the connected Caribbean : a socio-material network approach to patterns of homogeneity and diversity in the pre-colonial period

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Chapter 5

A Heart of Stone: Lithic Networks from 3200 BC to AD 400

No one could ever find a stone
that from splendour of sun or inner light
had such power or stood out so bright.

Excerpt from Dante Alighieri's *the Stone Beloved* (Kline 2008)

Following through with the main themes of this work, patterns of homogeneity and diversity and the socio-material networks of the Caribbean, this chapter will examine how lithic production and distribution is informative of the early socio-cultural history of the region, in particular that of the "Archaic"-Saladoid-Huecoid Interface period.[1] This will be done by discussing continuity and changes in the production and distribution of stone material sources endogenous to the Northeastern Caribbean from the period 3200 BC-AD 400 (Figure 5.1). With regard to a number of these materials a precise *chaîne operatoire* can be reconstructed presenting us with an insight into their production and (down-the-line) exchange (Cody 1990; Crock 2000; Knippenberg 2007; Murphy, *et al.* 2000; Watters and Scaglion 1994).

These lithic networks will be traced over a time-span of 3600 years, divided into five segments: Period A (3200-2000 BC), Period B (2000-800 BC), Period C (800-200 BC), Period D (AD 200 BC-100), and Period E (AD 100-400). The initial occupation of the islands in this study is dated to *c.*3200 BC at sites such as,

1 Corinne Hofman, Sebastiaan Knippenberg, Reniel Rodríguez Ramos and I collaborated on the case-study presented here and of which the network explorative and interpretational part is further dealt with. Working from an incipient idea developed by Hofman several years earlier, we focused on the role of lithic exchange – specifically in intercommunity gatherings such as feasts – with reference to the evolving social networks of this period. Knippenberg and Rodríguez Ramos undertook the lithic analyses and identifications that lie at the basis of the distribution networks. All credit for this should go to them, and any mistakes or generalizations made here are entirely my own. Hofman and I collected other relevant (site) data, such as the C-14 database (assisted by Anne van Duijvenbode), site classification and ceramic stylistic affiliation. The network data was explored by the present author and presented by Corinne Hofman as a paper at the 24th Congress of the International Association for Caribbean Archaeology in Martinique (Summer 2011). It is currently in preparation for a publication called *Islanders on the Move* (University of Alabama Press, edited by Corinne L. Hofman).

for instance, Jolly Beach I (Antigua) and Angostura (Puerto Rico), indeed – several hundred years later than the islands located beyond the western and southern extremes of the study region for example Hispaniola and Trinidad – which evolved into a local set of material culture practices during Period B. Period C witnessed an important shift: communities that had long been present in the Caribbean were presented either with (groups of) new settlers or with technical, cultural and social changes that must have taken place in a relatively small window of time. At the conclusion of period D permanent habitation sites, ceramics and subsistence practices partially based on garden farming had become the norm. These developments continued throughout and beyond period E. By that time the typical pre-period C a-ceramic, smaller temporary places of habitation or activity had been largely phased out and became a less ubiquitous feature of indigenous culture and society – although such sites never ceased to exist throughout the pre-colonial period and even up till today.

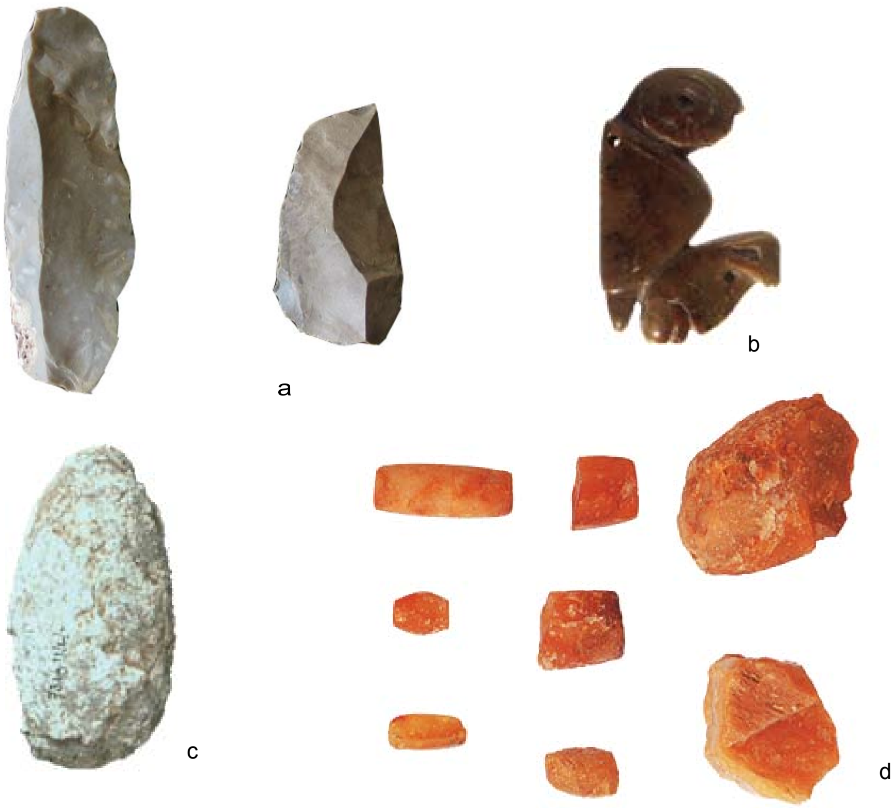

Figure 5.1: Local stone of the Northeastern Caribbean. A: Long Island Flint Blade and Flake (Photograph courtesy of Menno L.P. Hoogland). B: Puerto Rican serpentinite in the shape of a bird of prey amulet (Photograph courtesy of Reniel Rodríguez Ramos); St. Martin Greenstone axe, note that the original hue would have been a far more muddier green, but the material has weathered over time (Photograph courtesy of Sebastiaan Knippenberg); Carnelian beads, half-fabricates and raw material (Photograph courtesy of Arie Boomert).

This marks these periods out as being of formative importance for later Caribbean cultures and societies, as discussed at greater length in Chapter 2. Within this time frame, as I will outline below, the period between 800 BC and AD 400 sees the largest quantity of change in the networks under study. Although opinions differ on when, how and whence these changes were initiated, it is clear that around the start of the first millennium the previous ways of life led by small, mobile groups had been replaced by a full-fledged form of village society and a uniquely Caribbean material cultural repertoire. However, these revolutions did not occur as discrete events but are linked processes. Here, a series of network models will serve to explore how these overarching histories of societal and culture change are dialectically related to developments within interaction networks based on the production and distribution of stone raw materials and finished objects.

The network explorations will be contrasted to a hypothetical network model based on a more traditional view of this period focusing on migrations of peoples who only had limited interactions with each other, as forwarded in works by Rouse (e.g. 1986, 1992). Based on the rapid diffusion of Saladoid ceramics and (absence of) mixing of material culture styles, he suggested that during Period C and D culturally superior migrants moved in to the Northeastern Caribbean, supplanting the original inhabitants. It is their societal and material cultural practices that were believed to be at the base of the Early and Late Ceramic Ages. If this is explicated in terms of lithic distribution network structures and dynamics, this "migration network" is one in which new, culturally unified subgraphs (i.e. sites with "pure" ceramic assemblages) will be introduced in period C or D within which we would see a focus on shared lithic material cultural practices and repertoires, but between which little to no lithic materials would be exchanged (Figure 1.5.A).

Nodes and ties

The networks will be discussed at the scale of the region (running from St. Vincent in the south to Puerto Rico in the northwest; Figure 5.2) and, like other archaeological network studies of its kind (Golitko, *et al.* 2012; Phillips 2011), the majority of nodes represent sites and their assemblages. On the basis of more than three hundred C-14 dates a division into five network periods was developed, dating from between 3200 BC and AD 400, which have been labelled A to E. This division is based on mean data intervals coinciding with major socio-cultural processes in the region over time. It starts at the earliest securely dated site in the region and cuts-off at the time that the full arc of the Lesser Antilles has been occupied by ceramic using horticulturalists (Hofman, Mol *et al.* 2011).

During the earliest period several sites included in the sample are find scatters, temporary camps or sites with a presumed semi-sedentary occupation. For the latter periods all sites are considered to have been places of (semi-)permanent habitation – as geographically fixed and temporally contiguous parts of the network. With regard to the network models an extra layer of information has been added to node sites in order to establish their main cultural affiliation at that moment in time. This identification, based on the characteristics of the site's assemblage is indicated

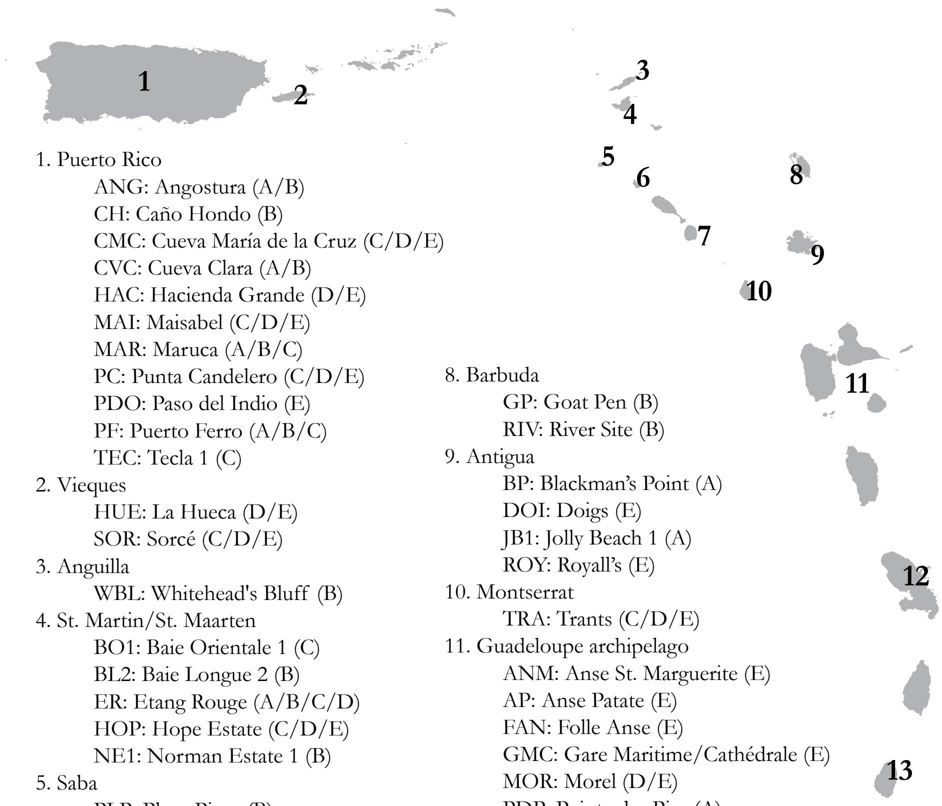

Figure 5.2: Map of sites with codes corresponding to the node names mentioned in the network visualizations. The name of the sites is followed by the period to which it can be dated (indicated in parentheses).

by means of node shape in the network models. The relational database compiled for this case-study also consists of various types of nodes, notably the sources of the lithic raw materials distributed between these sites, which are known to be local to the region (indicated by a rounded, horizontal rectangle in the network).

The nodes in the database are of two types: raw material source and habitation sites. The former are indicated by rectangles and the latter by triangles, squares and circles and a two or three letter code (see Figure 5.2 for a key). As dealt with in Chapter 3, one way to handle such variances in node character is by modelling them in 2-node networks, in which a site can be a "member" of a certain type of lithic material. As such the earliest periods (3200 - 200 BC) can be discussed in terms of their 2-mode network dynamics, which include sites, raw materials but also various technical lithic styles that can be found in the assemblages. These present us with insights into how early Caribbean sites were connected through time and space by means of lithic sources and technologies.

Thanks to the relatively high resolution of the data set it is also possible to draw a somewhat more interpretive 1-mode network for later periods that treats lithic sources and habitation sites as part of the same network. When drawing such a 1-mode model, site contemporaneity is of paramount importance. That is the reason why nearly all sites in these networks have absolute dates taken from two larger C-14 databases: one for Puerto Rico (see Rodríguez Ramos *et al*, 2010) and a second one covering the entire pre- and proto-colonial period of all the Lesser Antilles as assembled by the Leiden Caribbean Research Group.[2] The dates in this database originating from the sites that were part of the sample period and region have been selected based on the parameters for chrono-metric hygiene (Fitzpatrick 2006). As a result, the dates for the earliest sites in the case-study refer to a period lasting for several of thousand to several hundred years. Faced with the disparity of dates we cannot be certain of or even guesstimate whether sites dating from the earliest periods were contemporaneous or not.[3]

In the 1-mode, more interpretive models to be constructed for the later periods, ties between nodes are drawn on the basis of a number of characteristics. When constructing this network the production and distribution chain of the Antiguan Long Island Flint was of paramount importance. This, together with the production and exchange of other lithic materials, has been the feature of a highly valuable line of research carried out by Sebastiaan Knippenberg (2007). Based on an extensive study of lithic assemblages in the Northeastern Caribbean, he was able to map the distribution of Long Island Flint and St. Maarten greenstone and calci-rudite. The latter is not found in assemblages of these periods, but the other two are found over a large region from early to late pre-colonial times. What is more important is that, based on a fall-off analysis of production debris and flake size (cf. Renfrew 1977), it has been possible to distinguish sites with direct access from those that procured these materials through various degrees of down-the-line exchange.

Similar, if somewhat courser, distribution models could be established by means of other lithic raw material sources in the Caribbean as well, notably Puerto Rican serpentinite and carnelian (a yellow or orange variety of chalcedony) from Antigua. The latter two have obvious production centres respectively located in Puerto Rico and on the islands of Antigua and Montserrat from which other islands would have been supplied with raw materials and (semi-)finished objects (Narganes Storde

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2 This database will be included in the forthcoming *Islanders on the Move*, edited by Corinne Hofman (University of Alabama Press).

3 Later periods comprise only a few hundred years. The one-sigma range of C-14 dates from most sites overlap during this period. These are still arguably long lapses of time allowing for all sorts of movements and interactions to take place. However, these habitation sites seem to have been permanent places in the social landscape, continuously occupying the same location for several hundred years in some cases (Bright 2011). Although such longevity of a village is almost unheard of in modern ethnographic examples from Lowland South America (that often serve as an analogy for pre-colonial Caribbean communities) it has been argued to be a feature of island habitation sites (Samson 2010). Thus, although one can never be sure of anything in archaeology, it is assumed that these nodes represent discrete social collectives that engaged in exchange or other types of relations, which is reflected in the connections between lithic material culture assemblages.

1995; Watters and Scaglion 1994). In other words, in the 1-mode model, ties between site-nodes are based on the production and distribution of local lithic materials which is in turn based on the absence and presence and quantity of material. This presents an in-depth perspective on site relations during the later period of this case-study that can go far in creating a lithic distribution network.

