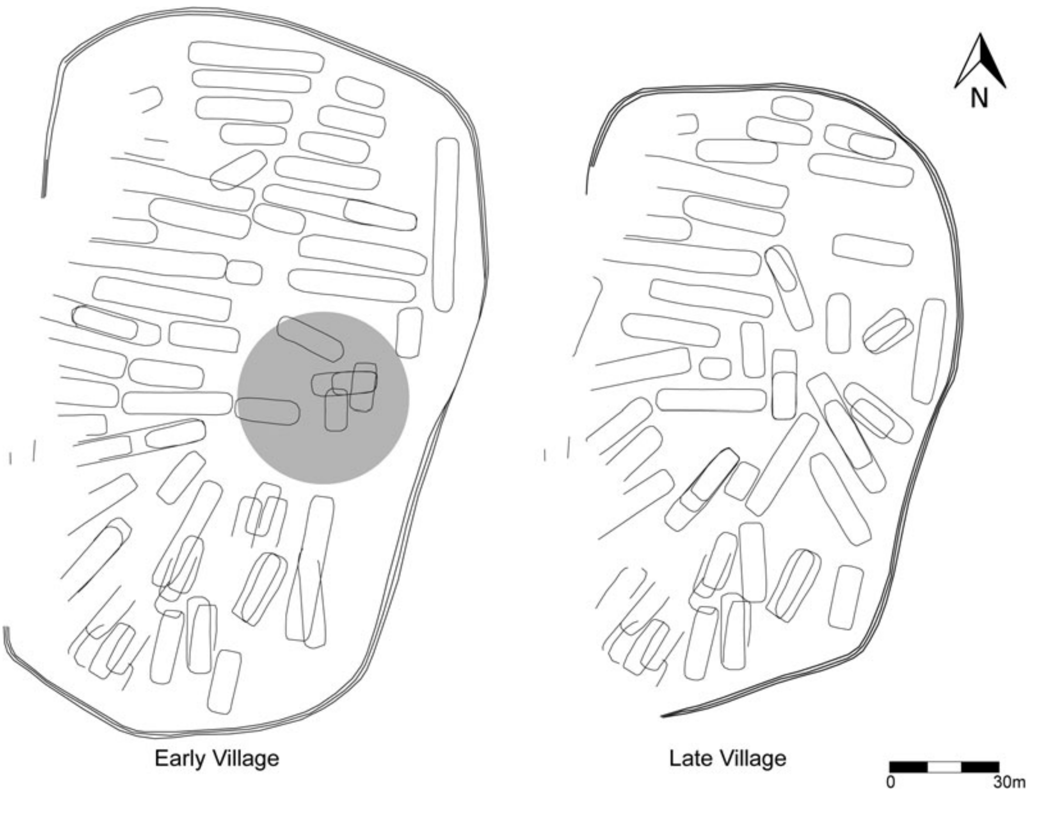

Figure 5. Jean-Baptiste Lainé site plan composite. The gray circle indicates the plaza area that was a feature of the original village plan before being filled in with lightly built and then permanent structures. For a thorough description of the Jean-Baptiste Lainé site excavations and occupational history, see ASI (2014) and Birch and Williamson (2013).

relocating to sites further north, including Aurora. Aurora's palisade also features the same ditch-and-embankment structure (Emerson 1954). The results of this network analysis offer an additional dimension to our understanding of the Jean-Baptiste Lainé site's occupational history. It now seems likely that Jean-Baptiste Lainé and Aurora were home to people with deep roots in the local drainage *as well as* people originating to the west who were relocating north and east, away from the frontier with the Seneca (Birch et al. 2021). The reconfiguration of the Jean-Baptiste Lainé site plan, including the in-filling of the plaza with new structures, may have been because of the inflow of people from outside the local sequence. Previous analyses of the Jean-Baptiste Lainé site have also recognized diversity in artifact assemblages and mortuary behavior, suggesting that Jean-Baptiste Lainé was more cosmopolitan than earlier communities in the north-shore region. Notably, strontium isotope analyses of human tooth enamel indicates the presence of individuals who originated from outside the region (Pfeiffer et al. 2020). This may have been in part because Jean-Baptiste Lainé and Aurora were among the last remaining communities on the Haudenosaunee frontier, and as such, they exhibit the characteristics of communities situated on frontiers or borderlands (e.g., Harry and Herr 2018). Aurora's strong ties to sites in the historic Wendake-Tionontaté homelands can be interpreted as relating to the eventual amalgamation of this community into the confederacy with the final abandonment of the north-shore region.

Conclusions

The new radiocarbon time frame for late precontact Iroquoia makes it clear that conflict between Haudenosaunee and ancestral Wendat communities was the impetus for the coalescence of settlements on the north shore of Lake Ontario as well as the relocation of these same communities northward along major drainages during the late fifteenth and sixteenth centuries AD. The data and interpretations presented here reveal a new dimension to site relocation sequences and processes of population movement.

Whereas it was previously thought that coalescence had been occurring primarily among local community groups throughout this period, the SNA analyses conducted here indicate that this was only the case initially—that is, in the mid-sixteenth century. Over the next 50-year period, as conflict and the withdrawal of ancestral Wendat populations north and east continued, the use of metaidentifiers and the fission and fusion of subcommunity groups contributed to both network topologies at the mesoscale and coresidential communities at the microscale that were more dynamic than the single-village relocation sequence model permits. Similar results have been obtained in a recent assessment of a proposed three-village sequence in the late fifteenth- to sixteenth-century Mohawk River valley in New York (Hart 2020).

By applying new analytical techniques to archaeological data—in this case, derived from extant collections—studies such as this one are causing us to rethink long-held assumptions about the cultural past (Wylie 2017). Bayesian modeling of radiocarbon dates and social network analysis of pottery decoration have resulted in the recognition that ancestral Wendat settlement dynamics were more variable than previous models of site relocation sequences or local processes of coalescence have suggested. These findings are also in keeping with ancestral Wendat understandings about the nature of circular relations between their communities and the centrality of processes of incorporation in ancestral Wendat society (Sioui 1999).

Acknowledgments. Thanks to Susan Winchell-Sweeney for drafting Figure 1. We also acknowledge our collaborators on the social network analyses and radiocarbon dating projects that laid the foundation for this work. Thanks to the Huron-Wendat Nation for the opportunity to learn more about the lives of its ancestors.

Date Availability Statement. Original radiocarbon data are identified in text. No other original data were presented in this article.

Supplemental Materials. For supplemental material accompanying this article, visit https://doi.org/10.1017/aaq.2021.5.

Supplemental Figure 1. Metric multidimensional scaling (principal coordinates analysis) plot of north-shore village sites BR matrix with minimal spanning tree and eigenvalue scaling, and no transformation exponent.

Supplemental Table 1. West Duffins Sequence Traditional Model Runfile.

Supplemental Table 2. West Duffins Sequence Traditional Model with Outlier Samples with Agreements <60 Omitted.

Supplemental Table 3. Cluster Analyses Results of All Southern Ontario Sites in the SNA Database.

Supplemental Table 4. Tests for Normal Distribution of BR Vector Differences between West Duffins Creek Sites and Sites to the West Dating from 1450 to 1650.

Supplemental Table 5. Test for Normal Distribution for BR Vectors between West Duffins Creek Sites and Sites to the West Dating from 1450 to 1650.

Supplemental Table 6. F-Test Results for BR Vectors Pairs between West Duffins Creek Sites and Sites to the West Dating from 1400 to 1650.

Supplemental Table 7. E-I Index Results for North-Shore Sites.

Supplemental Table 8. Percentages of Simple and Crossed Motifs by Site within SNA Clusters.

Supplemental Table 9. Normality Tests for West Duffins Creek 1450–1650 Wendake-Tionontaté Site BR Value Vectors.

References Cited

Allen, Kathleen M. S.
1988 Ceramic Style and Social Continuity in an Iroquoian Tribe. PhD dissertation, Anthropology Department, University of Buffalo, Buffalo, New York.

ASI (Archaeological Services Inc.)
2014 The Archaeology of the Mantle Site (AlGt-334). A Report on the Stage 3–4 Salvage Excavation of the Mantle Site (AlGt-334), Part of Lot 33, Concession 9, Town of Whitchurch-Stouffville, Regional Municipality of York, Ontario. Report on file at the Ontario Ministry of Culture, Toronto.

Bernardini, Wesley R.
2011 Migration in Fluid Social Landscapes. In *Rethinking Anthropological Perspectives on Migration*, edited by Graciela S. Cabana and Jeffery J. Clark, pp. 31–44. University Press of Florida, Gainesville.

Biggar, Henry P. (editor)
1922–1936 *The Works of Samuel de Champlain*. 6 vols. Champlain Society, Toronto.