Nevertheless, these models still lack certitude of tie direction required for a true, directed network model. Thus, as a final step to create a 1-mode network model of Period D and E in the fullest detail possible, the geographic distance between distribution and consumer sites has also been taken into account. By doing so the network based on the ties between a consumer site and the closest distributor could be further differentiated. This might resemble an unwarranted guidance of the original data set, yet two reasons justify this geographic constraint. Firstly, the simple fact of the geographic layout of the – almost literal – island chain must be considered. As discussed in Chapter 2, even if this does not necessarily mean that possible interregional voyagers must have travelled through this island bridge, this stepping-stone character will have had a large impact on interactions within the region. Secondly, the distribution model of Knippenberg (2007) supports this geographic constraint, where the fall-off model is proven to be correlated with geographic distance, suggesting that sites preferentially attach themselves to geographically close neighbours.

The downside of these 1-mode models is: they treat habitation sites and lithic raw material sources as equal nodes. Hence, because raw material nodes are donors in this directed network rather than groups of which sites can be a member of, this does not yield a comparable insight into the power of materials as a 2-mode network would. That is why 2-mode and 1-mode modelling has been jointly applied when referring to certain periods. To be sure, these models are not meant as absolute reflections of exchange or other type of socio-material networks. However, combined with an absolute chronology and insight into presence and absence of materials and in some cases even their production and distribution chains, the result is a model that provides a longitudinal view of the presence, production and distribution of endogenous lithic materials between 3200 BC and AD 400. Together with more substantive lines of evidence, these can then be used to draft further hypotheses on the history of society and culture in the early Northeastern Caribbean.

Period A: foundation

At first glance, the lithic network model of Period A, representing the first occupation of the Northeastern Caribbean, is clearly rather small. It nonetheless contains all sites that have been securely dated between 3200 BC and 2000 BC in the region of study. Other sites and finds have been identified as belonging to the earliest phase of human occupation on Antigua and other islands (Davis 2000; Nicholson 1994), but their site chronology is unfortunately only supported by one or no absolute dates. In addition it has to be mentioned that just to the south and the west of the region we find similar systems, for example those in Hispaniola which were already part of a small but burgeoning lithic network in the vicinity of the Barrera Mordan flint source (Pantel 1988; Veloz Maggiolo 1972).

Structure and subgraphs

Even though it represents the earliest phase of the human occupation of the islands the region seems to be relatively well connected. (Figure 5.3). If the flint sources and knapping techniques are taken as qualitatively similar nodes, an affiliation network from a 2-mode to a 1-mode site network can be made (using UCInet). This shows a maximally connected component, in other words a clique of all nodes. It has to be noted, however, that this is primarily based on the inclusion of flint knapping techniques as part of a multi-mode model. All sites with siliceous materials have evidence for both blade and flake knapping techniques in their assemblages. These visualize that, regardless of raw material acquirement strategies, ties to can be drawn between early users of chert material in the Northeastern Caribbean. Rather than being a region with isolated material repertoires and practices, we find a certain measure of connectedness in this incipient network.

In terms of lithic sources the small network is divided into a number of subgraphs, which revolve around the two main types of flint encountered in sites attributed to this Period. The {ANG-CCL-PF-MOC} 2-clique consists of site

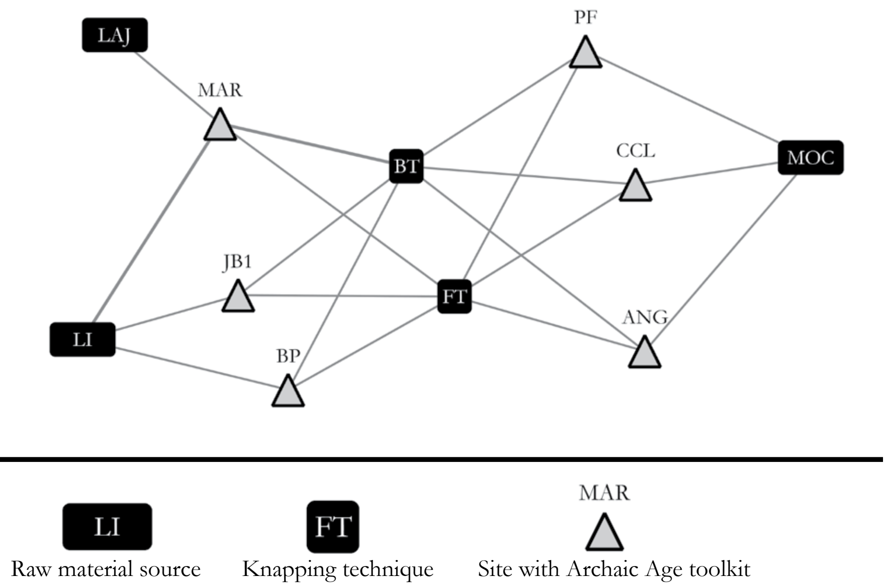

Figure 5.3: 2-mode network of Period A illustrating sites tied to raw material sources of which material is present in their assemblages. Nodes are also connected to a knapping technique node in order to indicate the presence of tools produced with that technique that were found at the site.

nodes that exploited the Mocca flint source in Puerto Rico.[4] Another 2-clique, {BP-JB1-MAR-LI}, centred on the Long Island flint source. Finally, the dyad {MAR-LAJ} is based on Maruca's exploitation of the Lajas material.[5] The network's cohesion is somewhat enhanced by the adoption of Long Island Flint at the site of Maruca (MAR). Such a transfer of Long Island Flint from Antigua to Puerto Rico at such an early stage in the development of regional networks would represent a significant achievement in terms of logistics.[6] On the other hand, unlike the other Puerto Rican sites, Maruca is not affiliated with the Mocca (MOC) but with the Lajas (LAJ) flint source. The tie only serves to connect the MAR node to the subgraph that makes up the "Long Island Flint" 2-clique. It is thus not truly a network bridge.

Interpretation

What can this network model say about overarching cultural and social interaction patterns of the early past of this region? Not much, to be fair: the low temporal resolution and small size of the data set warrants a very careful consideration of any inferences drawn from this model alone. It has to be stressed that the networks represented here are not models of social interaction. Rather they provide a view of how material cultural repertoires and practices are connected through time and space. This is particularly true for Period A, which has so few reliable data-points that it is impossible to say anything meaningful about social processes that could underlie this distribution.

Blade knapping techniques have traditionally been considered to be representative of the peoples that settled the Greater Antilles, while flake knapping is found in both the southern and western lithic traditions (Knippenberg 1999; Walker 1990). The cohesion in terms of flint knapping techniques of this small lithic network supports the idea that this region was the location of the first interactions between previously unconnected western and southern lithic traditions. This is also supported by the site contexts of two sites from the network, namely Jolly Beach I (JB1) and Maruca (MAR). Both present evidence for an interaction between two alternate knapping traditions in their lithic assemblages – blades with a much smaller quantity of typical Greater Antillean ground tools in the case of Jolly Beach I and Casimiroid and Ortoroid flint knapping styles in Maruca – and other evidence for interactions, such as converging subsistence practices (Wilson 2007).

4 All 2-cliques mentioned in this Chapter are also 2-clans (see Chapter 3).

5 Alternatively this can also be achieved by removing the knapping technique affiliations. If left out of the equation, a picture of a much less connected network emerges, breaking down in four separate components.

6 There are some qualifications to be made here. Firstly, although it has been documented in the assemblage by Jeffrey Walker (Rodríguez and Winter 1999) and later by Reniel Rodríguez Ramos (personal communication, 2011), it is not entirely clear that Long Island Flint can indeed be found in the earliest period at Maruca. Secondly, Long Island Flint constitutes only a minority of the lithic material found at the site, the majority of the siliceous materials originates from local sources.

However, there is a breakup in multiple small 2-cliques based around the various lithic sources. These mostly correlate with geographic proximity. If Long Island Flint is indeed found in the lower strata of Maruca this provides a bridge between the northern Lesser Antilles and Puerto. Nonetheless this far-reaching geographic distribution fails to truly connect the material networks of this period. The likelihood that social networks would have spanned the entire region – at least as can be deducted from the potential cotemporaneous direct procurement of the same lithic source – is minimal. This would be in line with an early human occupation of the island chain that consisted of local, small and mobile groups that would have only been loosely connected at the regional level.

Period B: growth

The multi-mode network of Period B (2000-800 BC) consists of "Archaic" sites, flint stone materials and knapping techniques (Figure 5.4). An added element is the presence of numerous unconnected sites dating to Period B. Their assemblages (many of which have been examined by Knippenberg and Rodríguez Ramos) have no known (i.e. published) flint or other non-local siliceous material connecting them to the larger network. The status of these unconnected components goes beyond the current analysis, but it has to be kept in mind that this network is based on the presence of stone materials not on discrete social or cultural ties. It is unlikely that unconnected sites were not frequented by similar (or even the same) peoples who left their lithic materials in sites connected by means of this network. These sites too were an integral part of the socio-economic system of the peoples living in the region, just not one that can be modelled applying the available data. The same goes for many small sites that would presumably fall in this Period, which are not part of the model here because they are not and often cannot be securely dated. Examples hereof are the isolated finds of Long Island Flint blades on sites such as Dog Island and Flower Avenue (Anguilla) or the Level in Saba (Cherry, *et al.* 2012). There is also a new raw material node: an unnamed flint excavated at the site of Caño Hondo that is probably local to Puerto Rico (Rodríguez Ramos, personal communication 2011). Maruca once again is connected to both Lajas and Long Island Flint.

Structure and subgraphs

In comparison to the model from the 1200 years before, the network has hugely expanded. Site node quantity shows a growth of 375% and the total amount of affiliation ties has increased with 182.2%. Naturally, this picture is partly biased by archaeological preservation. However, it is unlikely that the superior archaeological detection of later period sites is the only reason of this growth. Although the site nodes and ties have increased in quantity, relatively speaking the affiliation network has become more sparse and disconnected. During Period A 47.5% of all possible

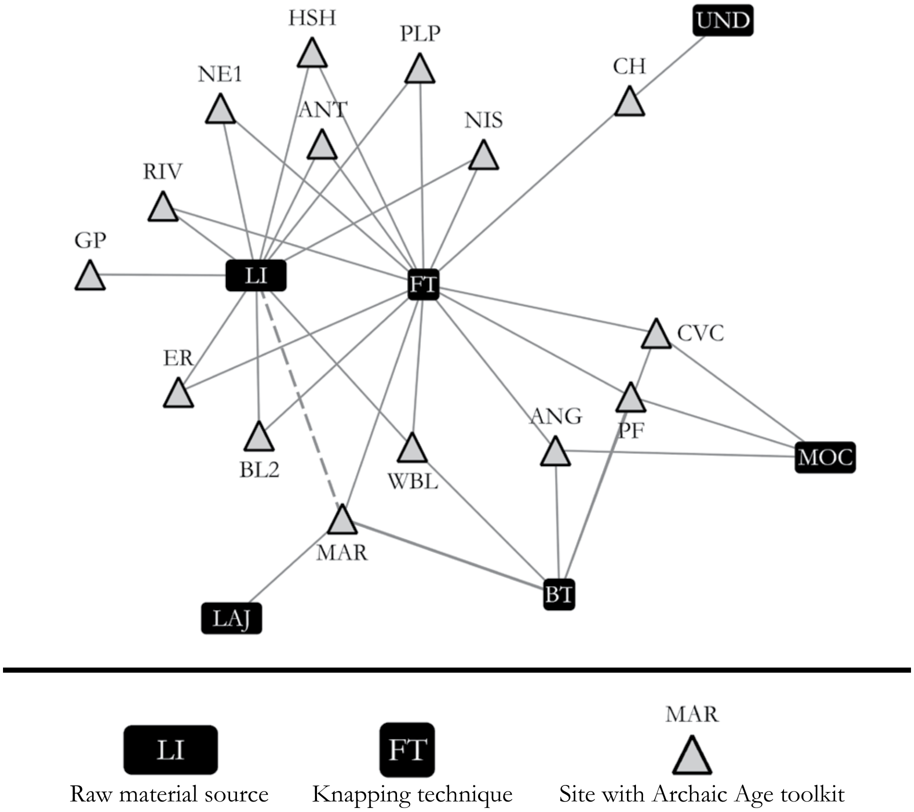

Figure 5.4: 2-mode network of Period B with sites tied to raw material sources of which material is present in their assemblages. Nodes are also connected to a knapping technique node in order to indicate the presence of tools produced with that technique that were found at the site.

affiliations were present versus 19.4% in this model.[7] In general, this is related to the fact that many sites that are securely related to this Period are without (published) evidence linked to the use of flint or other cherty material: fifteen out of thirty (50%) of the site nodes are not affiliated with any lithic material or technique in contrast to two out of eight (25%) attributed to Period A. If these unconnected components are left out of the picture the connectivity of the network increases to 31.5% of all possible affiliations. This is partly related to the fact that node sites are affiliated with only one type of lithic raw material, with the exception of MAR that is once again affiliated with both the LAJ and LI flint types.

This trend is also visible in the difference in total affiliations between lithic blade and flake technologies. Five sites belong to both the blade and flake knapping clique, four of which are located in Puerto Rico and one in the Lesser Antilles; the

7 As nodes are not directly related in this 2-mode network, the network density is not calculated here as indicated in Chapter 3, but by means of this calculation: , where *n* is the total amount of site nodes (columns in the matrix) and *m* is the total amount of lithic group nodes (rows in the matrix) and *t* the total amount of ties (sum of all cells in the matrix).

majority of the sites (ten) where siliceous materials have been reported employ only flake knapping techniques.

If we compare the degree centrality, in this case the total number of site node affiliations to raw materials nodes, it becomes clear that the clique surrounding Long Island Flint source has become much larger with eleven out of fifteen nodes affiliated to a lithic raw material linked to Long Island Flint, while the degree of the others has remained the same. On the other hand it is interesting to note that the network of Period B is structurally quite similar to that of Period A. The only real change is the addition of one extra but small clique: the CAN node and the unknown, presumably local source of its flint. In general, the large component consists of cliques merely connected through their lithic technology not their raw materials. Thus, the materials are at the centre of cliques of which the members have no ties with sites that make use of other lithic materials.

Interpretation

In the light of the development of the networks of the first colonists it is interesting to compare the model of Period B to the period before. It shows a mixture of sites already present during Period A and sites that are new. All the new sites, with the exception of Caño Hondo, can be found in the northern Lesser Antilles and not in Puerto Rico. Although influenced by the variances in archaeological coverage of the Period, the model suggests that Long Island Flint was an important attractor during this era. Moreover, the large number of shell-only sites in the northern Lesser Antilles, for example on St. Martin (Bonnissent 2008), suggests that the marine resources of the reasons also served to draw new settlers or enable the growth and fissioning of groups already established in the region.