Birch, Jennifer
2012 Coalescent Communities: Settlement Aggregation and Social Integration in Iroquoian Ontario. *American Antiquity* 77:646–670. DOI:10.7183/0002-7316.77.4.646.

2015 Current Research on the Historical Development of Northern Iroquoian Societies. *Journal of Archaeological Research* 23:263–323. DOI:10.1007/s10814-015-9082-3.

2019 Settlement Aggregation and Geopolitical Realignment in the Northeastern Woodlands. In *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*, edited by Attila Gyucha, pp. 349–368. State University of New York Press, Albany.

Birch, Jennifer, and John P. Hart
2018 Social Networks and Northern Iroquoian Confederacy Dynamics. *American Antiquity* 83:13–33. DOI:10.1017/aaq.2017.5.

Birch, Jennifer, and Louis Lesage
2020 When Detachment Is Not Complete: Emplacement and Displacement in Ancestral Huron-Wendat Landscapes. In *Detachment from Place: Beyond an Archaeology of Settlement Abandonment*, edited by Maxime Lamoureux-St-Hilaire and Scott Macrae, pp. 45–62. University Press of Colorado, Boulder.

Birch, Jennifer, Sturt W. Manning, Samantha Sanft, and Megan Anne Conger
2021 Refined Radiocarbon Chronologies for Northern Iroquoian Site Sequences: Implications for Coalescence, Conflict, and the Reception of European Goods. *American Antiquity* 86:61–89. DOI:10.1017/aaq.2020.73.

Birch, Jennifer, and Ronald F. Williamson
2013 *The Mantle Site: An Archaeological History of an Ancestral Wendat Community*. AltaMira Press, Lanham, Maryland.

2018 Initial Northern Iroquoian Coalescence. In *The Archaeology of Villages in Eastern North America*, edited by Jennifer Birch and Victor D. Thompson, pp. 89–105. University of Florida Press, Gainesville.

Bliege Bird, Rebecca, and Eric Alden Smith
2005 Signaling Theory, Strategic Interaction, and Symbolic Capital. *Current Anthropology* 46:221–248. DOI:10.1086/427115.

Blondel, Vincent D., Jean-Loup Guillaume, Renaud Lambiotte, and Étienne Lefebvre
2008 Fast Unfolding of Communities in Large Networks. *Journal of Statistical Mechanics: Theory and Experiment* 10:P10008. DOI:10.1088/1742-5468/2008/10/P10008.

Borck, Lewis, Barbara J. Mills, Matthew A. Peeples, and Jeffery J. Clark
2015 Are Social Networks Survival Networks? An Example from the Late Pre-Hispanic US Southwest. *Journal of Archaeological Method and Theory* 22:33–57. DOI:10.1007/s10816-014-9236-5.

Bowser, Brenda J.
2000 From Pottery to Politics: An Ethnoarchaeological Study of Political Factionalism, Ethnicity, and Domestic Pottery Style in the Ecuadorian Amazon. *Journal of Archaeological Method and Theory* 7:219–248. DOI:10.1023/A:1026510620824.

Bowser, Brenda J., and John Q. Patton
2004 Domestic Spaces as Public Places: An Ethnoarchaeological Case Study of Houses, Gender, and Politics in the Ecuadorian Amazon. *Journal of Archaeological Method and Theory* 11:157–181. DOI:10.1023/B:JARM.0000038065.43689.75.

Bradley, James W.
1987 *Evolution of the Onondaga Iroquois, Accommodating Change, 1500–1655*. Syracuse University Press, Syracuse, New York.

Brandes, Ulrik, and Dorothea Wagner
2004 Analysis and Visualization of Social Networks. In *Graph Drawing Software*, edited by Michael Jünger and Petra Mutzel, pp. 321–340. Springer-Verlag, Berlin.

Braun, Gregory
2015 Ritual, Materiality, and Memory in an Iroquoian Village. PhD dissertation, Department of Anthropology, University of Toronto, Toronto.

Bronk Ramsey, Christopher
2009a Bayesian Analysis of Radiocarbon Dates. *Radiocarbon* 51:337–360. DOI:10.1017/S0033822200033865.

2009b Dealing with Outliers and Offsets in Radiocarbon Dating. *Radiocarbon* 51:1023–1045. DOI:10.1017/S0033822200034093.

Brughmans, Tom
2013 Thinking Through Networks: A Review of Formal Network Methods in Archaeology. *Journal of Archaeological Method and Theory* 20:623–662. DOI:10.1007/s10816-012-9133-8.