The patterns in the model visualize what we already know from previous non-network analyses, for example the increase of the total number of sites. In addition, the differences in blade and flake affiliation are congruent with previous findings that suggest a gradual demise of the blade knapping technique on all of the islands (Hofman, Mol, *et al.* 2011). The model also reaffirms that it is not the access to good knapping material that causes the shift, but rather a change in flint knapping practices. While Whitehead's Bluff on Anguilla and Angostura, Maruca and Cueva Clara still have flint blades in their assemblages, in the majority of sites chert materials are only reduced using the flake knapping technique (Crock *et al.* 1995; Rodríguez Ramos 2010). Whether this is due to preference or loss of knowledge is difficult to surmise, yet it is interesting to observe that sites in Puerto Rico retain the blade knapping tradition for a longer period than those sites in the northern Lesser Antilles. However, even though we see an increase and the continuation of traditions, the relatively low overall connectedness of the network model indicates that as the region becomes more densely occupied (total number of sites) the lithic affiliation landscape does not show any greater cohesion. This suggests that the growth of social networks of this period is primarily at the local level.

The fact that this build-up seems to take place in localities where Long Island Flint was procured is telling. This pattern is best interpreted through sites that are known to have been semi-permanent settlements. Plum Piece in Saba, for example, shows a habitation pattern, faunal assemblage and toolkit that is typical of a seasonally occupied campsite (Hofman, *et al.* 2006; Hofman and Hoogland 2003). Plum Piece presents evidence for small, temporary shelters and the specialized procurement of black crabs (*Gecarcinus ruricola)* and Audubon's shearwaters (*Puffinus lherminieri lherminierii)*, both species with a seasonal presence on the island. Several other of such seasonal resources can be identified in the local archipelago. Furthermore, Knippenberg has found that Long Island flint nodules were probably directly acquired from Long Island itself as part of the mobility cycles of these groups (Knippenberg 2007). However, in contrast to seasonal resources or many other faunal and floral resources of which the ideal procurement area must have shifted around over time, Long Island flint, applied in many day to day activities, was always in high demand and permanently available at the same spot.

Aside from being easily accessible and the best of the few chert resources in the region, the Long Island flint source would thus have represented an often frequented and fixed spot in the landscape (Davis 2000; Knippenberg 2007; Nicholson 1994). It is presumed that this popularity and fixedness of the Long Island flint source implied that human habitation gravitated towards the islands in its general proximity. It is also telling that, in spite of the numerous small sites in the area of Long Island, no single large site during this or any later period seems to control access to the material.

Period C: transition

The model of Period C, which runs from 800 to 200 BC, is presented in two variants here. Figure 5.5.a presents all the sites datable to this period and their connections to Long Island flint, Mocca flint, Lajas flint and local chert sources. Blade and flake technology nodes are no longer part of the model, since blades have all but disappeared during this phase. The shape of the site nodes denotes the original interpretation of their ceramic assemblages: (1) a triangle for a site with a toolkit that is representative of the "Archaic Age", (2) a circle for a pure Saladoid assemblage, and (c) a rounded rectangle for a Huecoid site with Saladoid components. Figure 5.5.b is an expanded version of this model. It includes two new elements of the lithic networks in this region: down-the-line exchange (visualized by the northern Long-Island Flint distributor node) and the presence of semi-precious stones.

In this period down-the-line exchange, in contrast to the direct acquisition of material, can for the first time be attested on the basis of lithic studies. According to Knippenberg (2007) it can be confirmed for the site of Hope Estate on St. Martin and La Hueca and Sorcé on the island of Vieques. It has also been suggested to have been the means for the dispersal of Long Island flint to the site of Maruca and Paso del Indio in Puerto Rico (Rouse and Alegría 1990; Rodríguez Ramos, personal communication 2011). In order to investigate the structural position of a distributor node down-the-line exchange is simulated by adding a hypothetical distributor node.

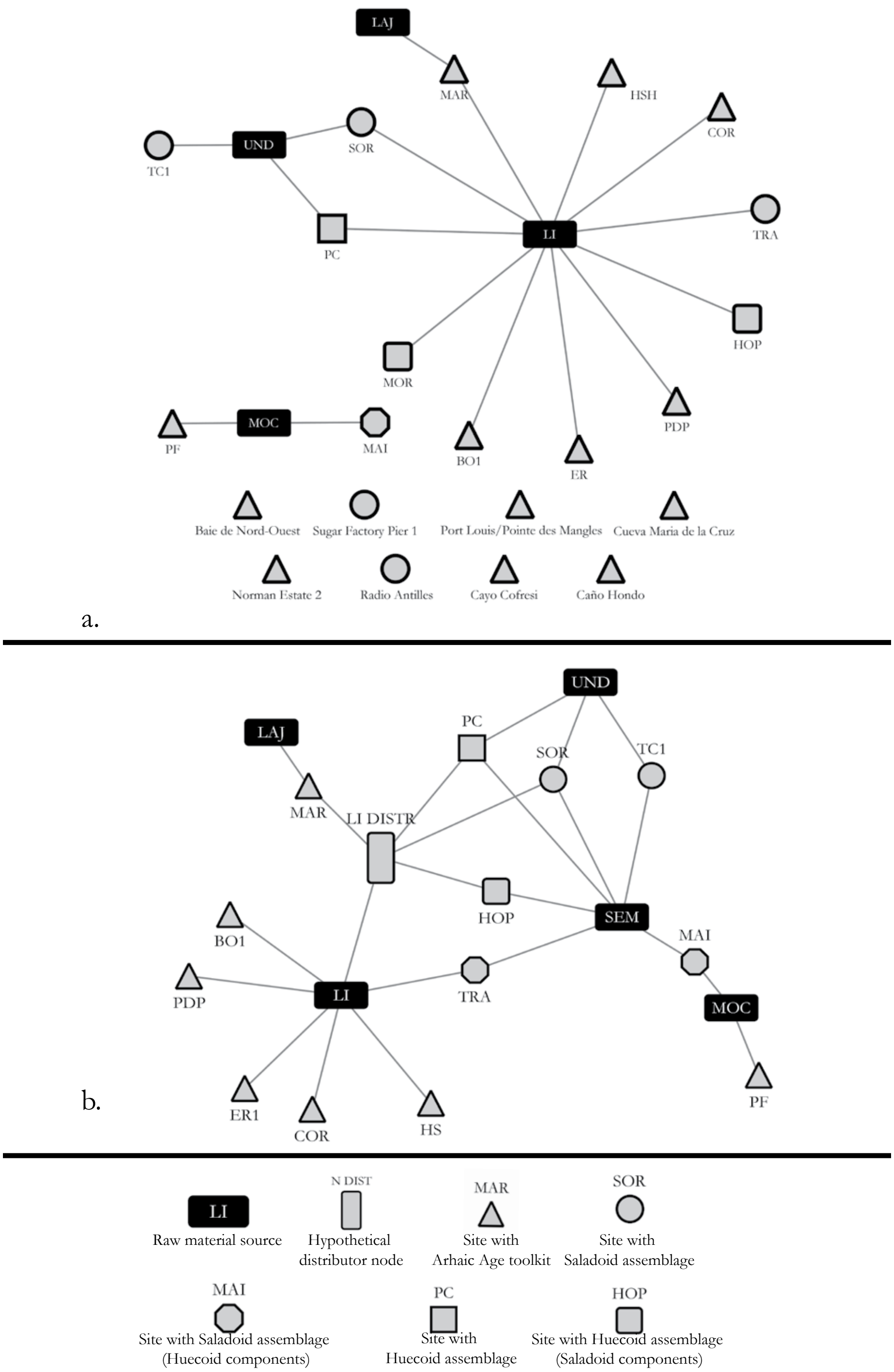

Figure 5.5: 2-mode network of Period C, illustrating sites tied to raw material sources of which material is present in their assemblages. Model A shows only the presence of chert sources, while Model B shows the presence of semi-precious materials and a hypothetical distributor node.

In the indigenous Caribbean we find a wide range of semi-precious materials: agate, amethyst, aventurine, diorite, quartz, jadeite, nephrite, malachite, topaz and turquoise (Narganes Storde 1995; Knippenberg 2007; Murphy 2000; Watters and Scaglion 1994). The exact sources of the majority hereof remains unknown. However, based on the geological layout and current known lithic sources of the region it is presumed that in general these materials originated outside the Caribbean. The semi-precious lithic node represents a type of stone materials that were and are primarily chosen for their aesthetic qualities in small decorative objects, mainly personal adornments. The adjective "semi-precious" is slightly misleading, since any ranking of lithic materials into precious, semi-precious and non-precious materials is not indigenous but a construct of modern gemology. However, certain material qualities, for instance translucency and brilliance, are shared among all specimens of rock that were regularly utilized during this period (Rodríguez Ramos 2011).

Down-the-line exchange of semi-precious stones is difficult to model because it is represented by a structural void in this period: it is suspected that one or more nodes and ties were responsible for the distribution, but we have no clear view of how communities acquired the material. Lithics in this Period could have travelled through various ways from various locales to their final place of deposition. In addition, the exact stratigraphic location of semi-precious lithics in sites, for example, is often not mentioned in reports. When they are indicated it is clear that the lower levels contain only very few semi-precious lithics. Later periods do have better evidence for a fully developed network with down-the-line exchange of endogenous lithic materials, among which semi-precious stones.

Structure, subgraphs and centrality

The number of sites in the network has diminished somewhat (now twenty-three), but the Period is also shorter by half than the ones before. When this is taken into account the model shows the same trend: other siliceous materials are being used but Long Island Flint continues to grow in affiliate ties (eleven members). Due to the absence of a distinct blade and flake technology group, the network in Figure 5.5.a falls apart in one large and one smaller component and many unconnected nodes. Once again sites from which no lithic materials have been reported. It is noteworthy, however, that the majority of the nodes are now connected.

A slightly different picture evolves when taking into account the down-the-line exchange and semi-precious stone presence in the site assemblages. Aside from the a-lithic sites, the network is now a single component. This is brought about by the distribution of semi-precious stone materials found in several sites not connected through their flint or jasper assemblages. Interestingly, this component can furthermore be divided into several subgraphs. This is most evident when taking a closer look at clique formation in an affiliation network (2-mode to 1-mode; here and below carried out with UCInet 6.0) of the graph in Figure 5.6. As explained in Chapter 3, such a network models the affiliations based one set of nodes of a 2-mode graph, in this case ties based on the co-affiliation of site nodes to a lithic group node.

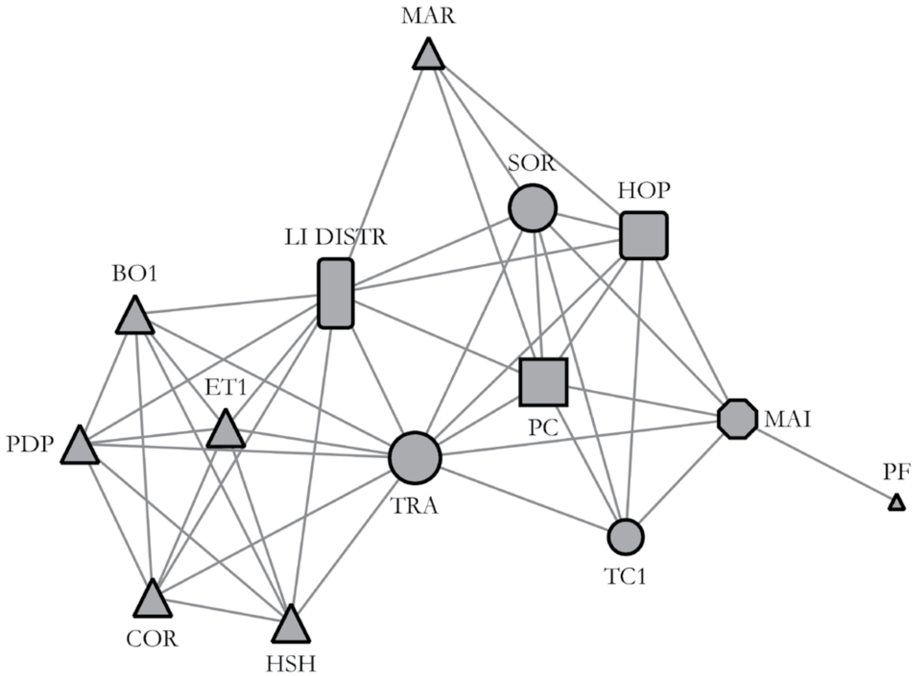

Figure 5.6: Affiliation (site to site) network of Period C. The node size is based on degree centrality.

All nodes are reachable from any other node and all nodes, except for PF (Puerto Ferro), are in fact part of a 2-clique. Therefore, because all nodes except Puerto Ferro can reach all other nodes in no more than two steps, this means that the network is rather "small in size" (i.e. with a small diameter). Nonetheless, the affiliation network is not exceptionally dense (44 ties = 48.35% of all possible ties). When looked at closer the network can be roughly divided in two regions: the 6-core {BO1-COR-ET-HSH-TRA-Distr} and the 5-core {HOP-MAI-PC-TC1-SOR}, where the Distributor and TRA node share the role of gatekeeper. These core areas are more or less contingent with a geographic focus on the southerly region of the network for the 6-core and the Puerto Rican and northerly Lesser Antilles for the 5-core. These cores can furthermore be divided into four cliques: A {BO1-COR-ER-HSH-PDP-TRA-Distr}; B {HOP-MAR-PC-SOR-Distr}; C {HOP-MAI-PC-SOR-TEC-TRA]}; D {HOP-PC-SOR-TRA-Distr}. These groups of nodes correspond with: Long Island Flint direct acquisition (Clique A), down-the-line acquisition of Long Island Flint (Clique B), presence of semi-precious stone in the site assemblage (Clique C), and, a focal point in the network of gateway nodes, Long Island Flint down-the-line acquisition and semi-precious stone presence.

Definite conclusions cannot be drawn based on this data set alone, but in terms of control of lithic resource distribution in the region it seems that both Trants (TRA) and the hypothetical distribution node would have occupied a central position. Trants even has a slightly more central position with a degree of 11 instead of 10 and a better structural position in the network. This is caused by the fact that it participates in the "semi-precious stone clique" to which a hypothetical node does *de facto* not have access. Based on the structural equivalence of the distributor node and Trants it could even be suggested that Trants is in fact the distributor node. In regards to network power, a note should be made about the triads in a valued affiliation matrix of this Period. Although there are sixty-seven triads in total,[8] one triad {HOP-PC-SOR} is exceptional since it is the only subgraph for which the link strength between all nodes is 2 rather than 1. This has to do with the fact that all three nodes are members of both the Long Island distribution and the semi-precious stone group. If this was to be calculated with merely the Long Island flint presence instead of down-the-line acquisition, Trants would also be added to this clique of ties with strength 2.

Interpretation

From a culture historical perspective, Period C is highly interesting because it covers the centuries in which many so-called "Archaic Age" resident and newly arrived, "Early Ceramic Age" communities contemporaneously occupy the islands. What does this network model and its analysis tell us about this Archaic-Saladoid-Huecoid interface period?

Firstly, the model is clear with regard to the presence of connections between resident commuities and sites that were in all likelihood communities of newly arrived settlers. Both types of sites take part in the same lithic network groups. During the entire Period several sites with an assemblage representative of "Archaic Age" communities were present on the islands and had direct access to Long Island, Mocca and Lajas flint. In the case of Long Island flint at Maruca this access was acquired through down-the-line exchange, suggesting that this site was either relying on pre-Period C distribition networks or able to tap into new ones. In addition we come across a host of evidence for a strong presence of "Archaic Age" communities on Antigua and other Lesser Antillean islands during this time. These sites are not part of the network because no secure dating is available. The same is true with reference to several possible Early Saladoid sites and finds in this region and on the Windward islands to the south.

Nonetheless, as to the second half of the Period, these latter materials can be clearly located and dated on Montserrat, St. Martin, Vieques and Puerto Rico. From that moment on, at least the Saladoid site of Trants had direct access to Long Island flint. Down-the-line, other Saladoid sites such as Sorcé also managed to acquire this now farspread material. The same goes for the Huecoid site of Hope Estate on St. Martin. A similar yet smaller version of this Archaic Age-Saladoid-Huecoid sharing of raw material sources is suggested by the ties of affiliation between Maisabel and Puerto Ferro – based on the presence of Mocca flint in their assemblages.[9] However, the overall model indicates it can hardly be argued that

8 As calculated by means of UCInet 6.0's "triad census" technique.
9 It has to be noted that absolute dating does not fully support site contemporaneity (Siegel 1992).

original residents of the islands were quickly displaced or assimilated upon the arrival of new settlers from other regions.

Analysis of lithics alone would suggest that (down-the-line) exchange is introduced with the arrival of new settlers. It seems unlikely, though, that exchange was not part of prior network strategies. It is unparsimonious to argue that for, example, the spread of cultivated crops into the archipelago was initiated by direct acquisition from donor areas rather than a phased region-by-region introduction. The same would be true for ceramic technology. The reason for the late introduction of down-the-line lithic distribution is impossible to surmise. It could be related to increased interaction due to new settlers or further population growth. Another possibility is a boom in the popularity of Long Island Flint. Perhaps these processes were even dialectically related, implying that a first increase in exchange of lithic materials like Long Island flint led to growing and better connected networks.

It should be remembered that there was already a long indigenous tradition of Long Island flint procurement. With this in mind it could be argued that newcomers arrived in an island region that had been connected by indigenous networks dating back for millenia. One version of this view would see migrants that were already tapped into these age-old networks because of previously established ties between their mother communities and mobile groups that were (partly) resident in the northern Lesser Antilles (Hofman, Mol, *et al.* 2011). In that case information on Northeastern Caribbean resources, such as Long Island flint, gained through prior trade contacts could have functioned as a motive for migration to the islands in the first place.

Precisely these kinds of processes could be behind the slight structural differences between nodes such as the centrality of Trants or the stronger triadic ties between the sites of Hope Estate and Sorcé. This increasing hierarchy and diversification indicate the evolution of new forms of network dynamics. In addition, Period C sees the existence of "networks within networks" for the first time in Caribbean history: based on the presence and absence of semi-precious stone. In this regard it is significant that the only nodes taking part in this clique are sites with either Saladoid or Huecoid ceramics (Hofman and Hoogland 1999; Oliver 1999). Semi-precious stone production, distribution or even presence is simply not reported from any of the sites with an assemblage typical of the earlier "Archaic Age". This suggests a certain limitation to at least some aspects of the Saladoid and Huecoid phenomena other than their specific ceramic styles. Any detailed conclusions on the Archaic-Saladoid-Huecoid interface to be drawn from the model are naturally hampered by the large timespan of the period. However, because absolute dates of many sites overlap, at the minimum we can state that contemporaneous acquirement of the same lithic resources was taking place over increasingly larger geographic distances and between culturally more differentiated groups.

Period D: robust networks

The growing availability of absolute dates from the following two periods allows for a smaller temporal resolution and thus an increasingly refined picture of their possible network dynamics. The network model of Period D depicts the relations between sites and notable stone resources from 200 BC to AD 100 (Figure 5.7). Aside from the by now familiar Long Island and Mocca flint sources, four new lithic raw material complexes are now part of the network: carnelian, St. Martin greenstone, serpentinite and jasper. As can be expected, numerous other types of (semi-precious) stones can be found at sites dating from this period; yet all four nodes represent raw material groups that can be sourced to a location in the region. Carnelian is found on the island of Antigua. There is furthermore evidence for a large carnelian (bead) workshop at the site of Trants on nearby Montserrat. In later times production also takes place at sites on Antigua (Murphy, *et al.* 2000). The

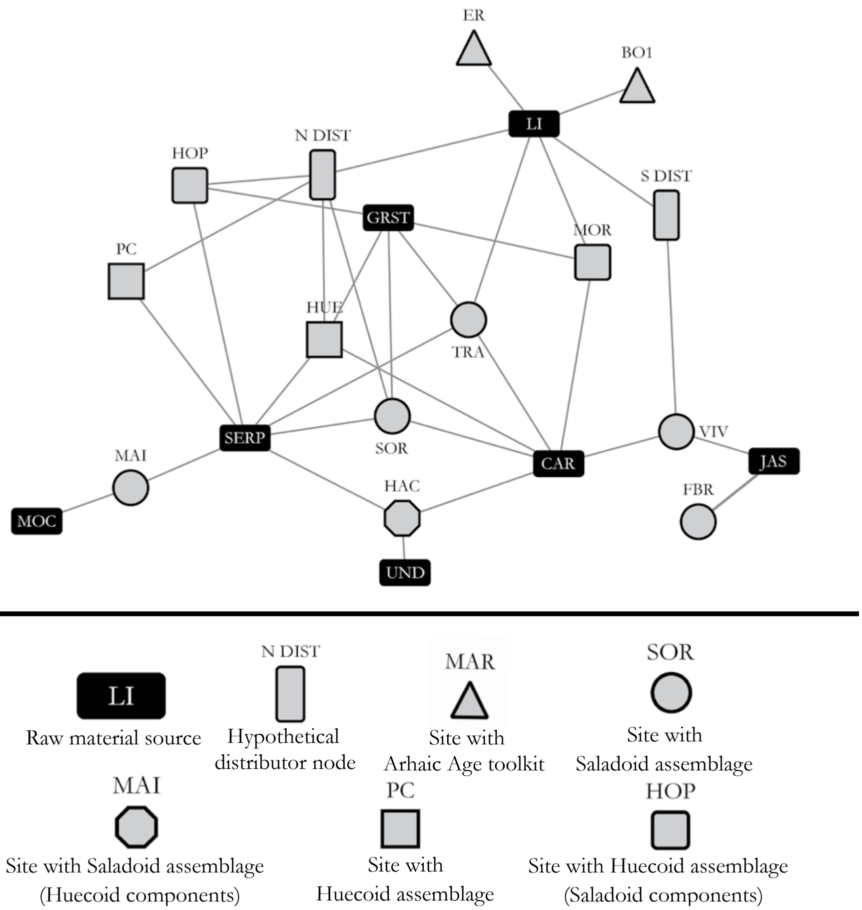

Figure 5.7: 2-mode network of Period D, showing sites tied to raw material sources of which material is present in their assemblages. The model also has a hypothetical distributor node (N DIST) to which some nodes are tied in order to indicate they did not have any direct access to Long Island flint.

name of the muddy green St. Martin greenstone is self-explanatory in terms of the provenance of this raw material source. Interestingly, the only site with direct access to St. Martin Greenstone is also found on St. Martin, namely Hope Estate. We do not know the exact location of the Puerto Rican serpentinite source, a greenstone material used for the production of beads, amulets and other personal adornments. Several serpentinite workshops were discovered on the island of Puerto Rico, one of which is the Saladoid-Huecoid site(s) of Sorcé and La Hueca, of which only the Saladoid component can be securely dated to this period. Finally, the source for red jasper, another chert material, is likely to be found on Martinique, which had an active lithic economy based on the material (Bérard 2004).

For Period D it is also possible to draw inferences beyond simply lithic presence in site assemblages, utilizing the information from the lithic production and distribution studies by Knippenberg and Rodríguez Ramos who have personally examined almost all sites in the network. Therefore this network does indeed not entail the same level of speculation as that of Period C. Based on this and other guidelines put forth in the beginning of this Chapter, I also suggest another hypothetical model below. This model equates flint sources with site nodes and plots them in a directed, 1-mode model of site interaction based on lithic exchange patterns. The validity of this interpretation is much strengthened by the evidence for direct acquisition of different semi-precious stone material and workshops in La Hueca (serpentinite), Trants (Long Island flint and carnelian) and Hope Estate, which held a monopoly on the distribution of St. Martin Greenstone (Knippenberg 2007; Rodríguez Ramos 2010).

Structure, subgraphs and centrality

The most striking difference between Period D and the periods before that is that lithic group node quantity has increased to seven different local groups. Once again the number of site nodes has decreased (n = 18), which is again explained by the shorter duration of the sample period. Long Island flint reigns supreme in the flint category with a degree of 9. Other flints and the jasper from Martinique only have a membership between one and three. Nonetheless, the presence of semi-precious stone types, such as carnelian (degree = 7), serpentinite (degree = 6), and St. Martin greenstone (degree = 5), now come close to being as central as Long Island flint. The network now has a southern down-the-line subgraph, a distribution network that caters to the Vivé site on the island of Martinique.

The network of site co-affiliation based on this 2-mode distribution network shows a possible slight increase in density (54.9% vs. 48.3%) compared to Period C (Figure 5.8). A direct comparison is somewhat skewed: the density of the Period D network in comparison to Period C is downplayed by the subdivision of semi-precious lithic materials and the addition of another hypothetical distributor site. A k-core analysis shows that the network has become more cohesive, the {HAC-HOP-HUE-MOR-SOR-TRA-VIV} six-core now dominates the graph, with a five-core including all nodes but FBR.

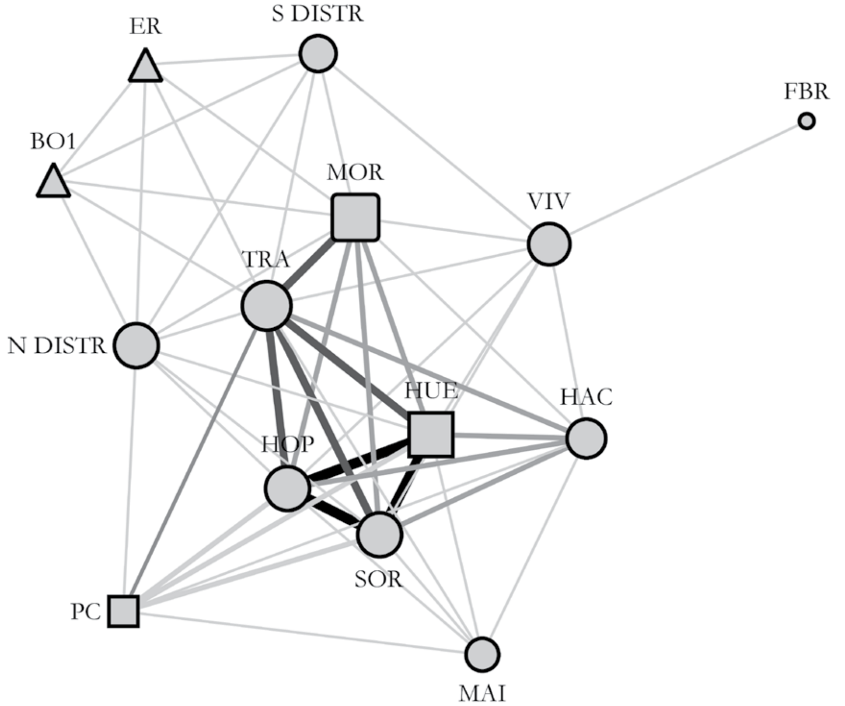

Figure 5.8: Affiliation (site to site) network of Period D. The tie colour and size is related to tie strength (from low to high = light to dark, thin to thick). Node size is based on degree centrality.

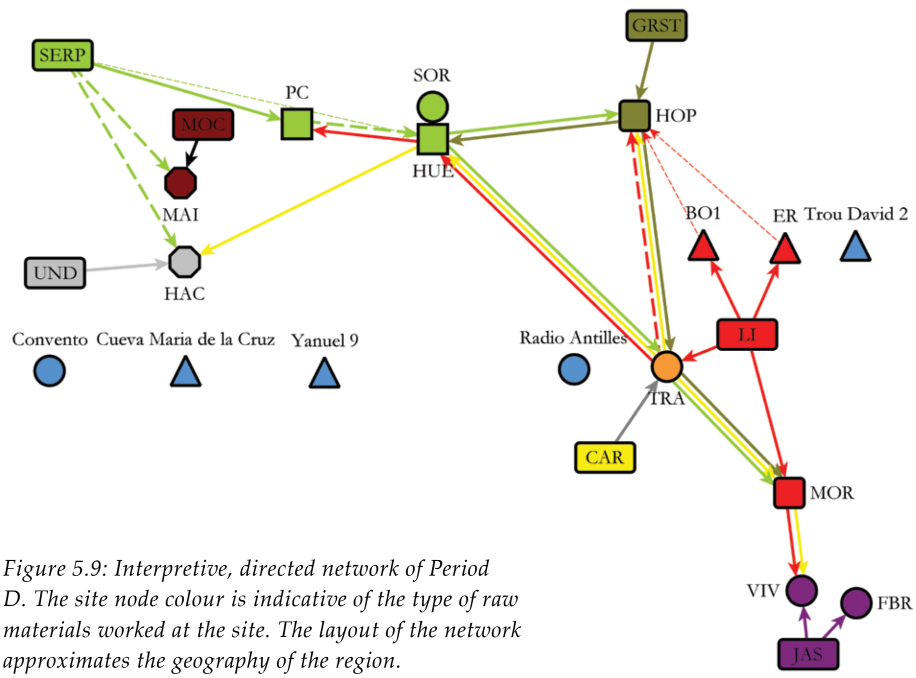

Figure 5.9: Interpretive, directed network of Period D. The site node colour is indicative of the type of raw materials worked at the site. The layout of the network approximates the geography of the region.