Carr, Christopher
1995 A Unified Middle-Range Theory of Artifact Design. In *Style, Society, and Person: Archaeological and Ethnological Perspectives*, edited by Christopher Carr and Jill E. Neitzel, pp. 171–258. Plenum Press, New York.

Chilton, Elizabeth S.
1996 Embodiments of Choice: Native American Ceramic Diversity in the New England Interior. PhD dissertation, Department of Anthropology, University of Massachusetts, Amherst.

Curtis, Jenneth E., and Martha A. Latta
2000 Ceramics as Reflectors of Social Relationship: The Auger Site and Ball Site Castellations. *Ontario Archaeology* 70:1–15.

Dee, Michael W., and Christopher Bronk Ramsey
2014 High-Precision Bayesian Modeling of Samples Susceptible to Inbuilt Age. *Radiocarbon* 56:83–94. DOI:10.2458/56.16685.

Dee, Michael W., David Wengrow, Andrew Shortland, Alice Stevenson, Fiona Brock, Linus Girdland Flink, and Christopher Bronk Ramsey
2013 An Absolute Chronology for Early Egypt Using Radiocarbon Dating and Bayesian Statistical Modelling. *Proceedings of the Royal Society A: Mathematical, Physical, and Engineering Sciences* 469(2159): 20130395. DOI:10.1098/rspa.2013.0395.

Emerson, John Norman
1954 The Archaeology of the Ontario Iroquois. PhD dissertation, Department of Anthropology, University of Chicago, Chicago.

Engelbrecht, William
2003 *Iroquoia: The Development of a Native World*. Syracuse University Press, Syracuse, New York.

Finlayson, William D.
1985 *1975 and 1978 Rescue Excavations at the Draper Site: Introduction and Settlement Patterns*. University of Ottawa Press, Ottawa.

Gramly, Richard Michael
1977 Deerskins and Hunting Territories: Competition for a Scarce Resource of the Northeastern Woodlands. *American Antiquity* 42:601–605. DOI:10.2307/278933.

Hammer, Øyvind, David A. T. Harper, and Paul D. Ryan
2001 PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica* 4:9. Electronic document, https://palaeo-electronica.org/2001_1/past/issue1_01.htm, accessed February 11, 2021.

Harry, Karen G., and Sarah A. Herr (editors)
2018 *Life beyond the Boundaries: Constructing Identity in Edge Regions of the North American Southwest*. University Press of Colorado, Boulder.

Hart, John P.
2020 Reassessing an Inferred Village Removal Sequence in the Proto-Historic Mohawk River Basin, New York, USA. *Journal of Anthropological Archaeology* 60:101236. DOI:10.1016/j.jaa.2020.101236.

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). DOI:10.1126/sciadv.1700497.

Hart, John P., and William Engelbrecht
2012 Northern Iroquoian Ethnic Evolution: A Social Network Analysis. *Journal of Archaeological Method and Theory* 19:322–349. DOI:10.1007/s10816-011-9116-1.
2017 Revisiting Onondaga Iroquois Prehistory through Social Network Analysis. 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. 189–214. University Press of Colorado, Boulder.

Hart, John P., Termeh Shafie, Jennifer Birch, Susan Dermarker, and Ronald Williamson
2016 Nation Building and Social Signaling in Southern Ontario, A.D. 1350–1650. *PLoS ONE* 11(5): e0156178. DOI:10.1371/journal.pone.0156178.

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. DOI:10.1371/journal.pone.0209689.

Hawkins, Alicia L.
2004 Recreating Home? A Consideration of Refugees, Microstyles and Frilled Pottery in Huronia. *Ontario Archaeology* 77–78:62–80.

Hawkins, Alicia L., Kaitlyn Malleau, and Deirdre Elliott
2018 A Consideration of Participants in Huron-Wendat Subsistence Strategies across the Pre-Contact and Early Colonization Periods. *Journal of Archaeological Science: Reports* 20:873–880. DOI:10.1016/j.jasrep.2017.10.024.

Hill, Mark A., Kevin C. Nolan, and Mark S. Seeman
2020 Social Network Analysis and the Social Interactions That Define Hopewell. In *Archaeological Networks and Social Interaction*, edited by Lieve Donnellan, pp. 173–195. Routledge, New York.

Jones, Eric E., and James W. Wood
2012 Using Event-History Analysis to Examine the Causes of Semi-Sedentism among Shifting Cultivators: A Case Study of the Haudenosaunee, AD 1500–1700. *Journal of Archaeological Science* 39:2593–2603. DOI:10.1016/j.jas.2012.04.019.