The site affiliation network contains eighty-two triads. These are part of six large cliques: A {BO1-ER-MOR-TRA-SDistr-NDist}; B {HOP-HUE-PC-SOR-NDistr}; C {HAC-HOP-HUE-MOR-SOR-TRA-VIV}; D {MOR-TRA-VIV-SDistr}; E {HAC-HOP-HUE-MAI-SOR-TRA}; and F {HOP-HUE-MOR-SOR-TRA-NDistr}. Clique A and B correspond to the direct and Northern distribution acquisition networks of Long Island flint. Clique C corresponds to the sites with access to carnelian, after Long Island flint the widest distributed local lithic material. Clique D represents a merger of sites that are affiliated through semi-precious stones and long island flint in the central-southern part of the region. Clique F fulfils a similar structural position for sites in the central-northern part of the network. All nodes, except for FBR, are part of a 2-clique. All of this suggests a strongly cohesive network with several possible paths through which sites may be connected.

However, not all paths are supported by equally strong ties. Most ties have strength one, implying they are connecting nodes that only share one affiliation. Yet at the centre of the network we see an increase in tie strength. There the "strong clique" {HAC-HOP-HUE-MOR-SOR-TRA} can be found. This clique consists of nodes connected by ties that have strength 2 or more. This subgraph can be further compartmentalized into a 2-clique with tie strength three {HOP-HUE-MOR-SOR-TRA}, which represents those sites that had access to all local semi-precious lithic types and Long Island flint. The subgraph is only a 2-clique because the site of Morel (MOR) does not connect with a 3-strength tie to any other site, except for Trants (TRA). This is because this 2-clique represents the full geographic distribution of Long Island flint, divided into a southern and northern group and connected by a central area. Finally, in the northern area we see a clique of tie strength 3 formed by the sites of Hope Estate, Sorcé and La Hueca and an even stronger triad of 4-strength ties between Hope Estate, Sorcé and La Hueca.

The 3-strength tie clique at the centre of the graph provides a possible indication of candidates for the role of distribution nodes, here substituted by hypothetical nodes. The network illustrated in Figure 5.9 presents an interpretation hereof, based on the evidence for direct acquisition of raw materials and workshops. It suggests that the three sites in the centre of the graph, Trants, Hope Estate and La Hueca, are not only a triad but as such were also a strong cyclical component (Chapter 3).[10] From this it should follow that they hold the majority of the power in the network. This is true: Trants, Hope Estate and La Hueca hold 44% of all the ties (i.e. relative degree). However, between the members of this powerful triad there is a further differentiation to be made. This can be analysed with alternative measures of centrality such as closeness, measuring the distances to all other nodes in the network, and betweenness, which measures the total amount of shortest paths on which a node lies and thus is a good indicator of a node's strategic position. These measures prove that Trants and La Hueca share the same closeness centrality, which is higher than Hope Estate (12.85% over 10.5%). These nodes have the absolute

10 The reason why Sorcé is not considered to be part of this component has to do with evidence for a workshop at the neighbouring site of La Hueca, yet no such workshops have been found at Sorcé itself (Rodríguez Ramos, personal communication 2011).

closest paths between them and all the other nodes within this network. In addition Trants and La Hueca have a much higher betweenness than Hope Estate (13.05%), but Trants (39.15%) has an even higher betweenness than La Hueca (32.60%). This indicates that Trants is located on most of the shortest paths between nodes in the network. Based on a sequential analysis of subgraph identification, tie strength, 1-mode remodelling, and centrality measures, Trants appears to be the node with the most central position of the Period D lithic network.

Interpretation

Period D has received relatively much attention from Caribbean archaeologists (Boomert 2000; Bérard 2013; Fitzpatrick 2013b). This is partly because it is often seen as an extension of the 500/400 BC hypothesized migration(s) from the mainland in which settlers slowly spread over the Northeastern Caribbean. Indeed, where Period C marked the first dated appearance of two new ceramic styles, Saladoid and Huecoid, this represented only a hesitant start. Sites with new ceramic series were still outnumbered by sites with more traditional assemblages. In Period D these new types of sites are now in the majority. Period C included five Saladoid and one Huecoid site, while Period D counts nine Saladoid sites and three Huecoid sites.

Continuing on where the discussion was left in Period C, this suggests that the so-called Archaic-Ceramic interface has started to fade and communities of descendants from migrants and the original inhabitants of the Northeastern Caribbean had started to coalesce. At the same time this saw the rise of two new "archaeological cultures", typified by differences in Saladoid and Huecoid assemblages and often thought to represent dissimilar communities with separate ancestries (see Chapter 2). What can the network of Period D teach us about the the relations between the Huecoid and the Saladoid?

The preliminary conclusion of this is that any notion of a complete social boundary between communities that were using either Huecoid or Saladoid ceramics can be rejected. Firstly, based on presence, there is no difference between lithic preferences of sites belonging to either series. Beyond the fact that Huecoid and Saladoid sites are equally strongly connected to all local lithic groups they also helped distribute them to each other. The most efficacious interpretation hereof is that lithic materials would have had an unrestricted flow between Huecoid and Saladoid sites. The best evidence for this actually comes from the heart of the network: the "strong clique" {HAC-HOP-HUE-MOR-SOR-TRA}. From Northeast to South it consists of almost alternate iterations of Saladoid and Huecoid sites.

This fact is already given away by the hybrid quality of the securely dated sites in this period. Of the nine Saladoid sites in the model three have some sort of Huecoid element and of the three Huecoid sites only Punta Candelero is supposedly a pure Huecoid site. Here, too, the mixed nature of the central triad is most telling. This triumvirate of nodes consists of a Saladoid site with some Huecoid influences (Trants), a Huecoid site with Saladoid components (Hope Estate) and a Huecoid site located within 100 m. of a Saladoid site (La Hueca and Sorcé). All three were lithic workshops, crafting materials found in the other two sites. The strong, mutually directed flows between these sites are exemplified by the cyclical nature of their clique. Furthermore the 1-mode, directed model suggests that between the three of them they were able to completely dominate the flow of lithic materials in the region. Such strong triadic connection would have included a downside. Being part of a clique comes with a price. With an increase in overall network power, cliques also increase the internal depencies between its members. Furthermore, a rise to power of one node can be countered by the other two members of the triad. Thus, it could very well be that the networks of the communities of La Hueca, Hope Estate and Trants were deeply interwined. Such a community of material cultural practices goes beyond any notion of cultural division between Saladoid and Huecoid as it might arise from previous culture historical pathways or different stylistic and technical differences in material cultural repertoires.

On the other hand, this was not an Arcadian paradise and competition, perhaps because of differential access to resources, seems to have been part of these exchange systems, as hinted at by the differences in the centrality of nodes in Period D. These suggest that there were major differences in access to raw materials between some sites and also minor variances between the three members of the central triad. This is also indicated by the boom in the quality and quantity of exotic stones and other materials, particularly ornaments and smaller amulets, found in sites dating from this period. The manner in which such a potential struggle for power affected the inter-communal relations within the region will be further evaluated by means of the model of Period E.

Period E: emulation

Period E does not witness any changes in lithic group nodes (Figure 5.10). There are, however, a number of new site nodes. Especially the southern region witnesses quite an increase in number of sites with the first securely dated ceramic site south of the Martinique passage in St. Vincent. St. Lucia and Dominica remain empty. Whether this represents a structural hole in archaeological practice or in the social networks of the period is difficult to surmise. Dominica has not seen much pre-colonial archaeological work and even then early sites in both islands are likely to be covered under several meters of volcanic deposits or to have been destroyed due to coastal erosion (Delpuech 2004). Antigua, although probably occupied continuously since Period A (Davis 2000; Nicholson 1994), also sees its first securely dated ceramic sites, like Royall's (ROY) and Doigs (DOI).[11] They have ceramic assemblages that are pre-dominantly Saladoid, although a fair number also have a Huecoid component. Puerto Rico still has a number of sites with assemblages that are characteristic of the period before the Huecoid and Saladoid appeared in the archipelago. It is unclear how they are related, yet some of these

11 Several sites with Saladoid components on Antigua of this period, such as Elliots (Murhpy, *et al.* 2000), are not dated.

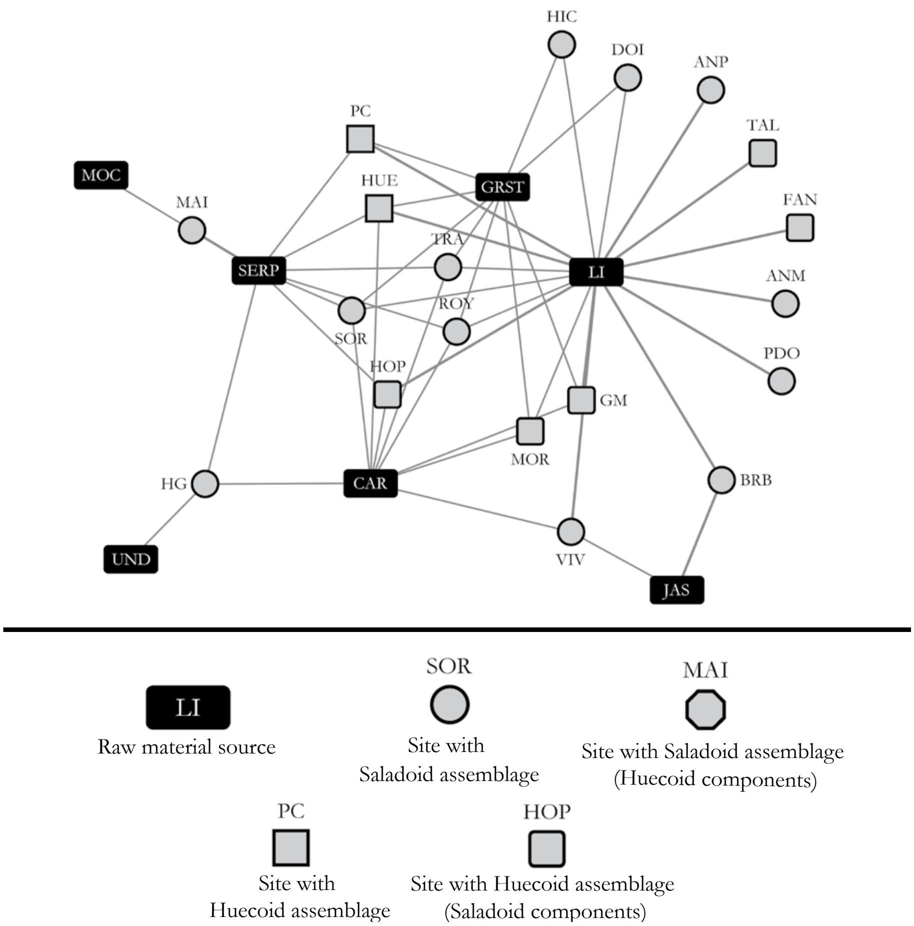

Figure 5.10: 2-mode network of Period E with sites tied to raw material sources of which material is present in their assemblages.

sites, such as Cueva Maria de la Cruz, are located in the vicinity of the Saladoid and Huecoid sites (Rodríguez Ramos 2010). This suggests movement and bilateral interaction, although this is not visible in the lithic network of this period.

Structure, subgraphs and clique strength

Interestingly, this Period once again witnesses growth in node quantity. Since it covers the same span of time as Period D (300 years) and lithic groups this increase is not dependent on any difference in temporal scales or node selection. It is therefore fully attributable to a rise in site nodes of which the network contains twenty-four in total. Of these, nineteen are connectable to any of the seven lithic group nodes in the network. Of the lithic group nodes, Long Island flint, which has already been the most popular lithic material through Periods B to D, sees its node affiliation almost doubled to seventeen. The presence of other lithic sources in sites also grows: carnelian (degree of 9), serpentinite (degree of 9), and St. Martin greenstone (degree of 8).

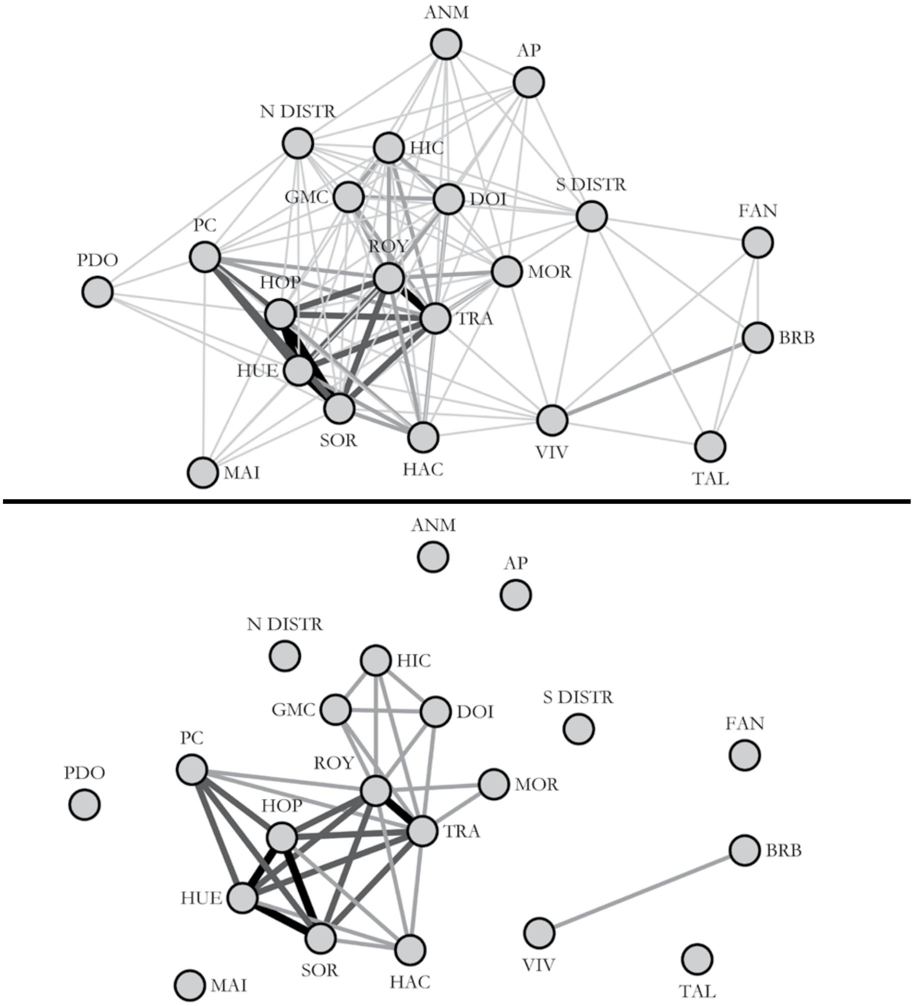

Figure 5.11: Affiliation (site to site) network of Period E. Tie colour and size is related to tie strength (from low to high = light to dark, thin to thick). The network above displays all ties, while the network below illustrates exclusively the ties with strength 2 and higher.

These increases in nodes and node membership are reflected in the down-the-line affiliation network of sites too (Figure 5.11). The graph consists of one component that looks rather cluttered with many ties crisscrossing the network at the centre. Nonetheless, appearances may deceive: the affiliation network of Period E is much sparser than that of Period D (27.6%). This is a result of the fact that the growth of nodes with Long Island flint affiliation occurs at the centre as well as southwards and northwards. This implies that, because of the down-the-line exchange once again modelled through a hypothetical node, some nodes will not be directly affiliated through the network's otherwise best path. In addition, several new nodes connect to only lithic material, often Long Island flint.

Predictably, a *k*-core analysis shows large subgraphs with high coreness values. The twelve members of the 10-core {DOI-GMC-HAC-HIC-HOP-HUE-MOR-PC-ROY-SOR-TRA-NDist} are all found in the North-central and central part of the network. In the Northeastern and Southern extremes of the network we find nodes related to fewer other nodes in the component, such as BRB, FAN and TAL (4-core) and PDO and MAI that have a coreness value of 5 and 6 respectively. Moreover, we see sites in the geographic extremes of the network like Vivé that connect better to the centre core (VIV; coreness value of 8). Overall, the network consists of only two 2-cliques with many shared members. The farthest nodes in this affiliation network are only separated by 3 degrees.

There are ten cliques in this network (see Table 5.1). Some of these maximally connected subgraphs correlate to central, Southern and Northern distribution regions (Clique A for the centre, Clique I for the South and J for the North). The majority of the cliques present network groups separated by geographically long-distances, such as Clique F {HAC-HOP-HUE-MOR-ROY-SOR-TRA-VIV} that affiliates for example the site of Hacienda Grande in Puerto Rico to the site of Vivé in Martinique. This is based on the presence of semi-precious material in their assemblages, which is not differentiated by a Northern and Southern distribution system for this graph.

ID	*k*-core	member of 2-clique	Member of clique
ANM	9	A, B	A
AP	9	A, B	A
BRB	4	B	I
DOI	10	A, B	A, B, C, D, E
FAN	4	B	I
GMC	10	A, B	A, B, C, D, E
HAC	10	A,B	C, D, F
HIC	10	A, B	A, B, C, D, E
HOP	10	A,B	B, C, D, E, F, H, J
HUE	10	A,B	B, C, D, E, F, H, J
MAI	5	A	H
MOR	10	A, B	A, B, C, F, G
NDist	10	A, B	A, B, E, J
PC	10	A	D, E, H, J
PDO	6	A	J
ROY	10	A, B	A, B, C, D, E, F, G, H
SDist	9	A, B	A, G, I
SOR	10	A,B	B, C, D, E, F, G, H, J
TAL	4	B	I
TRA	10	A, B	A, B, C, D, E, F, G, H
VIV	8	A,B	F, G, I

Table 5.1 The subgraphs of the affiliation network of Period E showing k-core numbers, and (2-)clique membership of nodes in the site-to-site affiliation model of the 2-mode network of Period E (Figure 5.11).

Here too we can find a differentiation in the tie strength of cliques. A progressive removal of ties with strengths 1 to 3, results in network decay. This starts at the fringes with cliques without access to Long Island flint or semi-precious stone and progresses to take apart all cliques but for the most strongly affiliated site nodes. Again we find the nodes of Trants (TRA), Hope Estate (HOP), La Hueca (HUE) and Sorcé (SOR) as part of the subgraph that withstands lower strength tie disintegration (Figure 5.11). This select group is now joined by two new members: the sites of Royall's (ROY) in Antigua and Punta Candelero (PC) in Puerto Rico. Together these five sites form a 2-clique that can be further subdivided in the four tie-strength triad {HOP-HUEC-SOR} and the strong dyad {ROY-TRA}. These shifts in the higher echelons of the affiliation network also have their impact on the 1-mode, directed network of lithic distribution during Period E.

Centrality

For this final directed model two possible networks were created to discuss centrality in the exchange networks of Period E (Figures 5.12 and 5.13). The outcome of the centrality measures are collected in Table 5.2. This has been done in order to mimic two possible scenarios, both of which have some plausibility. One (Figure 5.12) presents a situation of preferential interaction. Ties are wired based on the idea that sites with a longer history in the network would hold on to the exclusive nature of their contacts and access to raw material sources in the subsequent period. This introduces a form of hierarchy within the model and old nodes such as TRA, HOP, HUE and MOR have more ties then new nodes like ROY and PC. Being around for a longer time, older site nodes often have had the opportunity to acquire more ties over time, therefore attracting even more ties and thus gain more access to and control over the entire network – conform the preferential attachment model discussed in Chapter 3. The other model is based on the idea of "unrestricted trade" in the region. Whenever a material occurs at a site this is modelled as if it was drawing these materials from all possible partners at the same time. The result hereof is that the latter model has many more ties than the preferential interaction model. For both networks tie wiring is restricted in the case where a down-the-line chokepoint must have been positioned, based on the study of Knippenberg (2007).

In the preferential model Morel has the highest absolute degree, which is based on the high number of outgoing (outdegree) ties through its distribution network to the South of the region (Figure 5.12). Trants, however, has the highest closeness and betweenness rating, providing it with the best strategic position within the network. La Hueca and Morel follow at some distance in terms of betweenness and closeness. Even though it still holds the monopoly over St. Martin Greenstone distribution, Hope Estate has overall lower centrality measures. Growing hinterlands in Puerto Rico and the Martinique and Guadeloupe archipelago provide the power distribution in Period E with a more diffuse character. Indeed, the triad {HOP-HUE-TRA} has lost some of its absolute power within the network. Nevertheless, these sites as yet form the only strong and cyclical component in both models.

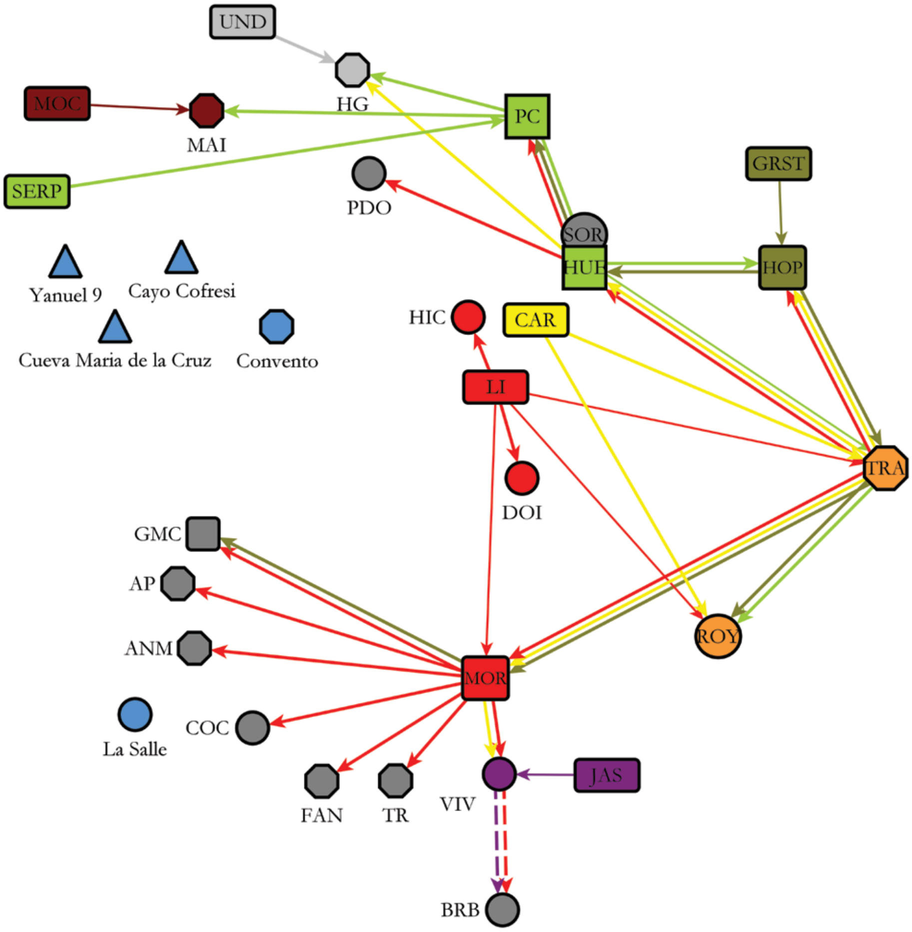

Figure 5.12: Directed network of Period E with preferential attachment to sites which were also present in previous periods (interpretation). The node colour is indicative of the type of raw materials worked at the site. The layout of the network approximates the geography of the region.

In the unrestricted model Royall's (ROY) is added to that central subgraph (Figure 5.13). Royall's is in many respects structurally similar to Trants in a 2-mode or affiliation network: presence of all local semi-precious material and direct acquirement of Long Island flint and Carnelian. However, when referring to both directed models the centrality of most sites, for example La Hueca and Sorcé (HUE/SOR), Vivé (VIV) and Hope Estate (HOP) remains roughly the same, the sites of Royall's and Trants are prime examples showcasing the differences between the preferential and unrestricted model. When serving as a supplier of Trants in the preferential model, in the unrestricted model it is on an equal footing. The other large difference is the site of Morel, which has also lost a fair amount of its network power. The reason being it is not modelled as the de facto down-the-line distributor of lithic materials making their way from North to South.

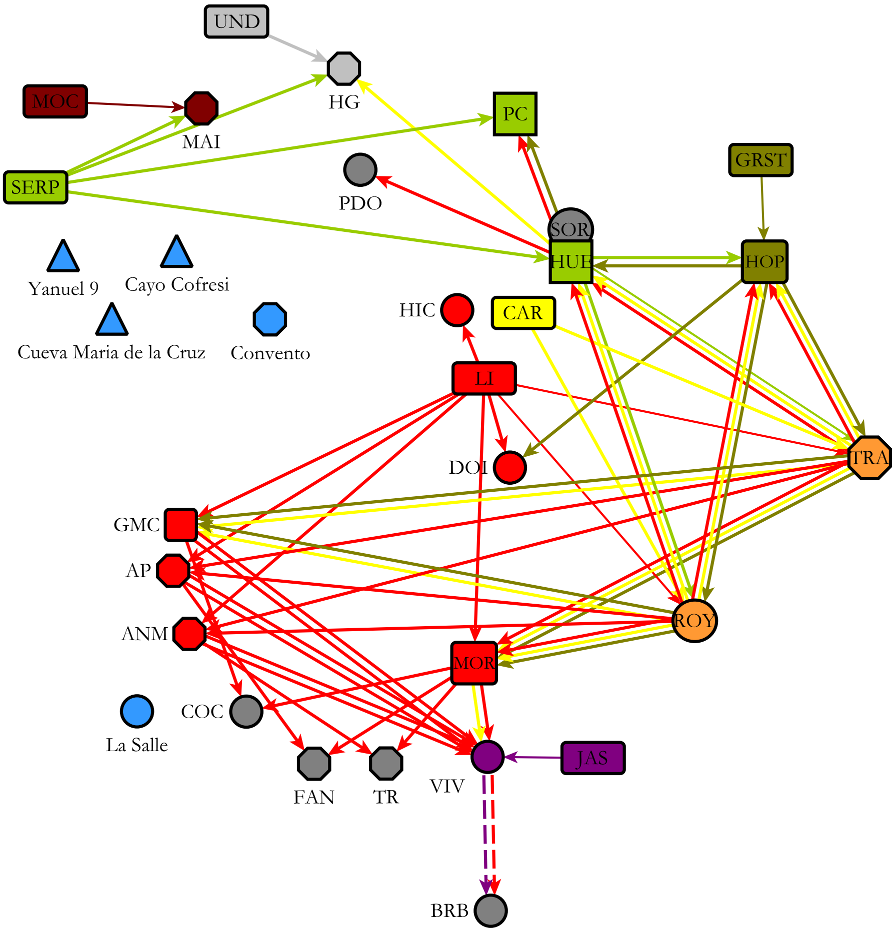

Figure 5.13: Directed network of Period E without preferential attachment to sites which were also present during previous periods (interpretation). The node colour is indicative of the type of raw materials worked at the site. The layout of the network approximates the geography of the region.

Nonetheless, the importance of these models lies not in their differences but in their similarities. Both models point to the same five highest ranking nodes: Morel (MOR) in Guadeloupe, Trants (TRA) and Royall's (ROY) on Montserrat and Antigua respectively, Hope Estate (HOP) on St. Martin and La Hueca (with Sorcé; HUE/SOR) on Vieques. Together these "big five" represent an aggregated 55.4% (preferential) and 60.4% (unrestricted) of the total value of centrality measures for both models. These are all, with the exception of Royall's, sites present in the models of Period D and some are even found in Period E, such as in the case of Trants. It seems that, at least in terms of lithic interaction patterns within the region, social networks had evolved towards a lasting differentiation of power between communities. However, in contrast to Period D, any power is somewhat more equally distributed through the network. We see differentiations between

ID	degree (%)		indegree (%)		outdegree (%)		closeness (%)		betweenness (%)		Rank	
	6.12	**6.13**	**6.12**	**6.13**	**6.12**	**6.13**	**6.12**	**6.13**	**6.12**	**6.13**	**6.12**	**6.13**
ANP	2.9	4.6	5.9	4.6	0	4.6	0	2.8	0	3.1	*13*	*7*
ANM	2.9	4.6	5.9	4.6	0	4.6	0	2.8	0	3.1	*13*	*7*
GMC	2.9	4.6	5.9	4.6	0	4.6	0	2.8	0	3.1	*13*	*7*
BRB	2.0	1.5	3.9	3.1	0	0	0	0	0	0	*15*	*13*
CAR	1.0	1.5	0	0	2.0	3.1	6.8	8.6	0	0	*11*	*9*
COC	1.0	1.5	2.0	3.1	0	0	0	0	0	0	*17*	*13*
DOI	2.0	1.5	3.9	3.1	0	0	0	0	0	0	*15*	*13*
FAN	1.0	1.5	2.0	3.1	0	0	0	0	0	0	*16*	*13*
HAC	2.9	2.3	5.9	4.6	0	0	0	0	0	0	*15*	*13*
HIC	1.0	0.8	2.0	1.5	0	0	0	0	0	0	*16*	*15*
HOP	6.9	7.7	7.8	9.2	5.9	6.2	9.6	9.4	6.1	13.5	*5*	*5*
JAS	2.0	1.5	0	0	3.9	3.1	2.7	2.5	0	0	*14*	*11*
HUE/SOR	9.8	10	7.8	9.2	11.8	10.8	10.3	10	18.0	20.2	*3*	*2*
LI	3.9	6.2	0	0	7.8	12.3	10.7	12.7	0	0	*6*	*6*
MAI	2.0	1.5	3.9	3.1	0	0	0	0	0	0	*15*	*13*
MOC	1.0	0.8	0	0	2.0	1.5	1.4	1.3	0	0	*16*	*14*
MOR	17.6	9.2	7.8	10.8	27.5	7.7	9.7	5.2	24.4	15.2	*1*	*4*
PDO	1.0	0.8	2.0	1.5	0	0	0	0	0	0	*17*	*15*
PC	4.9	2.3	5.9	4.6	3.9	0	2.7	0	3.4	0	*7*	*12*
ROY	6.9	10.8	9.8	6.2	3.9	15.4	8.4	11.9	8.1	17.2	*4*	*1*
SERP	1.0	3.1	0	0	2.0	6.2	6.7	8.5	0	0	*12*	*8*
SRPDis	2.9	/	2.0	/	3.9	/	8.2	/	6.1	/	*6*	*/*
GRST	1.0	0.8	0	0	2.0	1.5	7.5	7.1	0	0	*10*	*10*
TAL	1.0	1.5	2.0	3.1	0	0	0	0	0	0	*17*	*13*
TRA	13.7	10.8	7.8	6.2	19.6	15.4	12.7	11.9	30.5	17.2	*2*	*1*
UND	1.0	0.8	0	0	2.0	1.5	1.4	1.3	0	0	*16*	*14*
VIV	3.9	7.7	5.9	13.8	2.0	1.5	1.4	1.3	3.4	7.4	*8*	*4*

Table 5.2 The centralities of nodes in the directed networks of period E, showing the centralities of the nodes for the two models in Figures 5.12 (preferentially attached) and Figure 5.13 (non-preferentially attached) in percentages. Note that there are quite a number of shifts in the individual centralities and aggregated centrality ranks ("Rank" in the table) of the nodes. This rank is not based on one graph theoretical measure, but on the aggregate of all centrality measures presented in this table.

various types of centralities – e.g. Morel has a larger hinterland, yet Trants and Royall's occupy a better structural position, while La Hueca and Sorcé are all-round and consistent high scorers and Hope Estate has its monopoly of St. Martin Greenstone.