Kenyon, Ian T., and Thomas A. Kenyon
1983 Comments on 17th Century Glass Trade Beads from Ontario. In *Proceedings of the 1982 Glass Trade Bead Conference*, edited by Charles F. Hayes III, pp. 59–74. Research Records No. 16. Rochester Museum and Science Center, Rochester, New York.

Kintigh, Keith
2010 Tools for Quantitative Archaeology. Electronic document, http://tfqa.com/doc, accessed May 26, 2020.

Ladefoged, Thegn N., Caleb Gemmell, Mark McCoy, Alex Jorgensen, Hayley Glover, Christopher Stevenson, and Dion O'Neale
2019 Social Network Analysis of Obsidian Artefacts and Māori Interaction in Northern Aotearoa New Zealand. *PLoS ONE* 14(3):e0212941. DOI:10.1371/journal.pone.0212941.

Lulewicz, Jacob
2019 The Social Networks and Structural Variation of Mississippian Sociopolitics in the Southeastern United States. *PNAS* 116:6707–6712. DOI:10.1073/pnas.1818346116.

Lulewicz, Jacob, and Adam B. Coker
2018 The Structure of the Mississippian World: A Social

Network Approach to the Organization of Sociopolitical Interactions. *Journal of Anthropological Archaeology* 50:113–127. DOI:10.1016/j.jaa.2018.04.003.

MacDonald, Robert I.
2002 Late Woodland Settlement Trends in South-Central Ontario: A Study of Ecological Relationships and Culture Change. PhD dissertation, Department of Anthropology, McGill University, Montreal.

Manning, Sturt W., Jennifer Birch, Megan Anne Conger, Michael W. Dee, Carol Griggs, and Carla S. Hadden
2019 Contact-Era Chronology Building in Iroquoia: Age Estimates for Arendarhonon Sites and Implications for Identifying Champlain's Cahiagué. *American Antiquity* 84:684–707. DOI:10.1017/aaq.2019.60.

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). DOI:10.1126/sciadv.aav0280.

Martelle, Holly
2002 Huron Potters and Archaeological Constructs: Researching Ceramic Microstylistics. PhD dissertation, Department of Anthropology, University of Toronto, Toronto.
2004 Some Thoughts on the Impact of Epidemic Disease and European Contact on Ceramic Production in Seventeenth Century Huronia. *Ontario Archaeology* 77–78:22–44.

Mills, Barbara J.
2017 Social Network Analysis in Archaeology. *Annual Review of Anthropology* 46:379–397. DOI:10.1146/annurev-anthro-102116-041423.

Mills, Barbara J., Matthew A. Peeples, W. Randall Haas Jr., Lewis Borck, Jeffery J. Clark, and John M. Roberts Jr.
2015 Multiscalar Perspectives on Social Networks in the Late Prehispanic Southwest. *American Antiquity* 80:3–24. DOI:10.7183/0002-7316.79.4.3.

Mizoguchi, Koji
2013 Evolution of Prestige Good Systems: An Application of Network Analysis to the Transformation of Communication Systems and Their Media. In *Network Analysis in Archaeology: New Approaches to Regional Interaction*, edited by Carl Knappett, pp. 151–178. Oxford University Press, Oxford.

Niemczycki, Mary Ann Palmer
1984 *The Origin and Development of the Seneca and Cayuga Tribes of New York State*. Research Records No. 17. Rochester Museum and Science Center, Rochester, New York.

Peeples, Matthew A.
2018 *Connected Communities: Networks, Identity, and Social Change in the Ancient Cibola World*. University of Arizona Press, Tucson.
2019 Finding a Place for Networks in Archaeology. *Journal of Archaeological Research* 27:451–499. DOI:10.1007/s10814-019-09127-8.

Peregrine, Peter
1991 A Graph-Theoretic Approach to the Evolution of Cahokia. *American Antiquity* 56:66–75. DOI:10.2307/280973.

Perrelli, Douglas J.
2009 Iroquoian Social Organization in Practice: A Small-Scale Study of Gender Roles and Site Formation in Western New York. In *Iroquoian Archaeology and Analytic Scale*, edited by Laurie E. Miroff and Timothy D. Knapp, pp. 19–50. University of Tennessee Press, Knoxville.