Finally, these models also present an interesting alternative view of clique formation, with much more regionally restricted subgraphs. It is to be expected that such a directed, 1-mode network is far less dense (4.8% and for the preferential and 6.5% for the unrestricted model of all possible ties present) than their 2-mode counterpart. However, even taken on the whole, both models do not show much cohesion. Path analysis of the diameter of the network indicates that the farthest sites are separated by 6 degrees, a relatively small social distance for an area with a Euclidean diameter of *c.*850 km It is important to note that the only paths that cover the whole of the network run from the Northeast to the South and not vice versa. This is the reason why the only strong component is the one mentioned above. The same applies to any cyclical subgraphs, even on the level of the dyad. On the other hand the network contains quite a few two-cliques and even cliques: twelve two-cliques and four cliques in the preferential model and fourteen two-cliques and thirteen cliques in the unrestricted model. Most of these can be found in the central and Southern part of the network.

Interpretation

One might wonder which forwards a truer version of social networks during this era: the preferential or the unrestricted model? In fact, the question whether, for example, Trants or Royall's or Morel was more powerful is difficult to answer without looking more in-depth at the contexts of these sites, incorporating more lines of evidence and adjusting for imbalances in the collection of data. Even then it might be impossible to establish a complete picture of network relations between these specific sites. In my view, with regard to the matter at hand and at this level of analysis, such specific questions are ultimately not that important – or even interesting. What does fascinate is that all the models – 2-mode, affiliation, 1-mode preferential directed and 1-mode unrestricted – indicate the same trend: enduringly and increasingly powerful nodes, manoeuvring for power by new network players and down-the-line distribution of materials across the entire archipelago. It is obvious that these patterns are not the result of a disjointed socio-cultural landscape, divided into Saladoid and Huecoid spheres of influence. These models indicate that between AD 100 and 400 the network comprised of an integrated whole embracing several smaller interaction spheres (Boomert 2000; Hofman, Bright, *et al.* 2007). This integration suggests a stabilization of the potentially volatile situation as it had arisen when new cultural practices and, presumably, settlers had reached the islands during the previous centuries. In a matter of 1 or 2 centuries the old and new networks of people and objects had become enmeshed. A new Caribbean socio-cultural reality had been born.

This integration is clearly shown by the size and strength of subgraphs in the region. Based on the suggested scenario from Period D that presents us with incipient inequalities in network power, a falling apart of the social network in various competing, non-interacting factions might have been the case. Surprisingly, as the affiliation model of this period displays many connected sets of nodes. On the other hand there is also new evidence for strong dyadic formation, such as in the case of the new dyad {ROY-TRA}. Such strongly paired sites would have potentially been cooperating more closely than other dyads in the network.

The site of Royall's supports this. It is in many respects the "younger brother" or perhaps the "offspring" of the site of Trants. Being a larger habitation site, its assemblage contains a range of (semi-precious) lithic materials and there is evidence for carnelian bead production (Knippenberg 2007; Murphy, *et al.* 2000). We find a similar symbiotic, or at least, co-evolutionary bond between the La Hueca and Sorcé sites on the one and Hope Estate on the other hand. The dates for habitation are almost contemporaneous. What is more, all three sites include exotic materials originating from beyond the local region that were produced in one of the two other sites (Hofman and Hoogland 1999; Knippenberg 2007; Narganes Storde 1995; Rodríguez Ramos, *et al.* 2010). It remains unclear whether similar dyadic relations existed in the southern region of the archipelago. It is notable, however, that the relations between Vivé and Morel had a time-depth of several centuries. Furthermore a number of new habitation sites within the archipelago of Guadeloupe and Martinique were at the least integrated in the exchange network of Long Island flint, but possibly partook in other types of interactions, as well (Bérard 2004, 2013).

Although the core of the network provides us with an insight into the dynamics of networks around the turn of the first millennium, the fringes of the network show an equally interesting picture. The site of Brighton Beach in the southern extents of the network, recently investigated by Leiden University's Caribbean Research group, delivers a good case in point (Mol and Boomert 2011). The village at this site was, for all intents and purposes, able to see to its own needs. The direct location provided plenty of opportunities for food procurement. In addition, siliceous materials on the neighbouring islands of St. Lucia and Carriacou could serve to produce tools and personal adornments. Most of the ceramic assemblage at the site is typical of the late Saladoid, yet at the lower cultural strata we see several layers of early Saladoid material (Figure 1.3.f). C-14 dates of Cal. AD 150 that were acquired from just above these deposits suggest that this material dates from before the previously suggested starting point of Saladoid presence of AD 400 (Fitzpatrick 2009). Interestingly, a majority of the siliceous material found in these layers originates from the Long Island flint source – including a few, almost completely exhausted cores (Knippenberg, personal communication 2011). Although the Brighton Beach site is located at what is now regarded as the fringe area of the advancement of Saladoid communities in the area, the presence of Long Island flint at such an early phase shows it was already connected at the core.

The recent findings at Brighton Beach thus argue for a full integration of the southern Lesser Antilles into the island networks of the 1st century AD. If more archaeological fieldwork is carried out in the region and more absolute dates of early ceramic sites become available this might push this date back to well before AD. It also shows that, even though exotic materials were coming in from various other regions in the mainland, within the islands itself Long Island flint held great attraction for sites located far away from its source – in the case of Brighton Beach,

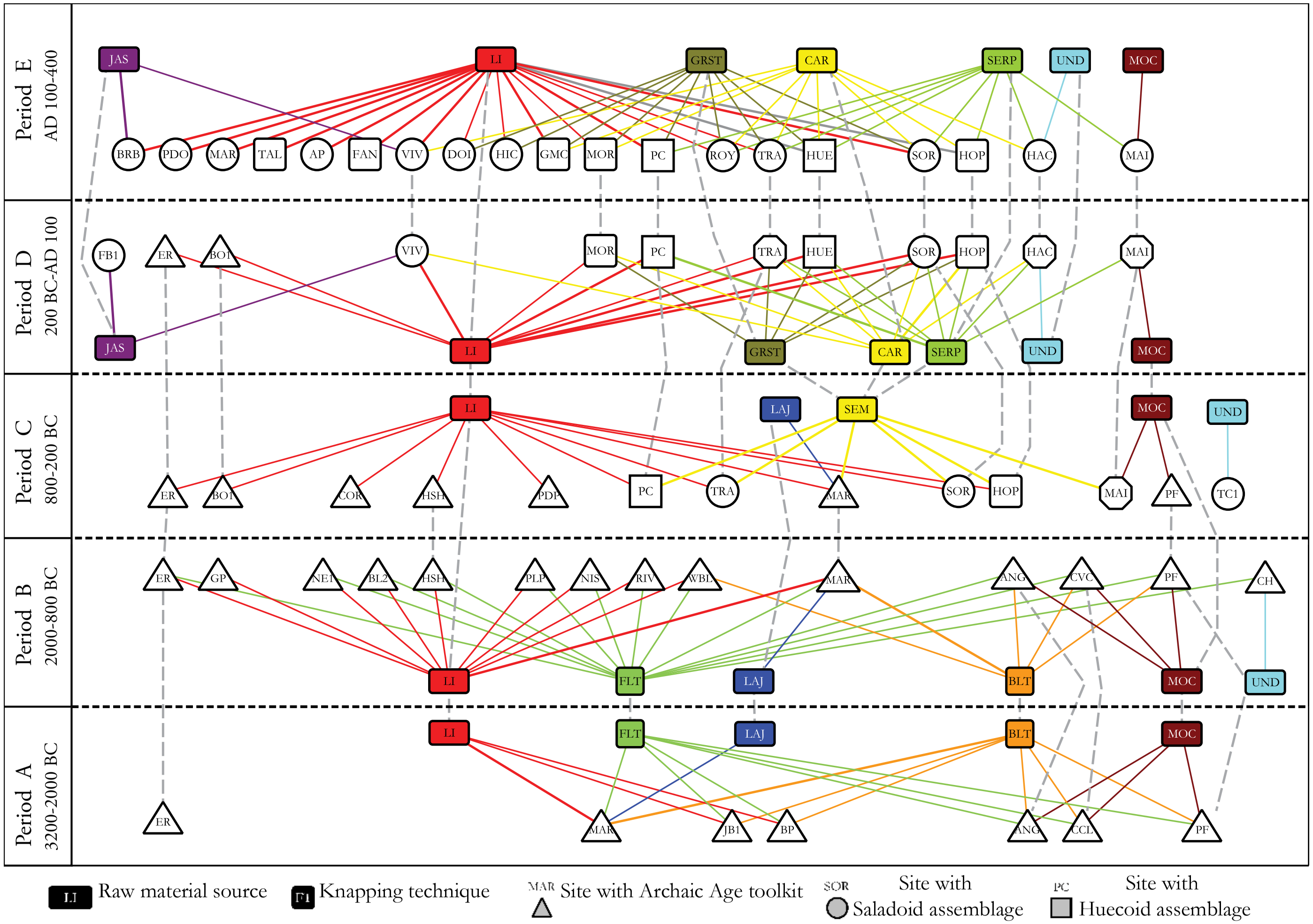

Figure 5.14: A longitudinal view of the 2-mode networks from period A to E (3200 BC-AD 400). It illustrates sites tied to raw material sources of which material is present in their assemblages. In period A and B the nodes are also connected to a knapping technique node in order to indicate the presence of tools produced with that technique found at the site. Sites are also connected to other sites with a dotted line, indicating their continued habitation and use during later periods. The same applies to raw material and knapping technique nodes.

c.450 km away. Even though the distances and the logistic difficulties of navigating the islands could be huge, through its widespread circulation Long Island flint created a socially small(er)-world in the North-eastern Caribbean and beyond.

Longitudinal trajectories of lithic production and distribution networks

The network in Figure 5.14 is a collection of all 2-mode networks dating from the Periods A to E. It shows the connections between sites and lithic groups within the region for each stage and between the stages for those sites and materials with a continued presence. As stated above, this network is not a social network. Its ties do not directly reflect social interaction and, even if they were, it would be difficult to almost impossible to substantiate this with any currently available archaeological methods and techniques. The network may also be considered as a simplification of a large amount of variability in material repertoires and practices throughout time. Because this network is based on currently available and dateable archaeological evidence, it is necessarily a simplified model of a situation that was in reality much more dynamic. Furthermore, because of its huge time-span it is also unlikely that it directly reflects a conscious reality in terms of the historical sense of the peoples themselves. The question is then: what does this network refer to?

This model of affiliations between sites and lithic raw material sources reveals an image of networks across time and space. It shows that from the earliest colonization of the islands humans and things were continously related to each other through networks that were both social and material. The connections and contrast between the lithic nodes in the network was dependent upon the social practices, landscape knowledge and passing on of time-honoured crafting traditions. On the other hand the social networks of these peoples were also founded upon the materiality of these stone materials, such as intrinsic material qualities and the geographic position and availability of the raw material sources. The temporal durability and structure of the network most certainly arose from mutually reinforced relations between people and things. Certain site nodes became increasingly central due to their participation in certain lithic networks and certain materials become increasingly popular the more they were distributed among (central) communities in the region. Cliques and other subgraphs arranged themselves around the distribution of local lithic materials and the distribution of these materials was possible due to the social networks between communities.

The first social networks (3200 - 2000 BC) of the region are shrouded by their light archaeological footprints. At this point the Caribbean presumably had only few inhabitants, which is indicated by the small number of nodes in the network. From analagous situations across the world we know that in such a sparse social landscape all or the majority of the social interactions between people were founded on close kin relations. In other words sharing of food, shelter and other resources was based on the sharing of blood.

This Communal Sharing models of relations seems to have been followed through in later centuries (2000-800 BC). Even though the (social) landscape was rapidly becoming more densely settled in Puerto Rico and the northern Lesser Antilles, this did not lead to an appropriation of important resources, such as sources for critically important flint tools. Rather, groups seem to have been incorporating these resources within their cyclical patterns of migration and probably made return-trips to these sources during the year. Analogous situations in Melanesia teach us that such stone material gathering expeditions can be highly important occasions, infused with communal and ceremonial aspects (Godelier 1973). Similar examples exist closer to home, such as the Warao expeditions in search of chert and other lithic materials from beyond their stone-less Orinoco delta homeland (Wilbert 1993). Building on the inherent social nature of these expeditions and the neutral and immobile quality of lithic sources it is not unthinkable that these developed overtime to become significant social events and the sources themselves important spaces – e.g. communal, perhaps intergroup, meeting places.

It seems that social networks grew beyond the local scale starting somewhere in *c.*1800 BC, but that they are best attested by archaeological evidence dating from 800-200 BC. The "cultural when, where and how" of the introduction of new materials and ways of life must be left in the middle for now. These local lithic networks do not present a clear view of this process beyond anything already known for certain, which is preciously little. At present, even more remains unknown concerning the social mechanics of an Archaic-Ceramic interface. This model suggests that the communities hiding behind the nodes in Period C were certainly contemporary to each other and their shared utilization of the Long Island and Mocca flint sources suggests they were also in contact. However, those already inhabiting the islands and any newcomers were simultaneously divided and united by their access to and treatment of (lithic) material culture. The accumulated force of interregional interactions and confrontations with new settlers, attested by the inclusive quality of Long Island flint and the exclusive nature of semi-precious lithics and ceramic assemblages, created a new dynamic in social networks. The differential presence of semi-precious lithic materials in Saladoid, Huecoid and "Archaic" sites, suggests a number of variations in the social value that was afforded to these materials. In turn this proposes a slight but critical difference in status based on personal objects. Perhaps this indicates a divergence between communities relying upon Communal Sharing models of relations to those increasingly concerned with fair exchanges (Equality Matching) and inter-personal hierarchies (Authority Ranking). In the network models this most clearly manifests itself in Period D (AD 200-BC 100) by cliques and nodes that come to hold more power in the network than others.

Outside of the lithic network this new dynamic is best visible in the way the Saladoid and Huecoid phenomena are connected. It is undeniable that (parts of) the Huecoid and Saladoid assemblages are distinct and this dissimilarity must have had some effect on the interactions between peoples practicing different material cultural repertoires. Nevertheless, more often as not, sites were internal hybrids, evidencing the incorporation of one another's social and cultural practices, the copying of stylistic motifs and the exchange of raw materials, tools and valuables.

More importantly, however, is the fact that the lithic network model of Period D shows that Saladoid and Huecoid groups were at least partially connected. Communities such as La Hueca, Sorcé, Hope Estate and Trants, together with older sites on Antigua and the surrounding islands, jointly participated in the lithic networks. The emergence of strong cliques in the network suggests they were even joined in their preferences for and distributon of local (semi-precious) stone materials. Therefore, at the very least it can be said that Huecoid and Saladoid communities did not view each other as contraposed groups of social others that were categorically inaccesible.

Thus, one may wonder whether there is even a "La Hueca problem"? Denying such a thing would amount to brushing over the intricacies of Saladoid and Huecoid assemblages. On the other hand it seems that the problem is not one of social incompatibility but perhaps the exact opposite of it. The root of the controversy can be found in an awkward dyad within the network: the sites of La Hueca and Sorcé. From the models it becomes clear that in every respect – but for the slightly earlier dating of Sorcé due to chronometric hygenic procedures – the sites are the same. The sites are located directly next to each other, as well. What, according to the Puerto Rican archaeologists who have excavated and studied the assemblages for nearly 30 years, is vastly different is the material culture styles, forms and techniques that are segmented across horizontal boundaries.[12] Yet even if it was culturally and horizontally divided, the social and material history of La Hueca and Sorcé is clearly connected. In fact, like a knot (*nodus*) consisting of various materials, it could be that a diversity in cultural practices of La Hueca and Sorcé actually benefited these two joined communities, augmenting their possibility to engage in sociable interactions with groups with a diverse range of cultural backgrounds. On the other hand a knot or node is only as strong as its ties. Perhaps this is the reason why peoples with different cultural backgrounds living at La Hueca and Sorcé sought to establish lasting relations with other communities, such as at Hope Estate and Trants, in the process excerting a homogeneizing cultural influence on the rest of the region.

Indeed, the differences in material cultural repertoires become less sharp during the last phase of this case-study (AD 100-400). Perhaps as a reaction to the emergent competition of Period D, cliques and site pairings increase. In this regard the clique of sites in the central and North-central part of the network, with increasingly stronger relations since Period C, is interesting. While all these sites are closely linked, some are more closely linked than others. For over several centuries La Hueca and Sorcé has continued close relations with the site of Hope Estate on St. Martin, for example. Early Trants perhaps had a similar relation with

12 As of yet, we can only guess which social mechanics were responsible for such a strong segmentation. However, it seems unlikely no social ties existed between the two sites while social ties were present across the region. These fixed identities were perhaps caused by internal competition and factioning – different clans, moieties, etc. It is still possible that a classical Greek-style of "colonialism" (Malkin 2011), in which Saladoid colonists would settle close to an autochthonous community, working and living together but upholding separate cultural practices, could be the cause of this dichotomy.

the other early site on Montserrat, Radio Antilles.[13] Later Royall's was to take up this role. Such a methodical formation of coalitions has already been discussed by Keegan (2007: 155). The main difference between Keegan's model and this one is the type of distance thought to be important: Keegan identifies geographically close sites as possibly paired settlements, while this pairing is based on the exchange of (lithic) materials.

What can be said about possible changes in the dominant models of relations during the Archaic-Saladoid-Huecoid Interface period? It seems reasonable to suggest that most of the social relations underlying the lithic acquisition and distribution of the earliest periods were predominantly about Communal Sharing models of relation. In most cases it seems to be the case that Archaic Age communities had direct access to raw material sources. Starting in Period C an emulation process starts with the advent of new endogenous and exotic semi-precious materials. If we accept the idea that the dyadic and clique ties resulting from this would have consisted of other models of relations becoming more dominant – it is unlikely that they were absent altogether in the earliest periods. This implies the development of a more "complex" socio-political structure.

The down-the-line distribution of raw materials, especially of semi-precious stones, and the influx of other exotic materials suggests first and foremost a web of reciprocal exchanges and thus the pre-dominance of Equality Matching relations (cf. Knippenberg 2007). It could be that the movements of exotic stone and other materials was based in the idea that leaders were those most successful in creating and maintaining ties with extra-communal others, which would have given them the possibility to come out on top in communal exchanges. This would have involved an early version of Authority Ranking relations, but it seems unlikely that such hierarchies had long-term sustainability. New opportunities for "networking" abounded in this dynamic period and political roles of individuals were more likely achieved than inherited (Boomert 2001a). The exchange of raw materials could also have been aimed at incorporating social others into one's own social sphere as a social life-line, which would be more of a Communal Sharing motive (Mol 2010). If so, this could still have also heralded greater socio-political complexity, based on an incipient variant of an Amerindian political economy of life (Santos-Granero 2007, 2009b).

All in all, it is very difficult to say something concrete about prevalent models of relations based on the developments and directions in lithic networks. Even when considering other availaible lines of evidence the picture is altogether unclear. Nevertheless what is clear from the lithic networks is that there were major shifts in the social structures of the Archaic-Saladoid-Huecoid Inteface period (Boomert 2001a; Hofman, Mol *et al.* 2011; Rodríguez Ramos 2010). Although, the research focus on changes and growing "complexity" in socio-political systems has traditionally focused on the period from AD 600/700 to AD 1000, the longitudinal developments dicussed here seem to indicate this was a process that started several centuries earlier.

13 Radio Antilles has a few dates but little has been excavated. Unfortunately, due to the volcanic eruptions on Montserrat, little more can be said about this subject.

The dynamics of lithic networks

Looking at the collected network of Figure 5.14 two patterns can clearly be discerned: (1) the increasingly small diameter of the network: even though there are more nodes in later phases the network does not lose full integration and geographically widespread nodes remain at roughly the same non-Euclidean distance to each other and (2) the growth of the Long Island flint group through time. Long Island flint starts out as a group with only two affiliates, both located in its direct vicinity. Next, it evolves into the material with the most members and furthest geographic distribution of them all. It is a fact that this increase is followed by some other lithic raw materials, such as carnelian and serpentinite and even some sites with increasingly more ties in the affiliation or 1-mode networks. When referring to the lithic raw material sources of the Northeastern Caribbean it seems to ring true that the longer they are around the "richer" in affiliations they become and that the rich only get richer.

This implies that the network, for an important part, structurally depended on Long Island flint distribution. It was not only the most important resource during the earliest periods but as the network grew, so did the distribution of Long Island flint. This pattern of sequential growth and preferential attachment tentatively suggests that Long Island flint functioned as a hub (cf. Barabasí 2003). We see nonetheless two issues with this tentative identification of a scale-free lithic network. Firstly, too few data-points substantiate such a claim. [14] Secondly, even with sufficient data, the scale-free model would have no real interpretive value.

Although the increase of the network between Period A and E seems to coincide with the concept of sequential network growth, this view is skewed. One set of nodes in this 2-mode network, the raw material sources, are not part of the growth of the network. Even if merely exploited (on a larger scale) from Period C onwards, semi-precious raw materials were already present in the "ecology" of the network during earlier phases. In other words, they could have been included as raw material nodes in the network of Period A and B, but they simply would have no ties to site-nodes (that we know of).

What about the notion that preferential attachment is the cause for the popularity of Long Island flint? As discussed in Chapter 3, in the scale-free model the concept is that if a node is present and connected in the first phases, this will pan out favourably for that node in the long run. Being the most central node in a growing network in this case simply means being the first well-connected node. This could be the case with Long Island flint which occurs in some of the

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14 The overall data set per period is too small to find the fat-tailed equation that is so characteristic of scale-free networks. A collection of all the affiliations of all the lithic group nodes results a slightly better fit. Although providing only a few data points, a linear Log-Log plot of each of them comes close to being a good fit to a power-law (R2 fitness test = 0.82). On the other hand a similar plot of site node affiliations provides no such fit, suggesting that relations between sites alone were not based on a scale-free network. A combination of lithic group and site nodes does produce a Log-Log scatter with a good fitness (R2 = 0.96). In addition, even if the blade and flake tech nodes are "knocked out" – deleted from the model so that their connections do not count towards node degree –, the large network component remains connected and a similar, if a less pronounced power law trend is present (R^2= 0.92).

earliest sites in the region. Yet this does not explain why it grew in popularity while the distribution of chert sources that are equally connected in period A and B, such as Mocca flint, were mostly contained to their respective islands during later periods. This indicates that selection processes are, even in the beginning phase of a network, based on more than preferential attachment to resources that have been around the longest.

This was also the case for many of the other real world scale-free networks that were studied. In order to remedy this problem, Barabasí (2003) introduced the concept that nodes have an added "fitness"-parameter that determines if they will be selected for connection with another node or not. Whenever the fitness ecology alters – the fitness of the nodes changes or new nodes appear–, this will sequentially impact the degrees of nodes. Although this seems like an intuitive solution, from the perspective of an archaeological network study, this is an unsatisfactory solution. With modern networks it may be possible to substantiate a claim of increasing or decreasing fitness of nodes – e.g. in his book Barabasí provides the example of early web search engines that were simply outcompeted when the much more "fit" Google came on the scene. Adding a fitness-parameter to an archaeological network however pre-supposes something that most studies would set out to investigate: the evolutionary dynamics behind the continuity and change in the network.

Thus, even if the dynamic behind the popularity of Long Island flint was based on preferential attachment, the question remains: how did Long Island flint and other "beloved stones" connect culturally diverse communities? Why did Long Island flint in particular become the most widely exchanged local stone material in the Archaic-Saladoid-Huecoid interface period? A stone does not move on its own accord and it certainly does not float, so ultimately human beings are the driving force behind its distribution. However, it is obvious that continuity and change in both supply and demand in these interaction networks was also driven by the material qualities of the stones themselves. For example, the reason that Long Island Flint shows such an expansive longitudinal and geographic pattern of distribution, while another chert such as the Puerto Rican Mocca flint did not, is that Long Island flint simply was by far the best chert available in the wider region (Knippenberg 2007). I would hypothesize that the Long Island flint source served as a fixed temporal and spatial point in the mobile lives of the earliest inhabitants of the region. In other words, while other resources were shifting across the landscape due to seasonal or ecological fluctuations, Long Island Flint was simply always there. I suggest that this "fixity" would have rendered it an early nexus of economic activity within the wider archipelago. What is more, following the idea of Amerindian perspectivism laid out in Chapter 4, it could be that such fixed raw material sources and the materials taken from them were also perceived as (the home of) non-human subjects. Combining an indigenous ontology of wider socio-cosmic conflicts and contracts with other than human beings to the quality and fixity of Long Island flint and other stones, we could perhaps understand how these materials made reliable social "partners".

With regards to the later period it is noteworthy that endogenous North-Eastern Caribbean Antiguan Long Island Flint and later on also carnelian, St. Martin greenstone and Puerto Rican serpentinite possessed the material cultural qualities to fit within a range of social strategies and structures as they evolved. The incipient importance of Long Island flint was thus transferred into the Archaic-Ceramic Age interface period, either by virtue of the material qualities of Long Island flint itself or, more likely, as part of exchange and information networks. These flints as well as other endogenous materials were not phased out when the range of (semi-precious) stone material originating from outside the region and even from outside the islands expanded during later periods. In fact it seems that production and distribution only increased (Knippenberg 2007). Endogenous lithic materials are also regularly found in correlation with more exotic stones. It can be hypothesized that the early and widespread distribution of these local materials functioned as the major affordances of other types of (lithic) exchange networks.

Cultural practices and affiliations obviously changed hugely in the course of 3500 years. Moreover, Caribbean cultures and societies were at all times diversifying in ways these "slow shutter speed" models cannot hope to capture. However, the models do serve to bring across the point that these changes cannot be the result of any single type of interaction or movement of peoples. As such they contradict the previous "hidden" network models about this formative period that was mentioned at the beginning of this chapter. Even at such an early state the Caribbean shows simply too much interconnected diversity for Rouse his standard model to hold. The explanations of underlying cultural and societal relatedness of Archaic-Saladoid-Huecoid interfaces cannot be explained by recourse to a culture history that stresses event-like migrations or attempts to identify one donor-region (cf. Rodríguez Ramos 2010; Hofman, Boomert, *et al.* 2011).

Throughout the period of this case-study and beyond, the societies and cultures of the Northeastern Caribbean were ever-changing. However, in some ways it remained an integrated whole. Endogenous stone sources continued to have a clear value and place in social and cultural systems. They remained part of the changing material repertoires and practices and even had increasingly greater areas of distribution. In Chapter 2, I suggested that the rapid societal and cultural changes taking place in period C could be considered as a "phase transition". In some ways, the societal and cultural "phase transition" of Period C may indeed have been a break with those of Period A and B. The network exploration in this chapter has confirmed that even if some aspects of societies and cultures of this period underwent dramatic changes, some material practices and repertoires were more durable (Rodríguez Ramos 2010). As we will see in Chapter 6, some of these materials, like Long Island flint and St. Martin Greenstone, would retain this connective property up to the late pre-colonial period. This implies that, from the perspective of lithic networks, the cultural history of the island can be connected from the first entry of humans into the region to the start of European expansion into the region – and perhaps beyond. Even when cultural practices had passed beyond tradition into obscurity or when the first migrants had become the locals that encountered new migrants, the "heart of stone" around which social networks partly revolved remained in place. Although it is on a different scale than the interpersonal networks discussed in Chapter 4, this is another example of how the interplay of social interactions and material practices and repertoires can give temporal and cultural transitivity to networks of persons and things.