Pfeiffer, Susan, Ronald F. Williamson, Jennifer Newton, Petrus le Roux, Crystal Forrest, and Louis Lesage
2020 Population Movements of the Huron-Wendat Viewed through Strontium Isotope Analysis. *Journal of Archaeological Science: Reports* 33:102466. DOI:10.1016/j.jasrep.2020.10246.

Ramsden, Peter G.
1977 *A Refinement of Some Aspects of Huron Ceramic Analysis*. National Museum of Canada, Ottawa, Ontario.
2009 Politics in a Huron Village. In *Painting the Past with a Broad Brush: Papers in Honour of James Valliere Wright*, edited by David Keenlyside and Jean-Luc Pilon, pp. 299–318. Mercury Series Archaeology Paper 170. Canadian Museum of Civilization, Gatineau, Quebec.
2016 Becoming Wendat: Negotiating a New Identity around Balsam Lake in the Late Sixteenth Century. *Ontario Archaeology* 96:121–133. https://www.ontarioarchaeology.org/resources/Publications/OA96-11%20Ramsden.pdf, accessed February 11, 2021.

Reimer, Paula, 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. Hoffman, Alan G. Hogg, Konrad A. Hughen, K. Felix Kaiser, Bernd 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. DOI:10.2458/azu_js_rc.55.16947.

Ritchie, William A., and Robert E. Funk
1973 *Aboriginal Settlement Patterns in the Northeast*. New York State Museum Memoir 20. University of the State of New York, Albany.

Rorabaugh, Adam N.
2019 Hunting Social Networks on the Salish Sea before and after the Bow and Arrow. *Journal of Archaeological Science: Reports* 23:822–843. DOI:10.1016/j.jasrep.2018.11.040.

Schachner, Gregson
2012 *Population Circulation and the Transformation of Ancient Zuni Communities*. University of Arizona Press, Tucson.

Sioui, Georges
1999 *Huron-Wendat: The Heritage of the Circle*. UBC Press, Vancouver.
2019 *Eatenonhia: Native Roots of Modern Democracy*. McGill-Queen's University Press, Montreal.

Smith, Michael E.
2014 Peasant Mobility, Local Migration and Premodern Urbanization. *World Archaeology* 46:516–533. DOI:10.1080/00438243.2014.931818.

Smith, Michael E., Gary M. Feinman, Robert D. Drennan, Timothy Earle, and Ian Morris
2012 Archaeology as a Social Science. *PNAS* 109:7617–7621. DOI:10.1073/pnas.1201714109.

Snow, Dean R.
1994 *The Iroquois*. Blackwell Publishers, Cambridge.

Thwaites, Reuben G.
1896–1901 *The Jesuit Relations and Allied Documents*. 73 vols. Burrows Brothers, Cleveland.

Trigger, Bruce G.
1976 *The Children of Aataentsic: A History of the Huron People to 1660*. McGill-Queen's University Press, Montreal.
Tuck, James A.
1971 *Onondaga Iroquois Prehistory: A Study in Settlement Archaeology*. Syracuse University Press, Syracuse, New York.
Warrick, Gary A.
1988 Estimating Ontario Iroquoian Village Duration. *Man in the Northeast* 36:21–60.
2008 *A Population History of the Huron-Petun, AD 500–1650*. Cambridge University Press, Cambridge.
Williamson, Ronald F.
2014 The Archaeological History of the Wendat to AD 1651: An Overview. *Ontario Archaeology* 94:3–64. https://www.ontarioarchaeology.org/resources/Publications/OA%20No%2094%20Journal_2014.pdf#page9, accessed February 11, 2021.
Williamson, Ronald F., Megan Burchell, William A. Fox, and Sarah Grant
2016 Looking Eastward: Fifteenth- and Early 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. 235–256. Mercury Series Archaeological Paper 176. Canadian Museum of History, Gatineau; University of Ottawa Press, Ottawa.
Williamson, Ronald F., Martin S. Cooper, and David A. Robertson
1998 The 1989–90 Excavations at the Parsons Site: Introduction and Retrospect. *Ontario Archaeology* 65:4–16.
Wrong, George M. (editor)
1939 *Sagard's Long Journey to the Country of the Hurons*. Champlain Society, Toronto.
Wylie, Alison
2017 How Archaeological Evidence Bites Back: Strategies for Putting Old Data to Work in New Ways. *Science, Technology, and Human Values* 42:203–225. DOI:10.1177%2F0162243916671200.

Submitted July 23, 2020; Revised September 18, 2020; Reviews completed September 25, 2020; Accepted September 25, 2020